PISSN 2508–1640 EISSN 2508–1667 an open access journal
East Asian Economic Review vol. 30, no. 2 (June 2026) 175–209
https://dx.doi.org/10.11644/KIEP.EAER.2026.30.2.464

The Impact of CPTPP's Deep Provisions on GVC Trade: Evidence from the Automotive Sector*

Minyoung Lee
Ministry of Trade, Industry and Resource
carpediem84@naver.com

This study empirically investigates whether accession to the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), a deep mega-regional trade agreement (MRTA), is associated with member countries' participation in Global Value Chains (GVCs), focusing on the complex automotive sector. Amid geopolitical fragmentation and slowing GVC expansion, the analysis addresses whether CPTPP deepens GVC integration and identifies which deep provisions—Rules of Origin (ROO), Trade Facilitation (TF), and Technical Barriers to Trade (TBT)—are most influential. Descriptive trends and Chow Test results indicate that CPTPP membership is associated with stronger GVC integration, but the effect is asymmetric: backward participation shows structural breaks and a sharp post-accession rise, while forward participation remains largely stagnant. PPML gravity further reveals that deep institutional provisions significantly promote integration. Specifically, the combined effect of enhanced ROO and TF is strongly and statistically significant, suggesting that flexible rules and streamlined procedures are crucial for lowering compliance costs and facilitating cross-border production. This suggests that deeper trade provisions are associated with stronger GVC resilience and participation.

Keywords: CPTPP, Global Value Chains, Rules of Origin, Trade Facilitation, Automotive Industry

JEL Classification: F13, F14, F15

* This article is based on part of the author's dissertation, *"Non-Tariff Provisions in Mega-Regional Trade Agreements and Backward Global Value Chain Trade in the Automotive Industry: An Empirical Analysis,"* which has been substantially revised and updated for publication.

I. Introduction

Since the 1990s, Global Value Chains (GVCs) have become a fundamental feature of international trade and the world economy. This expansion has been primarily driven by trade and investment liberalization, advances in information and communication technologies (ICT), declining transportation costs, and the growing role of multinational corporations (MNCs) (Seric and Tong, 2019; Cadestin et al., 2018).

However, following the 2007–2008 global financial crisis, intensifying geopolitical tensions—such as the U.S.–China trade conflict in 2018 and the Russia–Ukraine war in 2022—have contributed to both structural reconfiguration and a slowdown in GVC growth. In particular, the strengthened protectionist measures initiated by the Trump administration since 2017 delivered an unprecedented policy shock to GVCs. More recently, the proposal to impose a "reciprocal tariff," potentially extending additional tariffs even to traditional U.S. allies under a Trump 2.0 administration, has further increased uncertainty surrounding GVC participation.

In this environment of rising uncertainty in global supply chains, major economies are seeking alternatives, including supply chain diversification policies and expanded participation in mega-regional trade agreements (MRTAs).[1] Consequently, in response to the broad range of U.S. tariff actions, both the European Union (EU) and Korea have been actively considering accession to, or deeper cooperation with, the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP).

For example, Sweden—a EU member state—proposed that the EU explore accession to the CPTPP as part of its strategy to counter the Trump administration's protectionist shift (Reuters, 2025). Similarly, the Korean government announced that it would resume its previously suspended review of CPTPP accession to mitigate uncertainties stemming from extensive U.S. tariff measures and to secure a broader network of economic alliances (MOEF, 2025).

MRTAs such as the CPTPP offer not only significantly deeper tariff liberalization compared with traditional bilateral free trade agreements (FTAs) but also ambitious

[1] According to the World Economic Forum (2014), MRTAs involve a large share of global trade and FDI (typically over 25%), include at least two major hub economies, feature ambitious and deep commitments, and are built upon existing RTAs among members. Petri and Plummer (2019) similarly define MRTAs as agreements among three or more countries with significant implications for global trade.

non-tariff disciplines, such as consolidated rules of origin (ROO), high-level trade facilitation (TF), and advanced technical barrier to trade (TBT) provisions. This robust institutional framework is thus regarded as an effective mechanism for enhancing firms' GVC participation and strengthening supply chain resilience against rising protectionism.

Despite extensive analyses of the relationship between GVCs and FTAs, empirical studies specifically examining whether comprehensive MRTAs like the CPTPP promote GVC participation remain scarce. The relative novelty of the CPTPP's entry into force likely accounts for this research gap. Against this backdrop, this study empirically investigates whether CPTPP accession is associated with member countries' participation in GVCs, thereby contributing to trade policy discussions in an era of rising protectionism. The primary research question is as follows:

Research Question 1: Does CPTPP accession enhance the GVC participation of member countries?

This study focuses on the automobile industry, which exhibits highly complex supply chain structures and a strong dependence on intermediate goods trade. Automobile production involves the assembly of approximately 20,000–30,000 components, making it nearly impossible for any single country to undertake the entire production process independently (Shin and Shin, 2021). Moreover, the sector features exceptionally high levels of cross-border input sourcing (Schwellnus et al., 2023), suggesting that the CPTPP's effects on supply chain integration may be more salient than in other industries. This leads to the second research question:

Research Question 2: Which deep MRTA provisions—such as ROO, TF, and TBT—have contributed most significantly to enhancing backward GVC participation[2] in the automobile sector?

[2] We specifically focus on backward GVC trade rather than overall GVC trade. The rationale for this choice is further detailed in Section 4.2.

II. Literature Review

1. GVCs

GVCs refer to the fragmentation of production into multiple stages, with value added at each stage dispersed across different countries (Ferrantino and Schmidt, 2018). One way to understand GVCs is to view them as an international extension of intra-firm division of labor.

The academic discourse on the international division of labor intensified in the early 2000s, encompassing related concepts such as "global commodity chains" (Gereffi, 1999), "slicing up the value chain" (Krugman, 1995), "production fragmentation" and "fragmentation trade" (Arndt and Kierzkowski, 2001), and "vertical specialization" (Hummels et al., 1998). Within this context, "GVC-related trade" may be defined as transactions that cross at least two international borders (Borin and Mancini, 2019).

GVC trends can broadly be divided into two phases (ADB et al., 2021). The first phase, from the 1990s to 2008, is characterized by rapid globalization and sharp increases in trade and foreign direct investment (FDI)—often described as "hyperglobalization" (Subramanian and Kessler, 2013). This expansion was driven by the ICT revolution, trade and investment liberalization in emerging economies, and the establishment of the World Trade Organization (WTO), along with China's subsequent accession (Antràs, 2020).

In contrast, the second phase, beginning after 2008, is marked by a slowdown in trade growth and a deceleration in GVC participation, a period sometimes referred to as "slowbalization."[3] This shift reflects both the fading of earlier integration forces and the rise of new constraints, including reshoring policies, growing trade tensions, institutional paralysis in the WTO, and major geopolitical shocks such as COVID-19 and the Russia–Ukraine war (ADB et al., 2021; Plummer et al., 2023).

Nevertheless, even amid these headwinds, certain factors have the potential to support a GVC recovery. Particularly noteworthy are MRTAs, such as the CPTPP and the Regional Comprehensive Economic Partnership (RCEP) (Plummer et al., 2023). Building on this perspective, the present study empirically assesses whether

[3] See The Economist, 2019.

MRTAs, specifically the CPTPP, have promoted GVC participation and identifies the specific non-tariff provisions within these agreements that are most conducive to strengthening GVC integration.

2. Relationship between GVCs and RTAs

The WTO defines a regional trade agreements (RTAs) as a reciprocal trade agreement concluded between two or more partners. This broad category includes bilateral agreements such as the Korea–U.S. FTAs, trilateral agreements such as the United States–Mexico–Canada Agreement (USMCA), and plurilateral agreements such as the CPTPP and RCEP. Although both FTAs and MRTAs fall under the wider RTA umbrella, this study distinguishes between the two for analytical clarity, using "FTA" to refer to typical bilateral arrangements and "MRTA" to denote plurilateral agreements.

Since the early 2000s, a growing body of research has examined the relationship between FTAs and GVCs. However, early studies primarily focused on describing the parallel rise of FTAs and GVCs rather than empirically analyzing causal linkages. Early theoretical work suggested that tariff reductions foster vertical specialization (Yi, 2003). Pomfret and Sourdin (2009), analyzing East Asian trade agreements since the 1990s, found that agreements incorporating trade facilitation measures reduce trade costs and stimulate trade expansion. They also highlighted the emergence of regional value chains (RVCs), suggesting potential interactions between trade agreements and RVCs.

From the 2010s onward, quantitative research empirically validating the positive association between FTAs and GVCs has grown substantially. These studies generally conclude that FTAs contribute to GVC deepening by reducing trade barriers and promoting intermediate goods trade and production network formation (Hayakawa and Yamashita, 2011; Ferrarini and Brooks, 2012).

Key FTA provisions influencing GVC participation include tariff reductions, ROO, investment, and competition provisions. Dür et al. (2018) and Flaig and Greenville (2021) showed that tariff liberalization in intermediate goods fosters GVC participation, particularly in Asia. As tariffs have declined globally, the relative importance of ROO and non-tariff measures has increased. Azmeh (2015) demonstrated that flexible ROO contribute to export expansion, while Thang et al. (2021) showed that cumulation and de minimis ROO is associated with GVC

linkages. The importance of deep provisions—including services, investment, and competition—has also been emphasized. The WTO (2011) and Boffa et al. (2019) found that deep FTAs exert greater impacts on GVCs than shallow agreements; Laget et al. (2020) reported that WTO-plus provisions increase parts trade; and Delera and Foster-McGregor (2020) showed that depth of FTAs significantly affects intermediate goods trade.

