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The Effect of the Regional Comprehensive Economic Partnership on Taiwan's Global Value Chain of the Electronic Information Industry

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Abstract: Taiwan (China) is a global leader in the electronic information industry. However, previous studies have paid limited attention to the impact of international trade policies on Taiwan's electronic information sector. This study aims to examine the effects of the Regional Comprehensive Economic Partnership (RCEP) on the global value chain (GVC) of Taiwan's electronic information industry. Using the GTAP 10.0 database, this study applies the GVC-CGE model to measure the GVC participation and position index of the electronic information industry in Taiwan (China), Mainland China, and other RCEP member economies. The results show that, in the short term, the RCEP does not have a significant impact on Taiwan's electronic information industry's participation or position in the global value chain. However, in the long term, it is likely to negatively affect Taiwan's forward participation and position. Economies within the RCEP that possess technological or resource advantages are expected to see improvements in their electronic information industry's value chain position. As a result, Taiwan's electronic information industry faces the risk of being displaced in the global division of labor. These findings offer valuable insights into the position of the electronic information industry of Taiwan (China) within the global value chain, highlight the importance of regional economic cooperation, and provide crucial information for the development of this industry. This study reveals how the Regional Comprehensive Economic Partnership contributes to the regional reconfiguration of global value chains and its potential impacts on Taiwan's electronic information industry. We suggest that Taiwan should engage more actively in East Asian regional economic cooperation to mitigate these potential negative effects as much as possible.

Keywords: Regional Comprehensive Economic Partnership; global value chains; Taiwan; GVC-CGE model; electronic information industry

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1. Introduction

As consumer demand for electronic products continues to rise [1], the global electronic information industry has been rapidly developing. According to the Japan Electronics and

Information Technology Industries Association (JEITA), the global electronics and information technology industry was projected to have an output value of USD 3.5266 trillion in 2023. The value chain of the electronic information industry is spread across the globe, but significant agglomeration effects have emerged in certain regions. For example, the electronics sectors in the United States, the European Union, and some Asian economies are expected to experience expansion, while the global value chain of the electronics industry is undergoing a restructuring [2]. The fragmentation of production in the electronic information industry has facilitated the global production and assembly of electronic products. However, this modularity also presents challenges for developing economies, as it can integrate them into global value chains (GVCs), but may hinder their ability to move up the value chain. For example, the electronics industries in Malaysia and Thailand have faced limitations in upgrading value-added activities due to foreign direct investment [3]. The development of the electronics and information industry reflects a country's scientific and technological competitiveness [4]. A higher position in the GVC division of labor correlates with increased value-added income, prompting many economies to seek GVC upgrading or to maintain a strong position within GVCs. Increasing participation in regional value chains through economic cooperation can enhance a country's GVC position [5]. However, there is a lack of research on the GVC division of labor for economies that are not participating in regional economic cooperation. To address this gap, we have selected Taiwan's electronics and information industry as the focus of this study. Taiwan is a global leader in this sector, holding the top market share in manufacturing and a prominent position in design services, second only to the United States [6].

Previous research has explored various aspects of the electronic information industry, including illicit labor [7], fuzzy supplier selection models [8], policies to combat the flow of counterfeit electronic parts [9], load fluctuations [10], government subsidies [11], enterprise locations [12], and value chain organization models [13]. This broad approach provides a comprehensive view of the industry. However, the internal structure of the electronic information industry is complex, encompassing many manufacturing sectors [14]. Semiconductors are fundamental to this industry [15] and crucial for economic security [16]. Previous studies have addressed topics such as digital transformation [17], industry competition [18], corporate innovation [19], financial performance [20], national competitiveness [21], green supply chain performance [22], global value chains [23], global trade networks [24], trade dynamics [25], supply chain efficiency [26], and supply chain transparency [27]. Despite these efforts, there remains a gap in the research on the relationship between international trade policies and the electronic information industry. This study seeks to address this gap by examining the impact of international trade policies, specifically the Regional Comprehensive Economic Partnership (RCEP), which became effective on 2 June 2023. RCEP is the world's largest regional trade agreement, involving 15 Asia-Pacific economies [28]. Taiwan (China) has a unique geopolitical status, and its electronic information industry maintains strong trade ties with the RCEP member economies. According to data from the International Trade Department of Taiwan's "Ministry of Economic Affairs", in 2022, RCEP member economies accounted for 62.19% of the total exports and 73.46% of the total imports of Taiwan's electronic information industry. Therefore, Taiwan's electronic information industry is highly integrated with RCEP member economies.

