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The Impact of Regional Trade Agreement Depth on Regional Value Chains: Evidence from 21 Asia-Pacific Countries

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Abstract: This study aims to investigate the impact of the depth of regional trade agreements (RTAs) on the formation and expansion of regional value chains (RVCs). Focusing on RTAs and intermediate goods trade among 21 Asia-Pacific countries from 1995 to 2020, this study employs social network analysis to visualize the characteristics of RTAs and the intermediate goods trade network over a 26-year period. Using Quadratic Assignment Procedure (QAP) regression analysis, we empirically examine the effects of RTAs on intra-regional intermediate goods trade. The findings reveal that the depth and legal effectiveness of RTAs significantly enhance intra-regional intermediate goods trade. Specifically, deeper RTAs with more provisions effectively eliminate trade barriers, facilitating the movement of intermediate goods and significantly enhancing regional value chains. Furthermore, highly effective legal provisions reduce uncertainties in intermediate goods flow, further securing regional value chain development. This study provides robust theoretical support for the restructuring of regional value chains and economic integration in the Asia-Pacific region through detailed analysis and empirical validation.

Keywords: Regional Trade Agreements; Agreement Depth; Intermediate Goods Trade; Regional Value Chains

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1. Introduction

Amid the deepening of global economic integration, the reduction in transportation costs and rapid advancements in information technology have facilitated the global optimization of resource allocation, enabling "fragmented" production. Arndt and Kierzkowski (2001) pioneered this concept to describe the process of cross-border specialization in component production and shared manufacturing. They observed that trade in intermediate goods has increasingly surpassed trade in final products. This physical separation in production has driven globalization, leading to a stage characterized by specialization within global value chains. Miroudot and Nordström (2020) define global value chains as the vertical fragmentation of the production process, which involves dividing production activities into stages that are distributed across different economies. This indicates a growing tendency among countries and enterprises to specialize in the production of specific intermediate goods. As a result, global trade has entered an era characterized by value chain trade, where countries engage in the trade of intermediate goods based on their respective comparative advantages.

However, over the past two decades, this trend has undergone significant restructuring. The 2008 global financial crisis severely impacted global value chains, and since 2012, these chains have exhibited a contraction trend. Miroudot and Nordström (2020) provide a detailed examination of this phenomenon. According to the World Integrated Trade Solution (WITS) database*, the share of global value chain trade in total trade reached 51.84% in 2008, the highest to date. With the slowdown of globalization, regionalism has flourished, leading to a trend of increased regional economic cooperation. Global value chain development now exhibits a "tripolar" pattern centered around North America, Europe, and Asia (Ju et al., 2020). The Asia-Pacific region is the second most active area for regional cooperation, following the European Union. Mechanisms like the Asia-Pacific Economic Cooperation (APEC), the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), and the Regional Comprehensive Economic Partnership (RCEP) have played crucial roles in promoting economic development and enhancing overall competitiveness in the region. Today, the Asia-Pacific region is home to the world's largest free trade agreement, RCEP, and the most open regional trade agreement, CPTPP. Additionally, the United States-Mexico-Canada Agreement (USMCA) has reinforced provisions related to the digital economy, labor, and environmental standards.

Within the context of value chain specialization, frequent cross-border trade in intermediate goods encounters significant obstacles due to tariffs and non-tariff barriers. Multilateral trade negotiations led by the World Trade Organization (WTO) have struggled to harmonize the diverse demands of member countries, leading to a growing need for regional trade rules. Consequently, it has become increasingly common for cooperating economies to form Regional Trade Agreements (RTAs). The purpose of RTAs is to enhance regional economic ties by reducing trade restrictions and offering favorable trade conditions, and to promote trade and economic cooperation among member countries. By April 1, 2024, according to the Regional Trade Agreements Database†, there are 366 active Regional Trade Agreements (RTAs) worldwide, involving 212 countries. Among these, there are 2 Economic Integration Agreements (EIAs), 12 Customs Unions (CUs), 26 Partial Scope Agreements (PSAs), and 130 Free Trade Agreements (FTAs). Additionally, there are numerous hybrid agreements, including 190 FTA&EIA agreements, 1 PSA&EIA agreement, and 7 CU&EIA agreements. The development of RTAs is not only an inevitable outcome of the restructuring of regional value chains but also a fundamental prerequisite for their further development.

In the context of regional economic integration, this study focuses on 21 countries in the Asia-Pacific region and develops indicators to measure the depth of RTAs and their legal effectiveness. It analyzes the effects of RTAs on intra-regional trade of intermediate goods. The results of this study aim to provide empirical evidence to enhance the understanding and optimization of regional value chains.

* EORA26 (1990-2015) 199.82 version. https://wits.worldbank.org/.
† https://rtais.wto.org/UI/PublicMaintainRTAHome.aspx.

2. Literature Review

After the 2008 financial crisis, discussions on "de-globalization" and "re-globalization" have gained prominence in academic circles. In recent years, a series of external shocks, including the resurgence of trade protectionism and the global outbreak of the COVID-19 pandemic, have hindered globalization. The Global Value Chain Development Report 2023 highlights that the international division of labor is significantly restructuring, resulting in the reconfiguration of global value chains. This restructuring is ongoing and dynamic, driven by technological advancements, political pressures, environmental challenges, and exacerbated global issues. Technological advancements enhance efficiency and reduce costs, thereby promoting industrial agglomeration and shifts in production, which subsequently alter the distribution and structure of value chains (Hanson, 1998).

Yi et al. (2023) found that data elements can directly influence the restructuring of global value chains by altering production and trade costs. Meanwhile, geopolitical tensions and the rise of economic nationalism in various countries have led to greater control over critical industries and technologies, which have been key factors contributing to the slowdown of globalization (Miroudot and Nordström, 2020). As Gereffi and John (2005) pointed out, the decision regarding which activities and technologies to retain in-house and which to outsource to other companies is a significant strategic issue. Additionally, another crucial aspect within the context of the fragmented global division of labor is environmental sustainability. Antràs (2020) explored the complex relationship between global value chains and the environment. Certain production stages may be deliberately located in countries with less stringent environmental regulations to avoid stringent controls and higher costs in countries with stringent environmental standards. Consequently, all participants in the value chain must adequately balance economic benefits and social responsibilities.