3. Relationship between GVCs and MRTAs

Although bilateral FTAs have existed for decades, MRTAs in the Asia-Pacific region have only recently entered into force, leaving limited room for empirical ex-post analysis. Chang and Nguyen (2022) argued that GVC linkages among CPTPP members are stronger than those under the North American Free Trade Agreement (NAFTA), the EU, or the RCEP. However, their analysis relied on pre-CPTPP data up to 2015 and therefore did not capture the specific effects of CPTPP provisions.

While existing studies often posit that deep MRTA provisions—such as cumulation under ROO, trade facilitation measures, and reductions in non-tariff barriers—are important for GVCs, quantitative evidence remains scarce. This scarcity stems from the difficulty of measuring the effects of non-tariff provisions such as investment rules, data flows, and intellectual property protection. Recent efforts by international organizations have begun to address these limitations. For example, the OECD's Services Trade Restrictiveness Index (STRI) and the World Bank's Deep Trade Agreements database aim to quantify the effects of deep provisions. Using such data, Zhang et al. (2021) found that the depth of trade agreements positively influences trade and foreign value-added exports. Chung et al. (2022) showed that ROO cumulation under the CPTPP and RCEP reduces trade costs by 15–25% and increases real GDP and welfare. Choi (2019) quantifies the impact of key RCEP and CPTPP clauses on GVCs, finding that the depth of MRTAs is associated with forward GVC participation. However, a limitation of this study is its treatment of nine key MRTA provisions[4] as a single composite

[4] It identified nine key MRTA provisions highly relevant to GVCs: Sanitary and Phytosanitary Measures (SPS), TBT, state trading enterprises, anti-dumping duties, state aid, public procurement,

variable, which precludes the identification of the specific significance of each clause.

Therefore, this study contributes to the literature by using ex-post data to empirically assess whether the CPTPP has actually enhanced the automobile supply chain participation of member countries, and by quantitatively identifying which deep non-tariff provisions—newly introduced in MRTAs relative to traditional bilateral FTAs—have played a substantive role in promoting automobile GVC integration.

III. Research Methodology

This section outlines the data and empirical framework employed to examine whether CPTPP accession and key non-tariff provisions have enhanced member countries' participation in GVCs, with a particular focus on the automotive sector.

1. GVC Participation

The core variable of this study, the GVC participation rate, is constructed using Inter-Country Input-Output (ICIO) tables produced by major international organizations. To evaluate the effects following the entry into force of the CPTPP in December 2018, this study utilizes the ADB Multi-Regional Input-Output (MRIO) database, which provides data up to 2022.[5]

GVC participation is the sum of forward GVC participation and backward GVC participation. According to Plummer et al. (2023), forward GVC participation is defined as, "domestic value added contained in exports further exported by the destination country, expressed as a percentage of exports. These products also cross at least two borders, once as exports and later as exports of the destination country." Formally, it is expressed as:

$$GVCF_{sr} = \frac{\sum(DVA_{sr} - DAVAX_{sr})}{\sum_G E_{sr}} \quad (1)$$

Agreement on Trade-Related Investment Measures (TRIMs), General Agreement on Trade in Services (GATS), environmental laws, and labor market regulation.

[5] The ADB computes GVC participation using two complementary methodologies: a trade-based approach and a production-based approach. Consistent with prevailing international practices and prior literature, this study adopts the trade-based measure.

where:
-E_{sr}: Total exports from country *s* to country *r*
-DVA_{sr}: Domestic Value Added. The portion of exports that originates as value added from country *s* in exports to country *r*
-$DAVAX_{sr}$: Directly Absorbed Value-Added Exports. The domestic value-added from country *s* in exports that is directly consumed as either final or intermediate goods in the country *r*. This also represents direct trade between two economies.
-*G*: Set of all partner countries

Backward GVC participation is defined as, "imported inputs directly or indirectly contained in exports, expressed as a percentage of total exports. These products cross at least two borders, once as imported inputs and then as exports" (Plummer et al., 2023). Formally, it is expressed as:

$$GVCB_{sr} = 1 - \frac{\sum_G DVA_{sr}}{\sum_G E_{sr}} \quad (2)$$

2. Chow Test

To address Research Question 1—Does CPTPP accession enhance the GVC participation of member countries?—this study employs the Chow Test. The Chow test, first proposed by Gregory C. Chow in 1960, is designed to detect structural breaks by examining whether regression coefficients differ significantly across subperiods. The basic idea is to test the null hypothesis (H_0: $\beta_1 = \beta_2 = \beta$), which states that the regression coefficients for the two datasets are identical. If a structural break exists in the model, the regression coefficients for each data set will differ, leading to the rejection of the null hypothesis (Davidson and MacKinnon, 1993).

Furthermore, a preliminary stationarity test is required when applying the Chow Test to time-series data. Although the Chow Test examines structural stability, the underlying regression framework requires stationary variables to ensure valid inference and avoid spurious results. Stationarity implies that the mean and variance

of the series remain constant over time. If non-stationarity is detected, methods such as log transformation or differencing are applied to achieve stationarity.[6]

The objective of the Chow test here is to empirically assess the association between CPTPP accession and changes in GVC participation. The baseline break date is set to 2018, the year the CPTPP was formally signed. This timing reflects the well-documented expectation that firms and governments begin adjusting domestic laws and systems in anticipation of implementation once agreements' legal commitments become definitive (USTR, 2011; González, 2017). To accommodate potential lagged effects, all possible break points between 2018 and 2022 are examined.

3. Gravity Model

To address Research Question 2—Which deep MRTA provisions (e.g., ROO, TF, and TBT) have contributed most significantly to enhancing backward GVC participation in the automobile sector?—this study utilizes a gravity model.

Originally proposed by Tinbergen (1963), the gravity model has become a standard tool for analyzing determinants of bilateral trade flows. The canonical specification relates trade between countries i and j to their respective GDPs and bilateral distance:

$$T_{ij} = A \times Y_i \times \frac{Y_j}{D_{ij}} \tag{3}$$

where:
-T_{ij}: Value of trade between countries i and j
-Y_i, Y_j: GDP of country i and j
-D_{ij}: Distance between country i and j

Although early studies relied on log-linearized ordinary least squares estimations, such models suffer from bias due to the exclusion of zero trade flows and the presence of heteroskedasticity (Herman, 2023). As a remedy, the recent literature

[6] To ensure the reliability of the test, time-series stationarity is verified through the Augmented Dickey-Fuller (ADF) test, and differencing is applied where necessary to achieve stationarity (Hyndman and Athanasopoulos, 2018).

has widely adopted the Poisson Pseudo-Maximum Likelihood (PPML) estimator, which provides consistent and robust estimates in the presence of heteroskedasticity and naturally accommodates zero trade flows (Larson et al., 2018; Tyazhelnikov and Zhou, 2020).

Accordingly, this study estimates a PPML gravity model in which the dependent variable is bilateral backward GVC trade in the automotive sector:

$$\text{Backward GVC Trade}_{ijt} = \exp\left(\beta_0 + \beta_1 \log\left(\text{Distwces}_{ij}\right) + \beta_2 \log(\text{Diff. GDPPC}_{ijt}\right) + \beta_3 ROO\_TF_{ijt} + \beta_4 TBT_{ijt} + \varepsilon_{ijt}\,) \quad (4)$$

where:

-Backward GVC Trade$_{ijt}$: Backward GVC trade in the automotive sector between country i and country j in year t

-Distwces$_{ijt}$: Weighted city distance between country i and country j

-Diff. GDPPC$_{ijt}$: The GDP per capita difference between country i and country j in year t

-ROO_TF$_{ijt}$: Index variable measuring the depth of full cumulation provision in ROO and trade facilitation provisions in the most recent FTA between country i and country j in year t

-TBT$_{ijt}$: Index variable measuring the depth of TBT provisions in the most recent FTA between country i and country j in year t

-ε_{ijt}: Error term in year t

For the dependent variable, this paper employs ICIO-derived backward GVC trade instead of directly observable intermediate goods trade flows. The former is explicitly designed to measure foreign value added embodied in exports, aligning with the concept of backward GVC participation. In contrast, gross intermediate imports mix inputs used for domestic absorption with those re-exported within multi-stage production networks. While ICIO-based indicators entail some measurement error due to the underlying Leontief decomposition, they provide a conceptually consistent and internationally comparable measure of backward GVC integration, which is essential for assessing how deep MRTA provisions affect GVC linkages in the automotive sector.

Independent variables are sourced from multiple repositories: Distance data are from CEPII; GDP data are from the International Monetary Fund (IMF); and the

depth of MRTA provisions is measured using the World Bank Deep Trade Agreements Database 2.0.

4. Key Explanatory Variables

In addition, standard gravity variables (e.g., distance and GDP), this study incorporates indexes measuring the depth of ROO, trade facilitation, and TBT provisions, given their centrality to the functioning of GVCs.

(1) Rules of origin

ROO under MRTAs may operate differently from those under bilateral FTAs. From a GVC perspective, the harmonized and consolidated nature of MRTA ROO can mitigate the "spaghetti bowl" effect—the inefficiency arising from multiple overlapping ROO regimes (Bhagwati, 1995; Kim, 2022). A single, harmonized ROO regime across many partners reduces administrative burdens and encourages firms to expand cross-border sourcing and production.