This study uses the GVC-CGE model to analyze the global value chain participation and division of labor in Taiwan's electronics and information industry under the influence of the RCEP, applying the theory of economic integration. Additionally, the study highlights the relevance of United Nations Sustainable Development Goal (SDG) 17, which emphasizes regional cooperation and partnerships.

The possible marginal contributions of this study are threefold: (1) This study applies the GVC-CGE model to accurately quantify the specific impacts of the RCEP on Taiwan's electronic information industry from the perspective of value chain trade. (2) The study applies the concepts of trade creation and trade diversion from economic integration theory to analyze the impact of the Regional Comprehensive Economic Partnership (RCEP) on the regionalization of global value chains (GVCs). This theoretical framework helps explain how RCEP's reduction in trade barriers and its rules of origin may alter trade patterns and value chain structures within the region. (3) This study enhances the existing body of knowledge on the impact of RCEP and offers valuable insights to help policymakers develop strategies to mitigate its negative effects.

2. Literature Review

2.1. Impact of RCEP on the Regionalization of Global Value Chains

External factors often have complex impacts on economies, such as the influence of the COVID-19 pandemic on stock market performance [29] or the progress of infrastructure projects like the China–Pakistan Economic Corridor (CPEC) [30]. The Regional Comprehensive Economic Partnership (RCEP) is a regional trade agreement signed by the Association of Southeast Asian Nations (ASEAN), along with China, Japan, South Korea, Australia, and New Zealand. It represents a significant step toward regional integration in the Asia-Pacific region [31]. As an external factor, RCEP exerts a profound influence on both member and non-member economies through its intrinsic trade rules and policy arrangements, deepening economic ties among member countries and reshaping global value chains [32]. Regional trade agreements (RTAs) are treaties signed between two or more countries or regions to establish the rules governing trade among the signatories [33]. RTAs typically take the form of free trade areas, customs unions, or economic integration agreements [34]. Economic integration organizations began to emerge in the 1950s, with early free trade agreements focusing on reducing tariffs and addressing border issues. Jacob Viner developed the theory of customs unions, which introduced the concepts of trade creation and trade diversion. Viner's theory became a cornerstone of regional economic integration theory [35]. The regionalization of global value chains (GVCs) refers to the process by which firms within supply chains enhance their resilience through regionalization and reshoring [36], leading to a noticeable contraction or "shortening" of GVCs [37]. This study applies the concepts of trade creation and trade diversion from economic integration theory to analyze the impact of the RCEP on the regionalization of global value chains. Trade diversion occurs when the removal of trade barriers within a region causes member countries to replace imports from higher-cost sources within the region with imports from lower-cost sources outside the region [38]. For example, the signing and implementation of the RCEP reduced tariffs and non-tariff barriers among member countries, lowering the cost of trade within the region. Additionally, the RCEP's rules of origin encouraged firms to use more intra-regional raw materials and intermediate products [39]. This shift promoted industrial agglomeration and relocation, altering the distribution and structure of value chains [40].

There were two main types of potential effects involved. First, in the multi-stage production system of global value chains, parts of a product might have been subject to double taxation as they crossed borders multiple times. This increased trade costs, creating a "magnification effect" on trade expenses [41]. Second, the value added by the final exporting country might have represented only a small portion of the total value of the final product. However, the importing country imposed tariffs based on the total value of the product, leading to a "cumulative effect" on trade costs [42].