Finally, the rise of global challenges has created an external imperative for the regionalization of value chains. The unanticipated impact of the COVID-19 pandemic resulted in widespread disruptions across global supply and demand (Ivanov, 2022), leading to cascading effects (Smorodinskaya et al., 2021) and highlighting the inherent risks of sustaining economic globalization. In response, governments and enterprises are reconsidering the reallocation of production activities to mitigate risks more effectively. These dynamics have propelled the shift in globalization from global diffusion to regionalization.

The regionalization of global value chains has emerged as a significant characteristic of the restructuring of global value chains (Ni, 2021; Shen et al., 2023). RVCs are formed through geographic concentration and represent regional aggregation within the globally dispersed value chains. This manifests as a combination of a large-scale "multi-center equilibrium" and a "center-periphery" model (Zang et al., 2021). RVCs form a regional production division between National Value Chains (NVCs) and Global Value Chains (GVCs) (Zhao, 2016). Huang et al.(2018) used industry-level regional trade concentration indicators to describe the degree of "block formation" in global value chains by measuring the trade inclination of intermediate goods across 44 countries from 2000 to 2014. Using regional trade concentration as a measure for "block formation" in global value chains, they examined the impact of producer services trade on "block formation" at three levels: overall, by service-manufacturing groups, and by manufacturing technology level groups. Their findings confirmed the existence of "block formation" in global value chains. From an international perspective, the global value chain network presents a situation of "tripartite confrontation"(Ju et al., 2020), divided into the "Asian factory," "North American factory," and "European factory" (Baldwin et al., 2015). Moreover, the share of activities in the "Asian factory" region has been growing annually, becoming a crucial engine of the global economy (Lan et al., 2023).

There is a close and complex relationship between RTAs and the development of RVCs. RTAs can generally strengthen value chain integration and deepen value chain linkages among member countries (Lan et al., 2023). This relationship depends not only on the presence of agreements but also, more critically, on the specific content and depth of the agreement provisions. Research on the content of these provisions is extensive, particularly focusing on Rules of Origins (RoOs) and labor standards. RoOs are designed to prevent "trade deflection." According to Conconi et al. (2018), RoOs exert a protectionist effect by redirecting trade flows from non-member countries to the region, thus suppressing intermediate goods trade with non-member

countries. However, excessively stringent RoOs may hinder the benefits of such trade redirection (Yang et al., 2020; Thang et al., 2021).

Labor standards have also sparked diverse concerns and debates. Developed countries advocate for higher labor standards to prevent "social dumping," while developing countries worry that implementing higher labor standards will increase production costs and undermine the competitiveness of their products. Distelhorst et al.(2018) found that companies prefer that their trade partners implement higher labor standards to protect workers' rights but are opposed to the increased costs associated with higher standards. Additionally, the specific clauses regarding labor standards vary significantly. The implementation of core labor standards does not suppress exports; instead, it has a positive impact (Bonnal, 2010; Sun et al., 2023).

The depth of an agreement' s provisions in a RTAs refers to the range of areas it addresses and the extent of its regulatory depth. There is considerable variation in the content and depth of provisions across different RTAs. Lawrence(2000) differentiated between "deep" and "shallow" trade agreements. Horn et al.(2010) classified 52 provisions into 14 under the scope authorized by the WTO, termed WTO-Plus, and 38 that lie outside the WTO's authorization, termed WTO-X. Hofmann et al.(2017) further categorized these 52 provisions into "core" and "non-core" provisions. Falvey et al.(2022) performed a heterogeneity analysis by subdividing 18 core provisions into "border" and "behind-the-border" categories. These studies have laid the groundwork for the quantitative analysis of agreement texts. Early research on this topic highlighted two key characteristics. First, it primarily focused on the trade effects of Preferential Trade Agreements (PTAs). Second, it mainly examined the impact of RTAs on overall trade (Dür et al., 2014; Mattoo et al., 2022).

With the development of value chain segmentation and intermediate goods trade, studies examining the impact of RTAs on Global Value Chains (GVCs) trade have gained increasing attention. Laget et al.(2018) demonstrated that deep trade agreements have a positive impact on the development of global value chains, primarily through value-added trade in intermediate goods. Additionally, Xu et al.(2020) found that RTAs promote both total trade and the flow of intermediate goods. Peng et al.(2021) and Liu et al.(2023) further noted that the deepening of RTAs not only strengthens economic and trade cooperation but also accelerates the restructuring of global value chains and promotes regional value chain cooperation.

Concerning the critical role of intermediate goods trade in the development of regional value chains, Feenstra et al. (1999) were among the first to utilize intermediate inputs to measure trade within a macroeconomic context, albeit their research focused solely on the United States. Los et al.(2015) extended Feenstra et al.'s methodology to a multi-country setting, revealing that the dense network of intermediate input flows between nations has led to the fragmentation of production chains. Huang et al.(2018) constructed a series of intermediate goods trade indicators—including the intermediate goods trade distribution matrix, the intermediate goods trade integration matrix, and the regional concentration of intermediate goods trade—to empirically examine the "blockification" of global value chains. Bao et al. (2023) focused on the firm level, discovering that companies increase the proportion of intermediate goods within a region to meet the rules of origin, thereby obtaining tax benefits and further influencing the development of regional value chains.

In summary, with the increasing prominence of the regionalization of global value chains, research on the relationship between RTAs and value chain trade has grown more comprehensive and detailed. However, existing research still exhibits certain limitations. On the one hand, the majority of current studies focus on the effects of RTAs implemented by a single country or confined to a single region. On the other hand, many studies adopt the perspective of value-added trade, primarily focusing on the participation of economies in global value chains without directly addressing bilateral trade flows of intermediate goods between economies.