Moreover, full cumulation—commonly incorporated in MRTAs—allows value added from all member countries to count toward origin requirements, making it particularly conducive to GVC expansion. Park et al. (2021) show that under the RCEP, tariff reductions (28%) and ROO cumulation (24%) contribute substantially to trade expansion.

Past empirical studies consistently find that deeper cumulation rules enhance trade (Estevadeordal and Suominen, 2004; Augier et al., 2005; Park and Park, 2011). Using a gravity model, Park and Park (2011) demonstrate that full cumulation has the strongest trade-creating effect among cumulation types.

However, excessively restrictive ROO can impede GVC participation by raising compliance costs (Cadot and de Melo, 2008). In some cases—such as automotive and textile ROO under the USMCA or the textile chapter of the CPTPP—stringent ROO are designed to protect domestic industry, potentially reducing GVC integration.

(2) Trade facilitation

Given that GVCs rely on frequent cross-border movement of intermediate goods, trade facilitation measures are critical. Efficient procedures reduce information, processing, and coordination costs, thereby promoting deeper GVC participation. Cadestin et al. (2018) concludes that improvements in trade facilitation translate

directly into reduced trade costs and higher engagement in cross-border production networks.

(3) Technical barriers to trade

Technical regulations and conformity assessment procedures constitute major non-tariff measures that affect firms' ability to participate in GVCs. Excessive or duplicative technical standards pose disproportionate challenges, particularly for SMEs. TBT chapters in modern trade agreements mitigate these obstacles by ensuring that regulations are no more trade-restrictive than necessary and by promoting mutual recognition of conformity assessment results. OECD (2020) similarly highlights the importance of such provisions for firms embedded in GVCs.

Table 1. Depth of Rules in MRTAs

Agreements	ROO	Trade Facilitation			TBT		
	Full Cumulation	Advance rulings	Expedited Shipments	Single Window	Standards Mutual Recognition	Technical Regulations Mutual Recognition	Conformity Assessment Mutual Recognition
CPTPP	1	1	1	1	0	1	1
USMCA	1	1	1	1	0	1	1
RCEP	0	1	1	0	0	1	1

Note: Assigned 1 if relevant provision was introduced, 0 otherwise.

Source: Author compiled based on World Bank Deep Trade Agreements database 2.0.

As summarized in Table 1, MRTAs typically incorporate more advanced disciplines on ROO, trade facilitation, and regulatory coherence, making them particularly relevant for the coordination of fragmented production networks.

Building on this literature, this study includes ROO, trade facilitation, and TBT depth indexes into the gravity model to quantitatively assess the association between deeper MRTA provisions and increased bilateral backward GVC trade within the automotive sector.

IV. Empirical Analysis

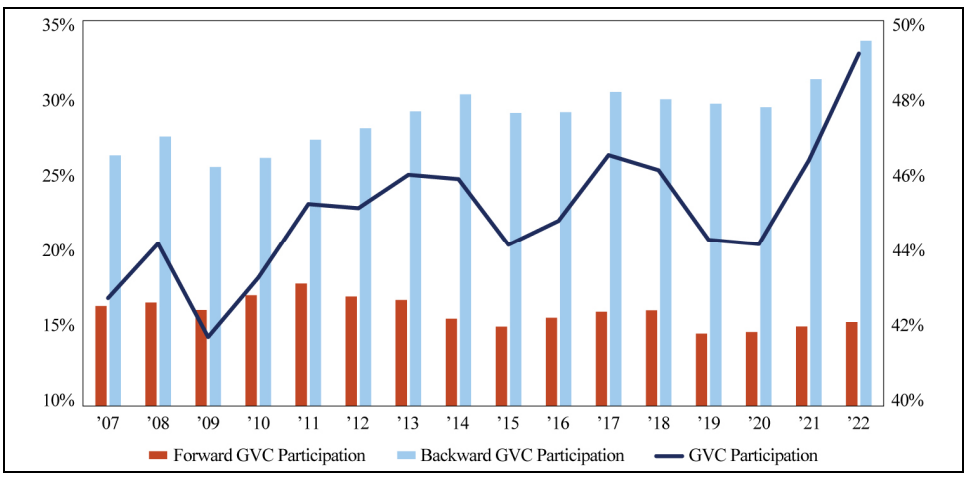
The primary objective of this section is to address the two research questions posed in this study. To answer the first research question, we begin by examining trends in the overall GVC participation rates of CPTPP member countries as well as those in the automotive sector, using graphical analysis and Chow tests. To address the second research question—identifying which deep non-tariff provisions of MRTAs have facilitated GVC integration in the automotive industry—we implement a PPML gravity model.

1. GVC Participation Trends in CPTPP Member Countries

(1) All sectors

The Joint Statement of the Fifth CPTPP Commission highlights the strengthening of "supply chain resilience" and the promotion of SME integration into global supply chains (DFAT, 2021). Similarly, the Joint Leaders' Statement of the RCEP emphasizes that the agreement contributes to "economic recovery, inclusive development, job creation, and strengthening regional supply chains" (ASEAN Secretariat 2020). These statements reveal that enhancing supply chain integration constitutes a core objective of both MRTAs.

Figure 1. Overall GVC Participation Trends of CPTPP (2007–2022)



Source: Author compiled based on ADB MRIO data.

Given that these goals were articulated during a period of decelerating global GVC participation, it is meaningful to empirically examine whether MRTAs such as the CPTPP function as catalysts for expanded GVC integration. We therefore begin by reviewing the aggregate trend in GVC participation (Figure 1).

The overall GVC participation rate of CPTPP members declined sharply during the 2008–2009 global financial crisis, followed by a period of fluctuations. GVC integration steadily weakened between 2017 and 2020, reflecting the intensification of U.S.–China trade tensions and broader geopolitical decoupling pressures. After 2020, however, participation rates began to recover and by 2022 approached nearly 50 percent.

Importantly, the upward trend after 2020 occurred despite negative supply chain shocks associated with the COVID-19 pandemic. This suggests that positive factors during this period—including the effects of CPTPP accession—may have outweighed the negative shocks.

A decomposition of total GVC participation into forward and backward components reveals contrasting patterns. Forward GVC participation of CPTPP members remains relatively low and does not exhibit the strong post-2020 rebound seen in total or backward participation levels. Thus, CPTPP members' GVC integration appears far more pronounced on the backward rather than the forward side.

Table 2. Chow Test for GVC Participation Rate of CPTPP Member Countries

[Forward GVC Participation]

Break point	ADF Statistic	ADF P-value	Stationarity (95%)	Chow Test Statistic	Critical Value	Chow P-value	Structural Break (95%)
2017	–1.852	0.355	FALSE	0.430	4.256	0.663	FALSE
2018	–1.852	0.355	FALSE	0.477	4.256	0.635	FALSE
2019	–1.852	0.355	FALSE	1.487	4.256	0.277	FALSE
2020	–1.852	0.355	FALSE	1.045	4.256	0.391	FALSE
2021	–1.852	0.355	FALSE	0.611	4.256	0.564	FALSE

[Backward GVC Participation]

Break point	ADF Statistic	ADF P-value	Stationarity (95%)	Chow Test Statistic	Critical Value	Chow P-value	Structural Break (95%)
2017	0.847	0.992	FALSE	1.881	4.256	0.208	FALSE
2018	0.847	0.992	FALSE	4.964	4.256	0.035	**TRUE**
2019	0.847	0.992	FALSE	5.305	4.256	0.030	**TRUE**
2020	0.847	0.992	FALSE	5.893	4.256	0.023	**TRUE**
2021	0.847	0.992	FALSE	6.530	4.256	0.018	**TRUE**

Note: If the stationarity test result is "false," the value used in the Chow test is not the standard CPTPP GVC participation rate, but rather the differenced value, "CPTPP GVC Participation_diff."

Source: Author compiled based on ADB MRIO data analyses.

The Chow test results corroborate these findings. As shown in Table 2, no statistically significant structural break is detected in forward GVC participation during 2017–2021. In contrast, backward GVC participation displays repeated significant structural breaks beginning in 2018, the year the CPTPP was signed/ went into effect for the initial signatories, with 2021 emerging as the strongest break point.

(2) Automotive industry

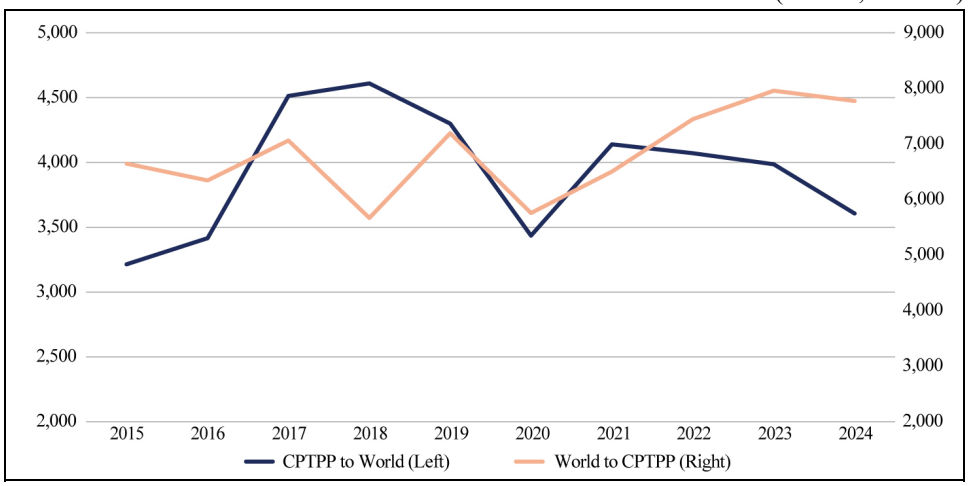
The divergence between forward and backward GVC participation becomes even more prominent in the automotive sector, and this pattern is also observed in a preliminary examination of trade data on automotive intermediate goods.[7]

Figure 2 presents the pattern of automotive intermediate goods trade involving CPTPP members over the past decade.