Unlike existing studies, this paper expands its research beyond a single country or region. Instead, it examines 21 economies across Asia, the Americas, and Oceania, and constructs a comprehensive dataset for the Asia-Pacific region. It observes the characteristics and evolutionary trends of the RTAs network from 1995 to 2020 and further explores the impact of the depth of RTAs provisions on intermediate goods trade among member countries within the region. The key contribution of this paper is its broad regional sample selection, enhancing the representativeness of the research findings. By focusing on bilateral intermediate goods trade among member countries in the region, this study provides a more precise analysis of how

the depth of RTAs provisions impacts the development of value chain cooperation in the region.

3. Analysis of Characteristic Facts

3.1 Network Characteristics of Sampled RTAs

This study provides a comprehensive analysis of the network characteristics of RTAs among 21 Asia-Pacific countries between 1995 and 2020. The specific results are presented in Table1. The analysis is conducted using a binary matrix to represent the RTA network, where a value of 1 is assigned if two countries signed an RTA in a given year, and 0 otherwise. In this section, the focus is exclusively on the number and timing of RTAs among the 21 member countries in the region, excluding those involving external regions. Between 1995 and 2000, all countries except China and Japan had signed RTAs with other member countries in the region. By 2005, all 21 countries had signed RTAs, achieving full regional connectivity. Furthermore, since 2005, the number of RTAs signed annually among the countries has increased, indicating a continuous strengthening of intra-regional connectivity and cooperation, thus further promoting economic integration and collaboration.

Japan signed its first free trade agreement with Singapore in 2002. Since 2008, the pace at which Japan signed RTAs has significantly accelerated, and by 2020, Japan had signed RTAs with 17 countries. China signed RTAs with India, South Korea, and Laos simultaneously in 2002, and with an additional 12 countries in 2005. By 2020, China had signed RTAs with 16 countries. Within the region, Chile, South Korea, Mexico, Peru, and the Philippines were among the earliest countries to sign RTAs, signing agreements with each other as early as 1973. By 2020, Singapore had the most RTAs, having signed agreements with all 20 other member countries in the region. Following Singapore’s lead, Australia, South Korea, and Vietnam had each signed RTAs with 19 countries.

Table 1. Basic Characteristics of the RTA Network in the Asia-Pacific Region

	1995	2000	2005	2010	2015	2020
Node	19	19	21	21	21	21
Edge	96	97	118	149	164	175

To better illustrate the characteristics and evolution of the RTAs network among 21 Asia-Pacific countries, this study visualizes the RTAs of 1995 and 2020. Figure 1 comprehensively depicts the evolution of the RTA network among the 21 Asia-Pacific countries.

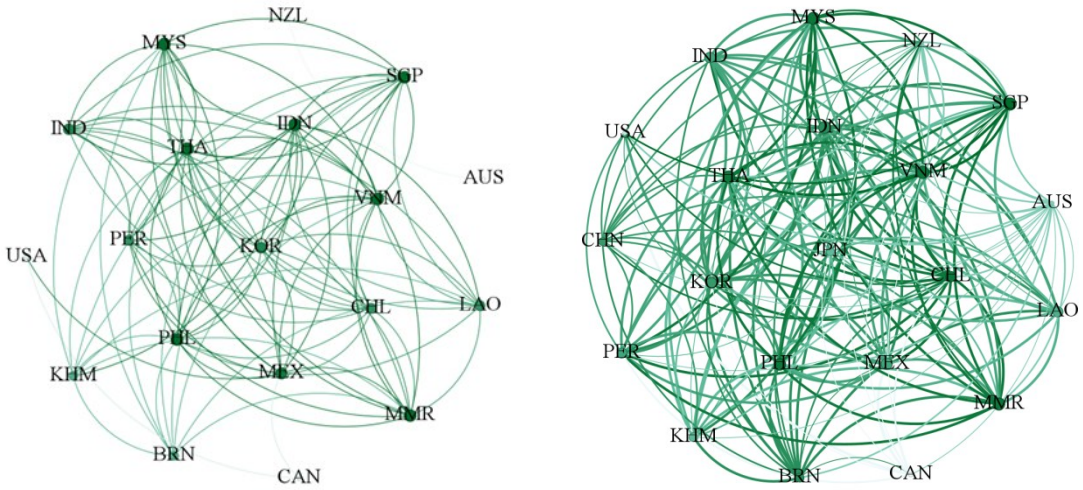

Figure 1. RTA Networks in 1995 (left) and 2020 (right)

In the figure, each node represents a country, and the lines between nodes indicate the existence of RTAs between those countries. In the 1995 RTA network, China and Japan were not yet integrated into the network, whereas Australia, the United States, and Canada were on the periphery, having signed RTAs with only a few countries. At that time, the RTA network was relatively sparse, featuring limited economic cooperation and trade agreements among the countries, especially because China

and Japan, two major economies, were not yet part of any RTAs in the region.

By 2020, the RTA network had become substantially denser, and nearly all countries were interconnected through RTAs. This indicates a substantial increase in regional economic integration, evidenced by tighter economic cooperation and trade relations among the countries. China and Japan have become active participants in the RTA network, thus fostering broader economic collaboration and trade within the region. A comparison of the RTA networks in 1995 and 2020 clearly shows the transition of regional economic cooperation in the Asia-Pacific from a loose to a more cohesive structure, reflecting the continuous deepening and strengthening of economic integration in the region.

3.2 Intermediate Goods Trade Matrix

Using data from the World Integrated Trade Solution (WITS) database, this study compiled data on the proportions of intermediate goods trade among 21 Asia-Pacific countries to construct a multi-value matrix. To conserve space, the matrix visualizations are presented only for the years 1995 (top left), 2005 (top right), 2015 (bottom left), and 2020 (bottom right), as shown in Figure 2. In the matrix, rows represent exporting countries, columns represent importing countries, and each cell indicates the proportion of intermediate goods trade between the respective countries. This proportion is calculated as the ratio of intermediate goods exported by one country to another, relative to the exporting country's total intermediate goods trade volume.