[7] Automotive intermediate goods refer to parts used in vehicle production. Although most automotive products fall under HS Chapter 87, some items (e.g., tires in Chapter 40 and engines in Chapter 84) are classified elsewhere. For simplicity, this study focuses on HS codes 8706–8708 and 8714 within Chapter 87 as proxies for automotive intermediate goods. These HS-based trade statistics do not directly measure value-added GVC participation, but serve as supplementary indicators of its directional patterns.

Figure 2. Automotive Intermediate Goods Trade Involving CPTPP Members

(Unit: 1,000 tons)

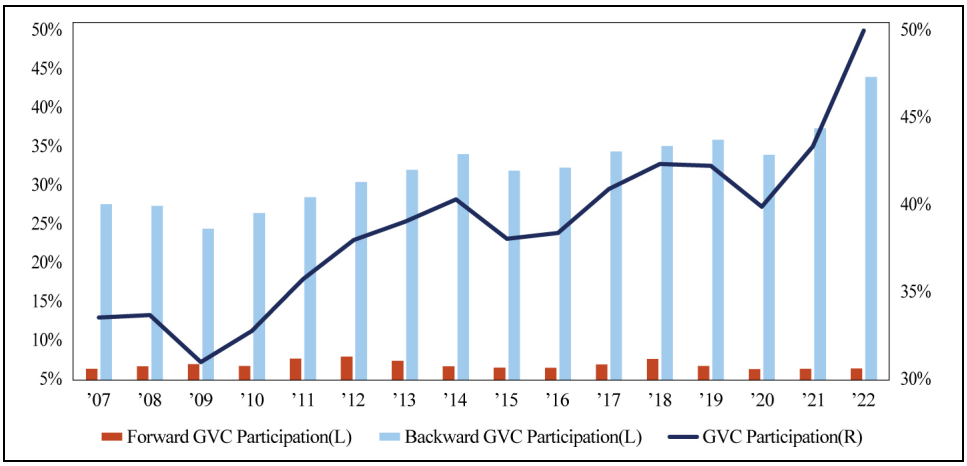


Source: Author compiled based on UN Comtrade data analyses.

Specifically, imports of automotive intermediate goods by CPTPP members for vehicle production are treated as backward GVC participation, while exports of such intermediates to other countries are classified as forward GVC participation. Following the entry into force of the CPTPP in December 2018, both forward and backward trade increased in the short term. However, changes began to emerge around 2020, and since 2021 a clear divergence has become evident: forward GVC participation has shown a declining trend, whereas backward participation has continued to rise. Overall, the trade pattern of automotive intermediate goods indicates a widening asymmetry between forward and backward GVC participation.

A more structural picture emerges when examining value-added-based GVC participation rates from the ADB MRIO database (Figure 3). CPTPP members' forward GVC participation in automotive goods remains extremely low, fluctuating around 6–7 percent. Backward participation, however, hovers around 30 percent and rises sharply to 43.1 percent in 2022, contributing to the increase of nearly 50 percent in total GVC participation that year.

Figure 3. GVC Participation Trends of CPTPP Countries in the Auto Sector



Source: Author compiled based on ADB MRIO data.

The Chow test results further support this asymmetry (Table 3). No statistically significant structural break is found for forward participation, whereas a statistically significant break is detected for backward participation. This suggests that around 2020 there was a fundamental shift in the sourcing structure of automotive production within the CPTPP region.

Table 3. Chow Test Results for Automotive GVC Participation (C15)

[Forward GVC Participation]

Break point	ADF Statistic	ADF P-value	Stationarity (95%)	Chow Test Statistic	Critical Value	Chow P-value	Structural Break (95%)
2017	−0.878	0.795	FALSE	0.537	4.256	0.602	FALSE
2018	−0.878	0.795	FALSE	0.010	4.256	0.990	FALSE
2019	−0.878	0.795	FALSE	1.685	4.256	0.239	FALSE
2020	−0.878	0.795	FALSE	0.173	4.256	0.844	FALSE
2021	−0.878	0.795	FALSE	0.169	4.256	0.847	FALSE

[Backward GVC Participation]

Break point	ADF Statistic	ADF P-value	Stationarity (95%)	Chow Test Statistic	Critical Value	Chow P-value	Structural Break (95%)
2017	0.502	0.985	FALSE	0.635	4.103	0.550	FALSE
2018	0.502	0.985	FALSE	1.575	4.103	0.254	FALSE
2019	0.502	0.985	FALSE	2.593	4.103	0.124	FALSE
2020	0.502	0.985	FALSE	5.791	4.103	0.021	**TRUE**
2021	0.502	0.985	FALSE	4.061	4.103	0.051	FALSE

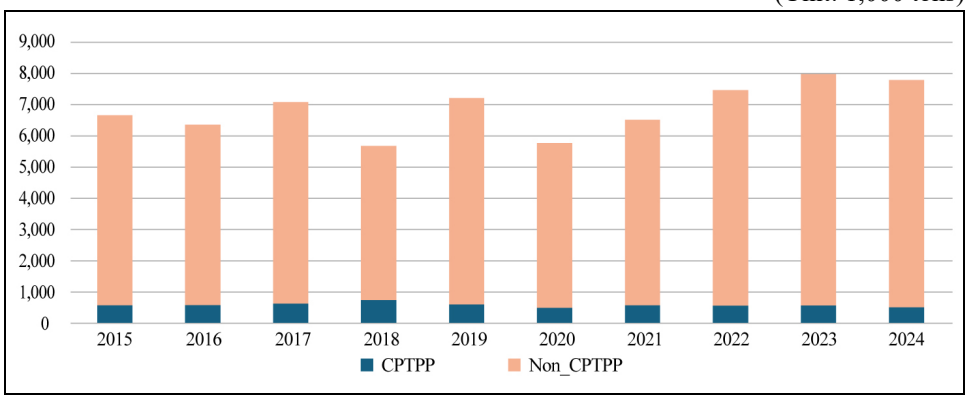
Note: If the stationarity test result is "false," the value used in the Chow test is not the standard CPTPP GVC participation rate, but rather the differenced value, "CPTPP GVC Participation_diff."

Source: Author compiled based on ADB MRIO data analyses.

To clarify the nature of this shift, we decompose CPTPP members' backward GVC participation by intermediate input origin—intra-CPTPP versus non-members (Figure 4). The results indicate that, both before and after CPTPP implementation, more than 90% of intermediate automotive inputs used by CPTPP members originate, on average, from non-member countries. Looking at the top five supplier countries of automotive intermediate inputs to CPTPP members over 2015–2024, the United States and China together account for roughly 70 percent of total supply throughout the period, while Korea, Japan, and Thailand consistently rank among the next three largest suppliers with individual shares fluctuating between 4 and 7 percent.

Figure 4. Origin of Intermediate Inputs for CPTPP Auto Production

(Unit: 1,000 tons)



Source: Author compiled based UN Comtrade data analyses.

These findings suggest that the observed increase in backward participation among CPTPP members primarily reflects continued dependence on major non-member suppliers rather than intensified intra-CPTPP sourcing. This helps explain the forward-backward asymmetry: if intermediate inputs are sourced predominantly from outside the CPTPP bloc, backward participation of CPTPP members may rise without a corresponding increase in forward participation within the bloc.

From an economic perspective, this pattern is consistent with the structural characteristics of the automotive industry. Automotive production involves tens of thousands of differentiated components, many of which require advanced technological capabilities and highly specialized production processes. Given the complexity of supplier networks and the sunk costs embedded in existing production lines, the reconfiguration of supply chains is unlikely to occur rapidly following the implementation of a mega-regional trade agreement such as the CPTPP. As a result, established major suppliers may continue to dominate intermediate input provision in the short to medium run. This persistent reliance on non-members, however, does not necessarily negate the institutional impact of the CPTPP. Rather, it suggests that the CPTPP functions as a stabilizing platform that facilitates complex, multi-tier sourcing strategies. Given the automotive sector's reliance on 20,000 to 30,000 parts, the agreement provides the necessary regulatory certainty for lead firms to maintain these extensive global networks while concentrating high-value assembly functions within the bloc.

Taken together, the evidence from automotive intermediate goods trade data, value-added GVC participation rates, and the Chow test indicates a pronounced asymmetry between forward and backward GVC participation in the automotive industries of CPTPP members. This asymmetry implies that while final vehicle production and assembly functions have been maintained or even strengthened within the CPTPP region, dependence on foreign intermediate goods and parts has deepened. In other words, downstream functions (assembly and final production) have been reinforced, whereas the relative competitiveness of upstream activities (core components and materials supply) has not expanded.