The trade of intermediate goods between countries within the region demonstrates both stability and dynamic evolution. First, the United States consistently serves as the primary exporter of intermediate goods to Canada and Mexico, with its share consistently exceeding 70%, which is significantly higher than its trade share with other countries. Second, Thailand, as an importer, has consistently sourced a substantial proportion of intermediate goods from Laos and Myanmar, maintaining a share of over 30% in most years, indicating stable trade relations within the region.

A significant shift in the region's intermediate goods trade is the transition of the largest importer of intermediate goods shifting from Japan to China. Concurrently, Japan's share of intermediate goods imports has gradually decreased. For instance, Brunei, which was a major market for Japan's intermediate goods exports, experienced a decline in its trade share with Japan from 54.5% in 1995 to 33.18% in 2020. Conversely, China’s share of intermediate goods imports has steadily increased and has become more evenly distributed across the region, engaging in trade with most countries. Australia, Laos, Peru, and South Korea have become major sources of intermediate goods for China, while trade with Brunei, Canada, Mexico, and the United States has been comparatively less significant. This reflects China’s strategic role within the regional value chain and its approach to addressing trade barriers.

These changes indicate a significant transformation in the structure of intermediate goods trade among Asia-Pacific countries, which profoundly impacts the restructuring of regional value chains. On the one hand, the stability of traditional trade partnerships persists, largely attributed to the continuous upgrades of the North American Free Trade Agreement (NAFTA) and its successor, the United States-Mexico-Canada Agreement (USMCA). These agreements have significantly facilitated intermediate goods trade among the three North American countries through the reduction of tariffs and non-tariff barriers, thus reinforcing the stability of the North American regional value chain.

On the other hand, new trade networks and relationships are rapidly forming. The rise of China has not only altered the trade landscape within the region but has also underscored its growing significance in the global supply chain. This phenomenon is closely linked to China's active participation in multilateral and bilateral trade agreements. Through the establishment of free trade agreements with multiple countries, China has significantly enhanced its economic influence and trade connections within the region. Meanwhile, other regional countries, such as South Korea and several Southeast Asian nations, have continually strengthened their manufacturing capabilities, leading to a gradual relocation of Japanese manufacturing to these countries. This shift in manufacturing has not only changed the pattern of intermediate goods trade within the region but also accelerated the restructuring of regional value chains, resulting in more complex and diversified trade relations among regional countries.

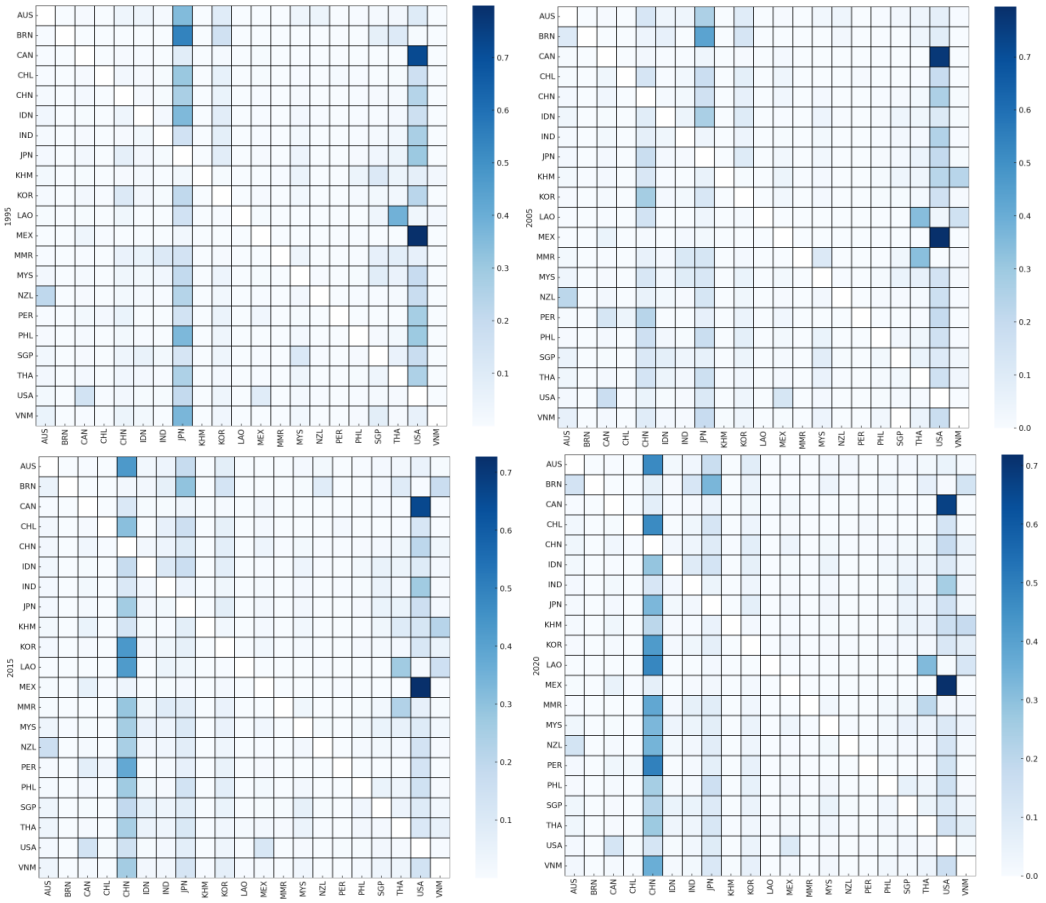

Figure 2. Intermediate Goods Trade Matrix for 1995, 2005, 2015, and 2020

4. Model Specification and Data Sources

4.1 Sample Selection

This study selects 21 countries in the Asia-Pacific region as the subjects, each of which participates in regional trade agreements such as the Regional Comprehensive Economic Partnership (RCEP), the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), and the United States-Mexico-Canada Agreement (USMCA). Specifically, the sample comprises 15 RCEP members, 11 CPTPP members, 3 USMCA members, and India, an emerging economy. Notably, 9 countries are signatories to multiple agreements. Thus, the 21 countries included in this study are: Brunei, Cambodia, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand, Myanmar, Vietnam, China, Japan, South Korea, Australia, New Zealand, Peru, Chile, Canada, Mexico, the United States, and India. The time frame from 1995 to 2020 was selected to ensure the study's comprehensiveness and representativeness.

4.2 Model Specification

To examine the impact of the depth of RTAs on RVCs, this study employs a gravity model. The core principle of the gravity model is to analyze how cost factors between countries affect their bilateral trade. In traditional gravity models, research traditionally focuses on general trade cost factors, such as trade distance, common language, and shared borders, primarily affecting transportation costs and initial cooperation levels. However, this study emphasizes how the depth of RTAs impacts bilateral intermediate goods trade. RTAs aim to maximize benefits at the policy level by reducing tariffs and non-tariff barriers, thereby lowering trade costs. By deepening RTA provisions, countries can better coordinate policies, eliminate trade barriers, and enhance facilitation, thus promoting the development of regional value chains. The baseline model is defined as follows:

$$RVC_{ijt} = \alpha_0 + \alpha_1 RTA_{ijt} + \beta X_{ijt} + \varepsilon_{ijt} \quad (1)$$

In Model (1), the subscripts i, j, and t represent the exporting country, importing country, and year, respectively. The dependent variable RVC_{ijt} represents the intermediate goods trade between economies i and j in year t. RTA_{ijt} indicates the presence and characteristics of the regional trade agreement between economies i and j in year t, encompassing two indicators: overall depth and legal effectiveness. X_{ijt} denotes the control variables, including both time-varying and time-invariant factors, and ε_{ijt} represents the error term.

4.3 Data Sources and Description

Dependent Variable.—In this study, RVC_{ijt} is measured by the proportion of intermediate goods trade between member countries, representing the share of intermediate goods trade from exporting country i to importing country j relative to the total intermediate goods trade of exporting country i. The data is sourced from the World Integrated Trade Solution (WITS) database, using the OECD TiVA (1995-2020) classification.

Key Independent Variables.—The depth indicator for Regional Trade Agreements RTA_{ijt} is obtained from the World Bank's Deep Trade Agreements database 1.0 (horizontal depth). The DTA dataset provides coverage information for 52 provisions across 400 trade agreements signed between 1958 and 2023, and it also reflects the legal enforceability of each provision.

This study uses two indicators to measure the depth of RTAs from different perspectives. First, following the method of Hofmann et al. (2017), an overall depth indicator of the RTAs—$RTADepth_{ijt}$—is constructed, representing the number of chapters included in the agreements signed between countries i and j in year t. If a provision is not mentioned in the agreement (or is mentioned too generally), it is scored as 0. If the provision is mentioned, it is scored as 1. The scores for the 52 provisions are summed to form a total depth index score, encompassing both the WTO-Plus and WTO-X depth indices.

The second indicator is the legal enforceability of the agreement provisions—$RTALegal_{ijt}$—which represents the legal effectiveness of all agreement provisions between countries i and j in year t. If a provision is not mentioned in the agreement or has no legal enforceability, it is scored as 0. If the provision is mentioned, has legal enforceability but is explicitly excluded from the dispute resolution provisions, it is scored as 1. If the provision is mentioned and is legally enforceable, it is scored as 2. Similarly, the legal effectiveness scores of the 52 provisions are summed to obtain the legal effectiveness index of RTAs between the two economies in year t.

Control Variables.—Economic Scale(*SIZE*): This is represented by the logarithm of the sum of GDP of countries i and j, denoted as $ln(GAP_{it} + GDP_{jt})$. Economic scale typically signifies market potential and resource supply capacity. The larger the scale, the more favorable it is for the production and trade of intermediate goods. The data is sourced from the United Nations' UNdata database.[‡]

Worldwide Governance Indicators(*WGI*): This index includes five components: control of corruption, government effectiveness, political stability, regulatory quality, and rule of law. The scores for these five components are summed, and then the scores for the two countries are added together to obtain the bilateral governance index, denoted as Sum($WGI_i + WGI_j$). A higher governance level indicates a more stable policy environment, transparent regulatory system, and efficient government services, which reduce trade uncertainty and risk. The data is sourced from the World Bank database.[§]

Contiguity (*Contig*): This variable is assigned a value of 1 if the two countries share a common border, and 0 otherwise. Whether or not countries share a border affects logistics costs and infrastructure sharing. The data is sourced from the CEPII database.[**]

[‡] https://data.un.org/.

[§] https://data.worldbank.org/. Since the Global Governance Index has been recorded from 1996 onwards, the data for 1996 is used in this paper to represent the situation for 1995.

[**] http://cepii.fr/.

Economic scale (*SIZE*) and the Worldwide Governance Indicators (*WGI*) are time-varying factors, while contiguity (Contig) is a fixed cost factor that does not change over time. Based on model (1), the basic regression models are constructed as shown in Equations (2) and (3).

$$\mathrm{RVC}_{ijt} = \alpha_0 + \alpha_1 \mathrm{RTADepth}_{ijt} + \beta_1 \mathrm{Size}_{ijt} + \beta_2 \mathrm{WGI}_{ijt} + \beta_3 \mathrm{Contig}_{ij} + \varepsilon_{ijt} \quad (2)$$

$$\mathrm{RVC}_{ijt} = \alpha_0 + \alpha_2 \mathrm{RTALegal}_{ijt} + \beta_4 \mathrm{Size}_{ijt} + \beta_5 \mathrm{WGI}_{ijt} + \beta_6 \mathrm{Contig}_{ij} + \varepsilon_{ijt} \quad (3)$$

5. Empirical Analysis of Results

5.1 Baseline Regression

Table 2 presents the impact of the overall depth and legal effectiveness of RTAs on the trade of intermediate goods among member countries. The findings indicate that across all years analyzed, both $RTADepth_{ijt}$ and $RTALegal_{ijt}$ of RTAs have a significant positive effect on intermediate goods trade between countries, at a 99% significance level. This indicates that the comprehensive nature and legal strength of RTAs play a substantial role in promoting the trade of intermediate goods between member countries. Specifically, more comprehensive agreements in terms of chapters and stronger legal effectiveness create more favorable conditions for intermediate goods trade.