It should be noted, however, that the post-2020 shifts in forward and backward GVC participation in automotive production cannot be attributed solely to the effects of CPTPP accession; they also likely reflect the combined influence of exogenous shocks such as global supply-chain reconfiguration, the acceleration of

the transition to electric vehicles, and the rising dependence on extra-regional sources for semiconductors and other critical components.

From a policy perspective, the sharp rise in backward participation indicates increasing reliance on extra-regional intermediate inputs. This heightened dependence implies greater vulnerability to supply chain disruptions—such as those caused by pandemics or natural disasters—which could lead to production delays or shutdowns. To address this, the role of the CPTPP's full cumulation system should be emphasized. Unlike traditional ROOs, full cumulation allows for the counting of value-added processes across all member countries, effectively incentivizing the gradual transition from extra-regional to more resilient intra-regional sourcing. While the current evidence shows a tension between growth driven by non-members and the agreement's goals, the institutional framework of full cumulation provides a long-term pathway to deepen regional value chains. Accordingly, joint efforts are required to increase regional self-sufficiency in automotive parts and establish a regional production safety net within the CPTPP framework.

Meanwhile, the persistence of forward participation at the 6–7 percent level suggests that CPTPP members occupy a relatively limited position in global markets for core automotive components. As the acceleration of the electric vehicle transition places increasing importance on high-value-added components—such as batteries and automotive semiconductors—competitiveness in these sectors will play a decisive role in national competitiveness. Therefore, strengthened regional cooperation in R&D support, investment promotion, and technological standardization within the CPTPP is essential.

2. MRTA Provisions Affecting Backward GVC Trade in the Automotive Sector

The purpose of this section is to empirically assess how core CPTPP provisions —particularly ROO, trade facilitation, and TBT—have influenced backward GVC integration in the automotive industry. For this analysis, we employ the PPML gravity model introduced in Section III.

Backward GVC trade is used as the dependent variable for several reasons. As shown in Subsection IV.1, CPTPP members' GVC participation is predominantly backward oriented, with this pattern especially pronounced in the automotive industry. Moreover, Chow Test results reveal significant structural breaks only in backward, not forward, GVC participation.

Table 4. Dataset for Gravity Model Estimation

		Description of Data Used for Analysis	
Basic	Years	2007–2022 (16 years in total)	
	Industry	Automotive industry: Among the ADB's 35 industry classifications (C35), Industry 15 is "Transport equipment."	
	Countries	62 countries (2007–2016) and 72 countries (2017–2022) -Rest of world (ROW) was excluded, as no specific trade agreements are linked to ROW. -Country pairs were generated without regard to order (e.g., Japan–Singapore and Singapore–Japan were treated as identical)	
	Agreements	Matched trade agreements applicable to each country pair and year (e.g., Trade agreements between Japan–Singapore: Japan–Singapore EPA (2002–) → CPTPP (2018–) → RCEP (2022–)) -In cases where agreements overlap, the more recent MRTAs was prioritized	
Independent variables (X)	ROO	Assigned 1 if full cumulation was introduced, 0 otherwise (min 0, max 1)	ROO and trade facilitation are core and complementary provisions that enable firms to utilize tariff reductions under FTAs → Combined ROO and Trade Facilitation scores ☞ (Variable) ROO_TF (min 0, max 4)
	Trade facilitation	Assigned 1 each if provisions for advance rulings, expedited shipments, and single window are included (min 0, max 3)	
	TBT	Assigned 1 each if there are provisions preventing excessive restrictions related to standards, technical regulations, and conformity assessment procedures (min 0, max 3)	
	Distance	Distance between countries based on "distwces" (weighted city distance based on population)	
	GDP per capita difference	The GDP per capita (current USD, IMF) is used to calculate the economic disparity between countries.	
Dependent variables (Y)	Backward GVC Trade	Backward GVC Trade from ADB MRIO data	

Source: Author compiled based on ADB (2025); Mayer and Zignago (2011); IMF (2025); World Bank (2020).

Additionally, I use backward GVC trade values rather than participation rates. Participation rates can underestimate the true degree of GVC involvement for economies with very large export denominators. For example, in 2020 Malta and Cyprus recorded high backward participation rates (0.642 and 0.457, respectively), placing them among the top ten countries. China, despite being one of the world's largest GVC hubs, recorded a much lower backward participation rate (0.158) due

to its large export base, masking the substantial scale of its actual GVC trade. Using trade values avoids such distortions.

The dataset used for estimation in Table 4 consists of 34,246 observations covering the automotive sector from 2007 to 2022, based on ADB MRIO data. ROO and trade facilitation are combined into a single measure due to their strong complementarity. Realizing the core benefit of FTAs—preferential tariffs—requires both elements to function jointly. Flexible ROO, such as full cumulation under the CPTPP, cannot yield their intended effects if trade facilitation systems (e.g., single window systems, advance rulings, and expedited shipments) are inadequate.

Empirical evidence reinforces this complementarity. For instance, Taguchi and Thet (2021) show that improved logistics performance in ASEAN economies significantly increases backward GVC participation. Conversely, even strong trade facilitation cannot compensate for excessively restrictive ROO, which may deter firms—especially in the automotive sector—from claiming FTA benefits. Thus, FTAs must evaluate ROO and trade facilitation jointly rather than in isolation.

(1) Fixed effects estimation

Before conducting the main PPML estimations, we perform a preliminary fixed-effects analysis. Fixed effects may be applied at the country or time dimension; here, we introduce country fixed effects to control for unobserved, time-invariant national characteristics. This captures cross-country heterogeneity not explained by observable variables.

Countries such as Germany, the United States, Japan, and China exhibit positive fixed effects. For instance, Germany's fixed effect of 2.7 indicates that its backward GVC trade remains approximately 2.7 percentage points above the average even after controlling for all observed covariates, reflecting its diversified industrial structure and deep manufacturing-based supply chain integration.

Conversely, countries with strongly negative fixed effects—including Saudi Arabia, Kuwait, and the United Arab Emirates—exhibit structural dependence on fuel exports, which account for 70–90 percent of annual exports. These economies specialize in upstream resource supply rather than downstream processing, resulting in below-average backward GVC integration.

Table 5. Country-level Fixed Effects Estimation Results

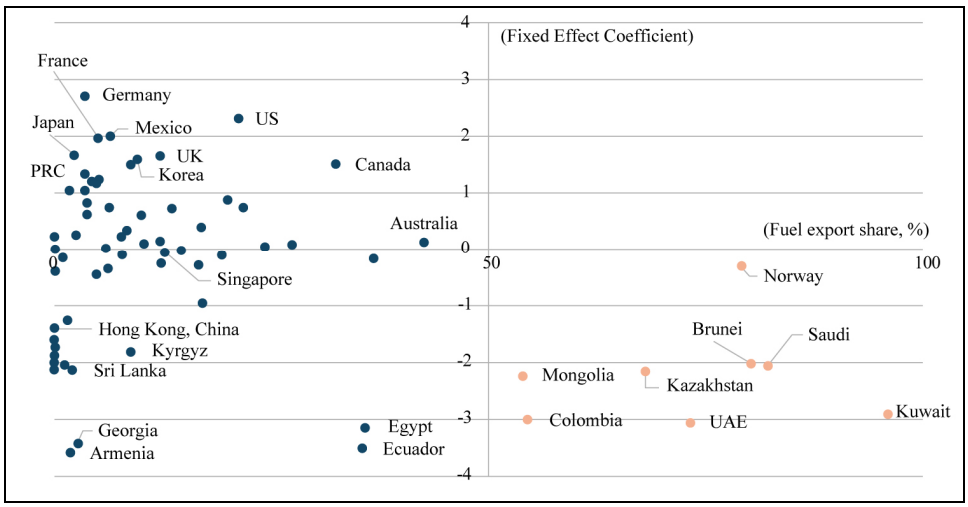
Country Name	Coefficient	Country Name	Coefficient	Country Name	Coefficient	Country Name	Coefficient
Germany	2.7	Türkiye	0.7	Singapore	−0.1	Kyrgyz	−1.8
US	2.3	Netherlands	0.7	Slovenia	−0.1	Bhutan	−1.9
Mexico	2.0	Thailand	0.7	Croatia	−0.1	Brunei	−2.0
France	2.0	Sweden	0.6	Ireland	−0.1	Lao	−2.0
Japan	1.7	Brazil	0.4	Greece	−0.2	Saudi	−2.0
UK	1.7	Portugal	0.3	Latvia	−0.3	Pakistan	−2.1
Korea	1.6	Switzerland	0.2	Lithuania	−0.3	Fiji	−2.1
Canada	1.5	Romania	0.2	Norway	−0.3	Sri Lanka	−2.1
Spain	1.5	Taipei	0.2	Argentina	−0.3	Kazakhstan	−2.2
Czech Republic	1.3	Bulgaria	0.1	Luxembourg	−0.4	Mongolia	−2.2
Slovak Republic	1.2	Finland	0.1	Malta	−0.5	Kuwait	−2.9
Hungary	1.2	Australia	0.1	Malaysia	−0.9	Colombia	−3.0
Italy	1.2	Cyprus	0.1	Philippines	−1.3	UAE	−3.0
PRC	1.1	Indonesia	0.0	Hong Kong	−1.4	Egypt	−3.2
Poland	1.0	Russia	0.0	Nepal	−1.6	Georgia	−3.4
Belgium	0.9	Denmark	0.0	Bangladesh	−1.6	Ecuador	−3.5
Austria	0.8	Estonia	0.0	Cambodia	−1.7	Armenia	−3.6
India	0.7			Maldives	−1.7		

Source: Author compiled based on fixed effects analysis results and World Bank (n.d.).