Table 2. Baseline Test of the Overall Depth and Legal Effectiveness of RTAs

	1995	2000	2005	2010	2015	2020
RTADepth	0.1870***	0.2498***	0.1689***	0.1714***	0.1722***	0.1508***
Size	0.4243***	0.5083***	0.4448***	0.4448***	0.04908***	0.5023***
WGI	0.1211**	0.1385***	0.0806**	0.0762**	n.s.	n.s.
Contig	0.1986***	0.2269***	0.2823***	0.3045***	0.2840***	0.2552***
Adj-R^2	0.2605	0.2732	0.2375	0.2388	0.2613	0.2599
	1995	2000	2005	2010	2015	2020
RTALegal	0.2283***	0.2813***	0.1788***	0.1717***	0.1700***	0.1487***
Size	0.4219***	0.5095***	0.4396***	0.4427***	0.4890***	0.5005***
WGI	0.1216*	0.1373**	0.0714*	0.0742**	n.s.	n.s.
Contig	0.1825***	0.2133***	0.2773***	0.3047***	0.2847***	0.2557***
Adj-R^2	0.2763	0.2878	0.2420	0.2394	0.2609	0.2595

NOTE:***, * *, * respectively represent significant levels of 99%, 95%, and 90%. n.s. represents insignificant.

This can be attributed to the advantages comprehensive trade agreements provide in reducing trade barriers, enhancing trade facilitation, and strengthening investment protection. In-depth trade agreements typically encompass more chapters and provisions, which can significantly reduce trade barriers, thereby facilitating smoother cross-border flows of intermediate goods. Many in-depth trade agreements also include investment protection clauses, which create a more favorable investment environment and encourage multinational companies to establish production and supply chains within member countries. This further boosts the cross-border flows of intermediate goods. Additionally, legally robust trade agreements ensure transparency and consistency in trade policy implementation among member countries, reducing uncertainty and risk for enterprises in international trade and thereby supporting the cross-border movement of intermediate goods.

The enhancement of intermediate goods trade indicates a more refined division of labor among member countries, enabling each to focus on production stages where they possess a comparative advantage. This facilitates the acquisition and provision of high-quality, cost-effective production inputs, improving overall regional production efficiency and helping form tighter regional value chain networks.

The control variables, economic size (*Size*) and contiguity (*Contig*), have a significant effect on bilateral intermediate goods trade at a 99% confidence level across all years. Specifically, the larger the economic sizes of the two countries, the greater their market demand and supply capacity, thus facilitating bilateral intermediate goods trade. Neighboring countries often share infrastructure and enjoy shorter transportation distances, thereby improving trade efficiency and convenience,

especially for the frequent cross-border movement of intermediate goods.

The control variable, governance level (*WGI*), exhibits a significance level of over 90% in three of the years, indicating that higher governance levels between two countries are conducive to the trade of intermediate goods. However, in 2015 and 2020, this variable did not show significant influence, possibly due to other impacting factors during these years, such as global economic fluctuations, policy changes, or unexpected events, which weakened the effect of governance levels on intermediate goods trade.

5.2 Robustness Check

In the previous analysis, the depth of trade agreements was assessed through their scope and legal effectiveness. To further test the stability of the model, this study incorporates dummy variables as a robustness check. If economies i and j have signed an RTA during period t, the variable is assigned a value of 1; otherwise, 0. The variable is denoted as $RTAIf_{ijt}$. The regression model is presented in Equation (4), and the regression results are shown in Table 3.

$$\mathrm{RVC_{ijt}} = \alpha_0 + \alpha_3 \mathrm{RTAIf_{ijt}} + \beta_7 \mathrm{Size_{ijt}} + \beta_8 \mathrm{WGI_{ijt}} + \beta_9 \mathrm{Contig_{ij}} + \varepsilon_{ijt} \quad (4)$$

The regression coefficient for $RTAIf_{ijt}$ is positive and statistically significant at the 99% confidence level across most years, indicating that the presence of an RTA significantly promotes intermediate goods trade between countries. This demonstrates that, regardless of the depth of provisions, regional trade agreements provide fundamental guarantees for tariff reductions and trade facilitation, thereby benefiting the circulation of intermediate goods among member countries.

The direction and significance of the impact of economic size (*Size*) and contiguity (*Contig*) align with the baseline model, further confirming the positive influence of these two variables on bilateral intermediate goods trade across all years. Specifically, larger economic sizes lead to greater levels of bilateral intermediate goods trade, and neighboring countries enjoy greater convenience in intermediate goods trade.

The regression results for governance levels (*WGI*) also align with the baseline model, indicating that countries with higher governance levels have a competitive advantage in intermediate goods trade. Additionally, the model shows a good fit, suggesting that the estimation results are robust and reliable.

Table 3. Robustness Test Using Alternative Variables

	1995	2000	2005	2010	2015	2020
RTAIf	0.1625***	0.1503***	0.0648*	0.1242***	0.1255***	0.0853**
Size	0.4834***	0.4586***	0.3911***	0.3894***	0.4326***	0.4466***
WGI	0.1511***	0.1461**	0.0859**	0.0908**	n.s.	n.s.
Contig	0.2212***	0.2654***	0.3115***	0.3203***	0.3024***	0.2773***
Adj-R^2	0.2450	0.2460	0.2203	0.2317	0.2548	0.2506

NOTE:***, * *, * respectively represent significant levels of 99%, 95%, and 90%. n.s. represents insignificant.

5.3 Heterogeneity Analysis

To analyze more comprehensively the impact of RTAs on the trade of intermediate goods within a region, this study categorizes economies based on their development levels and examines the heterogeneous effects of RTAs. The 21 economies are grouped into two categories: developed economies and developing economies. The study assesses the influence of RTAs' overall depth and legal effectiveness on intermediate goods trade within each category. The developed economies comprise Australia, Canada, Japan, South Korea, New Zealand, Singapore, and the United States. The developing economies include China, Indonesia, Malaysia, the Philippines, Thailand, Vietnam, Myanmar, Cambodia, Laos, Brunei, Peru, Chile, Mexico, and India. The regression results are presented in Table 4.

In the group of developed economies, the $RTADepth_{ijt}$ and $RTALegal_{ijt}$ of RTAs significantly enhanced intermediate goods trade in the years 1995, 2000, and 2020. However, this effect was not significant from 2005 to 2015. The differences observed in the early, middle, and later stages among developed economies may relate to market saturation and institutional environments. In the early stages, developed economies had established markets and economic systems, leading to a positive response to comprehensive agreements and legal provisions. By the middle stage, the high degree of trade integration among

developed economies indicated that major trade barriers had already been eliminated, reducing the marginal benefits of further agreement deepening or legal strengthening. The renewed significance in the later stage relates to new economic challenges and changes in global supply chains. Developed economies may have revitalized agreements' positive effects by updating and deepening agreements to meet these challenges, as seen with the upgrade from NAFTA to USMCA and the reorganization of the CPTPP.

For the developing countries, the $RTADepth_{ijt}$ and $RTALegal_{ijt}$ of RTAs had a significant positive impact on intermediate goods trade from 2000 to 2015, although the impact was not significant in 1995 and 2020. In the early stages, developing countries' economic systems were not mature, and few RTAs had been signed, preventing the influence of RTAs from becoming apparent. In 2020, global economic volatility severely impacted developing economies, weakening the impact of RTAs. From 2000 to 2015, the significant and stable impact of $RTADepth_{ijt}$ and $RTALegal_{ijt}$ on intermediate goods trade in developing countries can be attributed to the rapid economic growth and industrialization of these countries during this period. The deepening of regional trade agreements and the enhancement of legal effectiveness played a more pronounced role in promoting trade.

Overall, the impact of regional trade agreements' depth and legal effectiveness on intermediate goods trade varies by countries' economic development levels and across different years. This reflects the differing needs and dependencies upon regional trade agreements at various stages of development. For developed countries, policymakers should focus on stabilizing and enhancing the impact of regional trade agreements throughout different economic cycles. For developing countries, further deepening and strengthening regional trade agreements' content and legal effectiveness are essential to continuously promoting the development of intermediate goods trade.

Table 4. Heterogeneity Analysis of RTAs

		1995	2000	2005	2010	2015	2020
Developed	*RTADepth*	0.3106**	0.2799**	n.s.	n.s.	n.s.	0.1405**
	RTALegal	0.4655**	0.4204**	n.s.	n.s.	n.s.	0.1311**
Developing	*RTADepth*	n.s.	0.1992***	0.1646***	0.1837***	0.1550**	n.s.
	RTALegal	0.1076**	0.2069***	0.1683***	0.1762***	0.1450**	n.s.

NOTE:***, ** respectively represent significant levels of 99% and 95%. n.s. represents insignificant.

6. Conclusion and Recommendations

Establishing high-standard regional trade agreements and accelerating the restructuring of regional value chains are both practical choices and inevitable trends for regional economic development. This study utilizes a three-dimensional panel dataset of 'exporting country-importing country-year' to construct dynamic indicators of RTAs' overall depth and legal effectiveness as core explanatory variables. Controlling for cost factors in a traditional gravity model, we investigate RTAs' impact on intermediate goods trade among member countries. The empirical analysis shows that RTA signings and their depth and legal effectiveness significantly promote intermediate goods trade among member countries. The frequent movement of intermediate goods within the region enhances regional production specialization and overall economic competitiveness, further advancing the development of regional value chains.

Furthermore, the study reveals differences in the impact of RTA depth and legal effectiveness on intermediate goods trade between developed and developing countries. For developed countries, the marginal benefits of RTAs diminish in established markets but regain significance when new challenges arise. In developing countries, the positive effects of RTAs become more apparent during periods of economic development and governance improvement, although these effects are limited by implementation capacity and infrastructure.

This study not only confirms the impact of RTAs on intermediate goods trade within the region but also provides empirical evidence supporting the development of regional value chains. This is crucial for understanding and optimizing regional economic integration. Based on these conclusions, the following policy recommendations are suggested:

Firstly, deepen and expand regional trade agreements. Countries should actively participate in and promote high-standard regional trade agreements, ensuring that these agreements include comprehensive provisions with robust legal effectiveness. Furthermore, these agreements should be continually adjusted and updated according to economic development needs to maintain effectiveness and adaptability, thereby fostering continuous deepening of regional economic cooperation.

Secondly, promote infrastructure development and logistics network advancement. Developing countries should increase investment in infrastructure, such as transportation networks, ports, logistics centers, and IT facilities, to enhance trade conditions and reduce logistics costs and time for intermediate goods trade. Developed countries should support infrastructure development in developing countries with technology and funding, fostering connectivity and forming efficient logistics networks within the region to enhance overall trade efficiency.

Thirdly, promote regional economic integration. Countries should identify their comparative advantages within the regional value chain and establish clear mechanisms for production specialization and cooperation to extend and upgrade regional value chains, enhancing overall economic competitiveness. Moreover, countries should maintain policy flexibility and promptly adjust and optimize regional trade agreements to address challenges like global economic fluctuations, emerging technologies, and market changes. Regional economic organizations should coordinate and promote effective and coherent regional economic cooperation and policy implementation.

References

Antràs, P. (2020). Conceptual aspects of global value chains. The World Bank Economic Review, 34(3):551-574.

Arndt, S. W., & Kierzkowski, H. (Eds.). (2001). Fragmentation: New production patterns in the world economy. OUP Oxford.