Quadrant analysis in Figure 5 shows that countries with export structures dominated by fuels (over 50 percent) consistently display negative fixed effects. This suggests that structural reliance on resource-based exports limits incentives and capabilities to participate in complex manufacturing-oriented value chains.

Countries with both low fixed effects and low fuel export shares (Quadrant III) generally have small absolute export volumes and minimal participation in international production networks. Including these countries introduces noise and reduces the precision of GVC-related inferences. Additionally, while Hong Kong and Singapore have large export volumes, their exports consist predominantly of re-exports with low domestic value added. Since GVC analysis focuses on production-based trade linkages, excluding such economies enhances internal consistency.

Figure 5. Relationship Between Country Fixed Effects and Fuel Exports Share



Notes: The y-axis represents the estimated fixed effect coefficients, while the x-axis shows each country's fuel export share. Countries in QI (high fuel export share, positive coefficient) are rare and represent resource-rich countries that exhibit unexpectedly strong backward GVC participation. QII (low fuel export share, positive coefficient) includes diversified, manufacturing-driven economies. QIII (low fuel export share, negative coefficient) comprises typically small economies with limited GVC engagement. QIV (high fuel export share, negative coefficient) consists of resource-dependent economies with low backward GVC participation.

Source: Author compiled based on fixed effects analysis results and World Bank (n.d.).

Reflecting these considerations, approximately 30 countries with negative fixed effects are excluded from the gravity model dataset, with the exception of Singapore and Brunei, which are retained due to their CPTPP membership.

(2) PPML estimation results

Using the refined dataset comprising 24,588 observations, we estimate a nonlinear gravity model via PPML. Prior to presenting the baseline specification (Table 7), we first examine the individual effects of ROO and TF in a separate specification (Table 6) to assess their separate contributions.

Table 6 reports these results. The TF coefficient is positive and significant (0.220, $p<0.01$), indicating trade facilitation promotes backward GVC trade expansion. By contrast, the ROO coefficient is negative and significant (−0.277, $p<0.01$), contrary to expectations. Distance ($p=0.11$) and TBT ($p=0.275$) are statistically insignificant.

Table 6. PPML Estimation: Separated ROO and TF Specifications

	Coefficient	Std. err.	z	P>|z|	[0.025	0.975]
const	9.003	0.094	95.725	0.000	8.818	9.187
ln(Distance)	−0.013	0.008	−1.598	0.110	−0.030	0.003
ln(Difference in GDP per capita)	0.048**	0.006	7.473	0.000	0.036	0.061
ROO	−0.277**	0.028	−9.857	0.000	−0.332	−0.222
TF	0.220**	0.011	19.703	0.000	0.197	0.241
TBT	0.014	0.013	1.092	0.275	−0.011	0.039
Observations			24,588			

Note: ** indicates significance at the 99% level ($p < 0.01$), * indicates significance at the 90% level ($p < 0.10$), dependent variable is backward GVC trade.

Source: Author's calculation.

However, caution must be exercised in interpreting these results as evidence that CPTPP's harmonized ROO do not play an important role in expanding backward GVC trade. Rather, the findings suggest the need to consider whether the effective utilization of the core benefit of FTAs—namely tariff reductions—requires not only flexible ROO, such as full cumulation, but also strong trade facilitation measures, including single-window electronic documentation systems, operating in tandem. In practice, if either of these two elements is underdeveloped, overall FTA utilization may decline.

For example, even when ROO are flexible, inadequate trade facilitation may impose high administrative compliance costs, making it difficult—particularly for small and medium-sized enterprises (SMEs)—to fully utilize FTA preferences. Empirical evidence from emerging ASEAN economies (Taguchi and Thet, 2021) supports this complementarity, showing that improvements in logistics performance significantly increased backward GVC participation.

From this perspective, the preliminary findings provide justification for employing the composite ROO_TF index in the main specification. This index captures the joint institutional effect of ROO and trade facilitation, mitigates potential multicollinearity between the separate measures, and reflects their necessary complementarity for maximizing FTA tariff utilization.

Table 7 presents the main results using the ROO_TF index. Although the set of independent variables differs slightly from previous specifications, the effective

sample size remains consistent at 24,588 observations, as in Table 6, ensuring comparability across the models.

The coefficient for *ln*(Distance) is −0.0253 and statistically significant at the 1 percent level. This negative association is consistent with standard gravity theory: greater geographical distance increases transportation costs, delivery delays, and logistics uncertainties, thereby weakening backward GVC linkages. The coefficient for *ln*(Difference in GDP per capita) is 0.0465 and significant at the 1 percent level. This indicates that greater economic asymmetry between trading partners, reflected by the income disparity, is associated with greater backward GVC trade. Such asymmetry reflects differences in factor endowments and technological capabilities, facilitating vertical specialization. In the automotive industry, for example, high-income economies often supply capital-and technology-intensive intermediates, while lower-income economies specialize in labor-intensive assembly.

Turning to deep MRTA provisions, the coefficient for ROO_TF is 0.1266 and statistically significant at the 1 percent level. Importantly, this result should be interpreted in light of the institutional depth embodied in agreements such as CPTPP. Compared to many conventional RTAs included in the sample—which often focus primarily on tariff reduction with relatively limited harmonization of ROO or weak trade facilitation commitments—CPTPP incorporates a more comprehensive and harmonized framework. It features harmonized product-specific ROO, extended cumulation mechanisms (including full cumulation), and detailed trade facilitation disciplines such as advance rulings, expedited shipments, and single-window systems.

Table 7. Baseline PPML Results: Composite ROO_TF Index

	Coefficient	Std. err.	z	P>|z|	[0.025	0.975]
const	9.130	0.094	97.149	0	8.945	9.314
ln(Distance)	−0.025 **	0.008	−3.064	0.002	−0.041	−0.009
ln(Difference in GDP per capita)	0.047 **	0.006	7.238	0	0.034	0.059
ROO_TF	0.127 **	0.009	14.733	0	0.11	0.143
TBT	0.028 *	0.013	2.044	0.041	0.001	0.054
Observations	24,588					

Note: ** indicates significance at the 99% level ($p < 0.01$), * indicates significance at the 95% level ($p < 0.05$), dependent variable is backward GVC trade.

Source: Author's calculation.

These provisions reduce compliance uncertainty, streamline customs procedures, and enhance the reliability of multi-stage production networks. In highly fragmented sectors such as automotive manufacturing, where intermediate inputs cross borders multiple times, such institutional depth is particularly consequential. The positive and significant ROO_TF coefficient therefore suggests that CPTPP's deep integration architecture—rather than tariff liberalization alone—is associated with stronger backward GVC participation.

The coefficient for TBT is 0.0275 and significant at the 5 percent level. Harmonization of product standards and mutual recognition of conformity assessment procedures reduce compliance costs, particularly in highly regulated sectors such as automotive manufacturing, thereby encouraging cross-border production integration.

The empirical findings from the gravity model yield three key insights regarding the mechanisms of GVC integration:

- Geographic proximity remains a fundamental determinant of GVC integration. Conversely, increased distance significantly impedes participation as it raises transport costs and logistics uncertainties, which are particularly disruptive for the "just-in-time" supply chains characteristic of the automotive industry.
- Economic asymmetry between countries drives vertical specialization based on comparative advantage. Differences in labor costs and technological capabilities among member states incentivize the fragmentation of production—relocating labor-intensive assembly to emerging economies while concentrating capital-intensive component production in advanced economies. This structural disparity serves as the economic engine that strengthens backward GVC links.
- The depth of institutional provisions in trade agreements—particularly the combination of flexible ROO with extended cumulation and binding trade facilitation disciplines as exemplified by CPTPP—acts as a critical infrastructure for supply chain integration. From the perspective of transaction cost economics, these deep provisions reduce "institutional distance" and lower the administrative burdens associated with complex global sourcing. By providing "institutional thickness," the CPTPP mitigates the risk of hold-up problems and facilitates the long-term investments required for multi-tier production networks. Together, these results highlight while economic asymmetry provides the fundamental incentive for GVC formation, the depth of trade provisions provides the necessary institutional framework to realize these gains. This underscores the importance of combining traditional determinants of trade (e.g., distance and

economic structure) with modern, high-standard trade policy variables (e.g., the depth of ROO, trade facilitation, and TBT provisions) to understand GVC integration in complex industries such as automotive manufacturing.

V. Conclusion

This study set out to examine whether the CPTPP—a representative MRTA characterized by deep institutional disciplines—is associated with changes in member countries' participation in GVCs, particularly within the automotive sector. Motivated by the broader context of rising protectionism, geopolitical fragmentation, and the structural deceleration of GVC expansion since the late 2000s, the analysis addressed two research questions: (1) whether CPTPP accession strengthens member states' GVC participation, and (2) which deep provisions of MRTAs—such as ROO, trade facilitation, and TBT—most strongly stimulate backward GVC integration in automobile industry.