Baldwin, R., & Lopez-Gonzalez, J. (2015). Supply-chain trade: A portrait of global patterns and several testable hypotheses. The world economy, 38(11):1682-1721.

Bao Xiaohua, & Zhengying Xie. (2023). Rules of Origin and GVC Length—From the Perspective of Regional Value Chain. China Economic Quarterly, 23(06):2315-2331.

Bonnal, M. (2010). Export performance, labor standards and institutions: evidence from a dynamic panel data model. Journal of Labor Research, 31:53-66.

Conconi, P., García-Santana, M., Puccio, L., & Venturini, R. (2018). From final goods to inputs: the protectionist effect of rules of origin. American Economic Review, 108(8):2335-2365.

Distelhorst, G., & Locke, R. M. (2018). Does compliance pay? Social standards and firm-level trade. American journal of political science, 62(3):695-711.

Dür, A., Baccini, L., & Elsig, M. (2014). The design of international trade agreements: Introducing a new dataset. The Review of International Organizations, 9:353-375.

Falvey, R., & Foster-McGregor, N. (2022). The breadth of preferential trade agreements and the margins of exports. Review of World Economics, 158(1):181-251.

Feenstra, R. C., & Hanson, G. H. (1999). The impact of outsourcing and high-technology capital on wages: estimates for the United States, 1979–1990. The quarterly journal of economics, 114(3), 907-940.

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. Review of international political economy, 12(1):78-104.

Hanson, G. H. (1998). North American economic integration and industry location. oxford review of Economic Policy, 14(2):30-44.

Hofmann, C., Osnago, A., & Ruta, M. (2017). Horizontal depth: a new database on the content of preferential trade agreements. World Bank Policy Research Working Paper, (7981).

Horn, H., Mavroidis, P. C., & Sapir, A. (2010). Beyond the WTO? An anatomy of EU and US preferential trade agreements. The World Economy, 33(11):1565-1588.

Huang Jianzhong, & Yi WU. (2018). Producer services and the fragmentation of global value chains. Journal of Southeast University(Philosophy and Social Science), 20(01):49-60+147.

Ivanov, D. (2022). Viable supply chain model: integrating agility, resilience and sustainability perspectives—lessons from and thinking beyond the COVID-19 pandemic. Annals of operations research, 319(1):1411-1431.

Ju, Jiandong, Xinding Yu, Bing Lu, & Xin Li.(2020). Analysis of the "Tripod" Structure in the Global Value Chain Network. China Journal of Economics, 7(04):1-20.

Laget, E., Osnago, A., Rocha, N., & Ruta, M. (2020). Deep trade agreements and global value chains. Review of Industrial Organization, 57:379-410.

Lan Tian, & Fengxiang Zhao. (2023). Regional Trade Agreements and GVCs' Reshaping:Evolution,Deepening and Mechanism. Nankai Economic Studies, 10:103-126.

Lawrence, R. Z. (2000). Regionalism, multilateralism, and deeper integration. Brookings Institution Press.

Liu Wen, & Yichen Yang. (2023). Global Value Chain and Deep Regional Trade Agreement:Historical Evolution and Development Tendency. Shandong Social Sciences, 10:115-124.

Los, B., Timmer, M. P., & De Vries, G. J. (2015). How global are global value chains? A new approach to measure international fragmentation. Journal of regional science, 55(1), 66-92.

Mattoo, A., Mulabdic, A., & Ruta, M. (2022). Trade creation and trade diversion in deep agreements. Canadian Journal of Economics/Revue canadienne d'économique, 55(3):1598-1637.

Miroudot, S., & Nordström, H. (2020). Made in the world? Global value chains in the midst of rising protectionism. Review of Industrial Organization, 57(2):195-222.

NI Yueju. (2021). The Impact of RCEP on the Production Network in the Asia-Pacific Region——An Analysis from the Perspective of Global Value Chain. Journal of Northeast Normal University(Philosophy and Social Sciences). 03 :52-62+114.

Peng Dongdong, & Jue Lin. (). Does the Deepening of Free Trade Agreements among the Belt and Road Countries Promote Regional Value Chain Cooperation? Journal of Finance and Economics, 47(02):109-123.

SHEN Minghui, & Zhongyuan ZHANG. (2023). New Progress and Response Strategies in the Reconstruction of the East Asian Regional Value Chain. Intertrade, 09:21-34.

Smorodinskaya, N. V., Katukov, D. D., & Malygin, V. E. (2021). Global value chains in the age of uncertainty: advantages, vulnerabilities, and ways for enhancing resilience. Baltic Region, 13(3):78-107.

Sun Yuhong, & Xinya Wu. (2023) . A Study on the Impact of the Strengthening of Labor Standards in RTA on Global Value Chain Participation. International Business Research, 44(05):20-33.

Thang, D. N., Ha, L. T., Dung, H. P., & Long, T. Q. (2021). On the relationship between rules of origin and global value chains. The Journal of International Trade & Economic Development, 30(4):549-573.

Xu Yayun, Wen Yue, & Jian Han. (2020). The Impact of High Standard RTAs on GVC Trade——A Study on the Text Depth and Quality. Journal of International Trade, 12:81-99.

Yang Kai, & Jian Han. (2020). Trade Diversion Effects of Intermediate Goods Caused by Preferential Rules of Origin of Final Goods: A Case of Rules of Origin in CAFTA. International Economics and Trade Research, 36(04):38-54.

YI Ziyu, Long WEI, & Peimin CAI. (2023). How Data Elements Restructure the Global Division of Labor in Value Chains: Regionalization or Fragmentation. Journal of International Trade. 08:20-37.

Zang Xin, & Jiahui Liu. (2021). Fragmentation of Global Value Chain:Theoretical Mechanism Quantitative Measurement. Jianghai Academic Journal, 01:246-253+255.

Zhao Jianglin. (2016). Regional Value Chains: Building a Common Interests Foundation and Policy Directions for the Silk Road Economic Belt. The Journal of Humanities, 05:21-28.