The empirical findings offer several important insights. First, descriptive trends and Chow Test results consistently reveal that CPTPP membership is associated with increased GVC participation, but this effect is strongly asymmetric across forward and backward linkages. Whereas forward participation, representing domestic value added embodied in foreign exports, remains largely stagnant across both total industries and the automotive sector, backward participation, sourcing foreign intermediate inputs, increases substantially after the CPTPP entered into force. This pattern is particularly pronounced in the automotive industry—an archetypal complex-production sector characterized by multi-stage cross-border input sourcing.

Second, structural break analysis confirms that backward participation experiences significant regime changes following CPTPP implementation, with the early 2020s emerging as a critical turning point. Given the concurrent presence of adverse shocks—including U.S.–China trade tensions, COVID-19 disruptions, and heightened geopolitical uncertainty—the observed rise in backward GVC integration among CPTPP members suggests a possible role for the agreement in mitigating negative global shocks through institutional stability and harmonized trade rules.

Third, the gravity model using PPML estimation provides clear evidence that deep provisions embedded in MRTAs exert meaningful effects on GVC outcomes, with the combined effect of enhanced ROO and trade facilitation being particularly pronounced. Enhanced ROO and trade facilitation—captured jointly to reflect their

functional complementarity—exert a strong and statistically significant positive influence on backward GVC trade in the automotive sector. Flexible ROO frameworks such as full cumulation, combined with streamlined administrative procedures, reduce compliance costs and increase predictability for firms embedded in fragmented production networks. These results support the view that policy design within trade agreements matters as much as tariff reduction itself in shaping modern supply chain integration.

Similarly, advanced TBT provisions also promote GVC integration, indicating that the harmonization of technical standards and mutual recognition of conformity assessment procedures reduce regulatory frictions in industries where safety, quality, and standardization requirements are particularly stringent. In the automotive sector—where regulatory heterogeneity can impose substantial fixed costs on producers—such provisions are essential for maintaining uninterrupted cross-border production flows.

The results further highlight the continuing relevance of traditional determinants of international trade such as geographic distance and income asymmetries. Distance remains a significant impediment to backward GVC integration, reflecting persistent logistical constraints and transportation frictions. Meanwhile, greater differences in per capita income promote vertical specialization, consistent with classical theories of production fragmentation: capital-intensive economies tend to supply high-value intermediates, while labor-abundant economies specialize in assembly tasks.

These findings carry important policy implications, suggesting that deep trade integration, rather than mere tariff preference, is crucial for GVC resilience and participation in complex sectors. Taken together, the findings contribute to the growing literature on mega-regionalism and supply chain resilience. They suggest that deep MRTAs can help offset global geopolitical disruptions by strengthening cross-border production links, especially in sectors where GVC fragmentation is structurally entrenched. The CPTPP is associated with a stabilizing institutional framework that supports member economies' efforts to diversify supply sources, reduce trade-policy uncertainty, and maintain access to efficient cross-border production networks.

While this study offers meaningful contributions, several limitations suggest avenues for future research. First, the reliance on MRIO-based measures may mask firm-level heterogeneity; incorporating firm-level microdata would make it possible to

uncover more nuanced mechanisms through which deep trade agreements affect production networks, including the role of lead firms and suppliers in shaping GVC structures. Expanding sectoral coverage beyond the automotive industry to semiconductors, electronics, or agriculture would also help assess whether the patterns documented here generalize across sectors with different production technologies and value-chain configurations.

Second, the relatively short post-treatment period (post-CPTPP) limits the ability to identify long-term dynamic effects. As more ex-post data become available, longitudinal and dynamic analyses could track the evolution of GVC participation over time, capturing both short-term adjustments and longer-run responses to mega-regional trade agreements. Dynamic modeling frameworks and richer identification strategies—for example, exploiting staggered implementation of specific provisions or using lagged independent variables—could also help better disentangle correlation from potential causal relationships.

Third, future work could more explicitly examine the interactive effects between CPTPP and other MRTAs such as RCEP, as well as possible spillover effects on non-member economies. Comparing the impacts of different MRTAs within a unified framework would enable a more comprehensive assessment of how alternative institutional architectures and provision designs are associated with GVC integration. Building on this, provision-level analyses could be deepened by developing more granular measures of MRTA depth, identifying design features that are most strongly associated with GVC outcomes.

References

ADB. 2025. "Key Indicators Database-Globalization [Data set]." *Asian Development Bank,* https://kidb.adb.org/globalization.

ADB, UIBE, WTO, IDE-JETRO and CDRF. 2021. *Global Value Chain Development Report 2021: Beyond Production*. Asian Development Bank.

Antràs, P. 2020. "De-Globalisation? Global Value Chains in the Post-COVID-19 Age." NBER Working Papers, no. 28115. National Bureau of Economic Research. https://www.nber.org/papers/w28115

Arndt, S. W. and H. Kierzkowski. (eds.). 2001. *Fragmentation: New Production Patterns in the World Economy*. Oxford University Press.

Arriola, C., Guilloux-Nefussi, S., Koh, S.-H., Kowalski, P., Rusticelli, E. and F. van Tongeren. 2020. "Efficiency and Risks in Global Value Chains in the Context of COVID-19." OECD

Economics Department Working Papers, no. 1637. Organisation for Economic Co-operation and Development. https://doi.org/10.1787/3e4b7ecf-en

ASEAN Secretariat. 2020. "Joint Leaders' Statement on the Regional Comprehensive Economic Partnership (RCEP)." https://asean.org/joint-leaders-statement-on-the-regional-comprehensive-economic-partnership-rcep-2/

Augier, P., Gasiorek, M., Tong, C. L., Martin, P. and A. Prat. 2005. "The Impact of Rules of Origin on Trade flows." *Economic Policy*, vol. 20, no. 43, pp. 567–624.

Azmeh, S. 2015. "Transient Global Value Chains and Preferential Trade Agreements: Rules of Origin in US Trade Agreements with Jordan and Egypt." *Cambridge Journal of Regions, Economy and Society*, vol. 8, no. 3, pp. 475–490.

Bhagwati, J. N. 1995. "US Trade Policy: The Infatuation with FTAs." Discussion Paper Series, no. 726. Department of Economics, Columbia University. https://doi.org/10.7916/D8CN7BFM.

Boffa, M., Jansen, M. and O. Solleder. 2019. "Do We Need Deeper Trade Agreements for GVCs or Just a BIT?" *World Economy*, vol. 42, no. 6, pp. 1713–1739.

Borin, A. and M. Mancini. 2019. "Measuring What Matters in Global Value Chains and Value-Added Trade." Policy Research Working Papers, no. 8804. World Bank. https://doi.org/10.1596/1813-9450-8804

Cadestin, C., de Backer, K., Desnoyers-James, I., Miroudot, S., Ye, M. and D. Rigo. 2018. "Multinational Enterprises and Global Value Chains: New Insights on the Trade-Investment Nexus." OECD Science, Technology and Industry Working Papers, no. 2018/05. Organisation for Economic Co-operation and Development. https://doi.org/10.1787/194ddb63-en

Cadot, O. and J. de Melo. 2008. "Why OECD Countries Should Reform Rules of Origin." *World Bank Research Observer*, vol. 23, no. 1, pp. 77–105.

Chang, P. L. and P. T. B. Nguyen. 2022. "Global Value Chains and the CPTPP." *World Economy*, vol. 45, no. 12, pp. 3780–3832. https://doi.org/10.1111/twec.13300

Choi, N. 2019. "Deeper Regional Integration and Global Value Chains." KIEP Working Papers, no. 19–02. Korea Institute for International Economic Policy. https://www.kiep.go.kr/gallery.es?mid=a10105020000&bid=0001&list_no=2363&act=view&cg_code=

Chung, C., Park, I. and S. Park. 2022. "Estimating the Impact of Cumulative Rules of Origin on Trade Costs: An Application to Mega-Regional Free Trade Agreements in the Asia-Pacific Region." *Asian Economic Papers*, vol. 21, no. 1, pp. 92–109. https://doi.org/10.1162/asep_a_00846

Davidson, R. and J. G. MacKinnon. 1993. *Estimation and Inference in Econometrics*. Oxford University Press.

Delera, M. and N. Foster-McGregor. 2020. "On PTAs and Bilateral Trade: Is GVC Trade Sensitive to the Breadth of Trade Policy Cooperation?" *Economies*, vol. 8, no. 4.

Department of Foreign Affair and Trade (DFAT). 2021. "CPTPP Joint Ministerial Statement on the Occasion of the Fifth Commission Meeting." Australian Government. https://www.dfat.gov.au/trade/agreements/in-force/cptpp/news/cptpp-joint-ministerial-statement-occasion-fifth-commission-meeting

Dür, A., Baccini, L. and M. Elsig. 2014. "The Design of International Trade Agreements: Introducing a New Dataset." *Review of International Organizations*, vol. 9, no. 3, pp. 353–375.

Estevadeordal, A. and K. Suominen. 2004. "Rules of Origin: A World Map and Trade Effects." Paper prepared for the 7th Annual Conference on Global Economic Analysis: Trade, Poverty, and the Environment. World Bank, Washington, DC. June 14–16. https://www.gtap.agecon.purdue.edu/uploads/resources/download/1866.pdf

Ferrantino, M. J. and G. Schmidt. 2018. "Using Gross Trade Data to Map Archetypal GVCs." Policy Research Working Papers, no. 8296. World Bank. https://doi.org/10.1596/1813-9450-8296

Ferrarini, B. and D. H. Brooks. 2012. "Vertical Gravity." ADB Economics Working Paper Series, no. 303. Asian Development Bank. https://www.adb.org/publications/vertical-gravity

Flaig, D. and J. Greenville. 2021. "Trade Liberalization in APEC and Global Value Chain Participation: What Can Value Added Indicators Tell?" *Journal of Economic Integration*, vol. 36, no. 2, pp. 308–338. https://doi.org/10.11130/jei.2021.36.2.308

Gereffi, G. 1999. "International Trade and Industrial Upgrading in the Apparel Commodity Chain." *Journal of International Economics*, vol. 48, no. 1, pp. 37–70. https://www.cambridge.org/core/books/abs/trade-multilateralism-in-the-twentyfirst-century/helping-businesses-navigate-wto-accession/78E0B93F515BA939B5263D236A425F42

González, A. 2017. "Chapter 5. Helping Businesses Navigate WTO Accession." In Kireyev, A. and C. Osakwe. (eds.). *Trade Multilateralism in the Twenty-First Century*. Cambridge University Press. pp. 81–98.

Hayakawa, K. and N. Yamashita. 2011. "The Role of Preferential Trade Agreements (PTAs) in Facilitating Global Production Networks." IDE Discussion Papers, no. 280. Institute of Developing Economies.

Herman, P. R. 2023. "Gravity Estimation: Best Practices and Useful Approaches." Working Paper Series, no. 2023-10-C. United States International Trade Commission. https://www.usitc.gov/publications/332/working_papers/herman_2023_gravity_estimation_guide.pdf

Hummels, D., Rapoport, D. and K. M. Yi. 1998. "Vertical Specialization and the Changing Nature of World Trade." *Economic Policy Review*, vol. 4, no. 2, pp. 79–99.

Hyndman, R. J. and G. Athanasopoulos. 2018. *Forecasting: Principles and Practice*, 2nd Edition. OTexts. https://otexts.com/fpp2/

IMF. 2025. "World Economic Outlook (April 2025)-GDP per Capita, Current Prices [Data set]." International Monetary Fund. https://www.imf.org/external/datamapper/NGDPDPC@WEO

Kim, J. B. 2022. "Rules of Origin: Bridging Regions to Withstand Turbulent Times." In Adriaensen, J. and E. Postnikov. (eds.). *A Geo-Economic Turn in Trade Policy? EU Trade Agreements in the Asia-Pacific*. Palgrave Macmillan Cham. https://doi.org/10.1007/978-3-030-81281-2_8

Krugman, P. 1995. "Growing World Trade: Causes and Consequences." *Brookings Papers on Economic Activity*, vol. 1995, no. 1, pp. 327–377. https://doi.org/10.2307/2534577

Laget, E., Osnago, A., Rocha, N. and M. Ruta. 2020. "Deep Trade Agreements and Global Value Chains." *Review of Industrial Organization*, vol. 57, no. 2, pp. 379–410.

Larson, J., Baker, J., Latta, G., Ohrel, S. and C. Wade. 2018. "Modeling International Trade of Forest Products: Application of PPML to a Gravity Model of Trade." *Forest Products Journal*, vol. 68, no. 3, pp. 303–316.

Mayer, T. and S. Zignago. 2011. "Notes on CEPII's distances measures: The GeoDist database." CEPII Working Paper, no. 2011-25. Centre d'Études Prospectives et d'Informations Internationales. https://www.cepii.fr/CEPII/en/publications/wp/abstract.asp?NoDoc=3877

Ministry of Economy and Finance (MOEF). 2025. "[Government Holds Joint Meeting of Ministers on Economic Affairs and Industrial Competitiveness Enhancement]." September 3. https://www.moef.go.kr/nw/nes/detailNesDtaView.do?searchBbsId1=MOSFBBS_000000000028&menuNo=4010100&searchNttId1=MOSF_000000000075142 (in Korean)

Park, C.-Y., Petri, P. A. and M. G. Plummer. 2021. "The Economics of Conflict and Cooperation in the Asia-Pacific: RCEP, CPTPP and the US–China Trade War." *East Asian Economic Review,* vol. 25, no. 3, pp. 233–272. https://dx.doi.org/10.11644/KIEP.EAER.2021.25.3.397

Park, I. and S. Park. 2011. "Best Practices for Regional Trade Agreements." *Review of World Economics*, vol. 147, no. 2, pp. 249–268.

Petri, P. A. and M. G. Plummer. 2019. "Mega-Regional Agreements and Their Impact on Australia." *Australian Economic Review*, vol. 52, no. 4, pp. 468–475. https://doi.org/10.1111/1467-8462.12355

Pomfret, R. and P. Sourdin. 2009. "Have Asian Trade Agreements Reduced Trade Costs?" *Journal of Asian Economics*, vol. 20, no. 3, pp. 255–268. https://doi.org/10.1016/j.asieco.2009.02.007

Reuters. 2025. "Sweden to Propose EU Membership of Pacific Rim Free Trade Group CPTPP." Updated May 14. https://www.reuters.com/world/china/sweden-propose-eu-membership-pacific-rim-free-trade-group-cptpp-2025-05-13/

Schwellnus, C., Haramboure, A., Samek, L., Pechansky, R. C. and C. Cadestin. 2023. "Global Value Chain Dependencies under the Magnifying Glass." OECD Science, Technology and Industry Policy Papers, no. 142. https://doi.org/10.1787/b2489065-en

Seric, A. and Y. S. Tong. 2019. "What Are Global Value Chains and Why Do They Matter?" August 2019. Industrial Analytics Platform. https://iap.unido.org/articles/what-are-global-value-chains-and-why-do-they-matter

Shin, S.-H. and S.-Y. Shin. 2021. "A Study on the Reinforcement of Supply Chains Corresponding to Global Value Chain Reforms in the Automobile Parts and Component Industry." *Journal of International Logistics and Trade*, vol. 19, no. 3, pp. 163–179. https://doi.org/10.24006/jilt.2021.19.3.163

Subramanian, A. and M. Kessler. 2013. "The Hyperglobalization of Trade and Its Future." PIIE Working Paper Series, no. WP13-6. Peterson Institute for International Economics. https://www.piie.com/sites/default/files/publications/wp/wp13-6.pdf

Taguchi, H. and M. S. Thet. 2021. "Quantitative Linkage between Global Value Chains' Backward Participation and Logistics Performance in the Host Country: A Structural gravity model analysis of emerging ASEAN economies." *Asia-Pacific Journal of Regional Science*, vol. 5, no. 2, pp. 453–475. https://doi.org/10.1007/s41685-020-00187-z

Thang, D. N., Ha, L. T., Dung, H. P. and T. Q. Long. 2021. "On the Relationship between Rules of Origin and Global Value Chains." *Journal of International Trade & Economic Development*, vol. 30, no. 4, pp. 549–573.

The Economist. 2019. "Globalisation Has Faltered." January 24. https://www.economist.com/briefing/2019/01/24/globalisation-has-faltered?utm_campaign=shared_article

Tinbergen, J. 1963. "Shaping the World Economy." *International Executive*, vol. 5, no. 1, pp. 27–30. https://doi.org/10.1002/tie.5060050113

Tyazhelnikov, V. and X. Zhou. 2020. "PPML, Gravity, and Heterogeneous Trade Elasticities." https://www.vtyazhelnikov.com/uploads/1/3/3/4/133413130/ppml_heterogeneous_elasticities.pdf

USTR. 2011. "From Enactment to Entry into Force: Next Steps on The Trade Agreements." Office of United States Trade Representative. https://ustr.gov/about-us/policy-offices/press-office/fact-sheets/2011/october/enactment-entry-force-next-steps-trade-agreements

World Bank. 2020. "DEEP TRADE AGREEMENTS (DTAs): Data, Tools and Analysis [Data set]." https://datatopics.worldbank.org/dta/table.html (accessed September 2024)

———. n.d. "Fuel Exports (% of Merchandise Exports) [Data set]." https://data.worldbank.org/indicator/TX.VAL.FUEL.ZS.UN (accessed April 30, 2025)

World Economic Forum. 2014. "Mega-Regional Trade Agreements: Game-Changers or Costly Distractions for the World Trading System?" World Economic Forum. https://www.weforum.org/publications/mega-regional-trade-agreements-game-changers-or-costly-distractions-world-trading-system/

World Trade Organization (WTO). 2011. *World Trade Report 2011: The WTO and Preferential Trade Agreements: From Co-Existence to Coherence*. WTO Publishing. https://www.wto.org/english/res_e/publications_e/wtr11_e.htm

———. n.d. "Regional Trade Agreements-Scope of RTAs." World Trade Organization. https://www.wto.org/english/tratop_e/region_e/scope_rta_e.htm (accessed February 21, 2023)

Yi, K. M. 2003. "Can Vertical Specialization Explain the Growth of World Trade?" *Journal of Political Economy*, vol. 111, no. 1, pp. 52–102. https://doi.org/10.1086/344805

Zhang, R., Zhao, J. and J. Zhao. 2021. "Effects of Free Trade Agreements on Global Value Chain Trade-A research perspective of GVC backward linkage." *Applied Economics*, vol. 53, no. 44, pp. 5122–5134. https://doi.org/10.1080/00036846.2021.1917763

First version received on November 30, 2025
Peer-reviewed version received on February 13, 2026
Final version accepted on April 2, 2026