The implementation of the RCEP reduced trade costs among member countries and further refined the division of labor within the region [43]. Specifically, the "amplification effect", caused by the multiple cross-border movements of intermediate goods, increased the costs of value chain cooperation for economies outside the region [44]. As a result, value chain cooperation gradually shifted from partnerships between RCEP members and non-member economies to cooperation solely among RCEP members.

Trade creation refers to the process where the removal of intra-regional trade barriers allows a member country to replace its high-cost domestic production with imports from another member country [38]. For example, the implementation of the RCEP increased the trade volume among member countries [45]. This led to a greater variety and higher quality of intermediate inputs available within the region, which member countries used in the production of goods [46]. As a result, the value chain positions of these countries were strengthened.

Supply chain linkages connected demand, trade, and production across economies [43]. The trade creation effects of the RCEP were transmitted through these supply chains, leading to more integrated and interdependent economies within the region. Additionally, the competitive pressure from an increased variety of similar products in the region encouraged firms to engage in global value chains and shift toward producing higher-value goods and services [47]. Ultimately, this resulted in stronger and more competitive regional value chains.

2.2. Impact of the RCEP on the Electronic Information Industry

The implementation of the Regional Comprehensive Economic Partnership (RCEP) primarily impacted the electronic information industry through economies of scale and economies of scope. This study used these concepts to explain how the RCEP affected the sector. Economies of scale refer to the reduction in per-unit production costs that occur when output is increased [48]. Economies of scope describe the situation where producing multiple product lines together is more cost-effective than producing each line separately [49]. The competitive landscape of the electronic information industry, with semiconductors at its core, often benefited enterprises that achieved both economies of scale and scope.

Economies of scale were especially important in the electronic information industry, as large-scale production could lower per-unit manufacturing costs and enhance production efficiency [50]. Additionally, this industry is characterized by rapid product iteration, requiring companies to continually invest in technological innovation and product upgrades. To sustain ongoing research and development (R&D), electronic information companies needed to achieve significant scale [51]. The implementation of the RCEP was expected to increase intra-industry trade volumes [45], and larger export scales could stimulate innovation [52], helping firms expand production capacity [53]. However, the benefits were not evenly distributed. Economies with advanced technology, such as Japan, were likely to gain more from their participation in global value chains [54]. Conversely, the RCEP's implementation may have negatively impacted the export scales of economies outside the region [55]. As RCEP members advanced up the value chain in the electronic information industry, they could create competitive pressure on non-member economies.

Unlike the competitive strategy of reducing unit costs through economies of scale, adopting a strategy of product differentiation and service diversification allowed firms to build flexible production capacity and broaden their offerings. This approach helped firms achieve greater economies of scope, enhance their competitiveness, and avoid becoming overly dependent on specific products or services [56]. Economies of scope relied on a firm's strong dynamic capabilities, which included efficient use of internal resources

and the ability to assimilate external knowledge [57]. The establishment of the RCEP was expected to boost regional investment [58], which, in turn, could have fostered technological innovation among electronic information enterprises in the region [59], thereby enhancing their dynamic capabilities [60]. Conversely, electronic information enterprises in non-member economies might have faced adverse effects.

This study hypothesizes that the Regional Comprehensive Economic Partnership (RCEP) negatively affects the global value chain (GVC) position of Taiwan's electronic information industry. Additionally, it is hypothesized that the impact of the RCEP on the electronic information industries of member economies varies. Specifically, economies within the RCEP that have technological advantages are expected to see a positive impact on their GVC position in the electronic information industry, while economies lacking such advantages are likely to experience a negative impact.

3. Materials and Methods

3.1. GTAP-GVC Model

Since the RCEP has been formally implemented only for a short period, most current research focuses on policy evaluation or ex ante forecasting using quantitative models. Among these, computable general equilibrium (CGE) models are an important tool for evaluating policy effects and have been widely used to assess the impact of the RCEP on economic growth [61], trade and income [62], regional value chains [32], and specific industries, such as the textile industry [63], with potential impacts. These studies have demonstrated the wide-ranging effects of the RCEP. The Global Trade Analysis Project (GTAP) model is one of the most widely used CGE models. This study utilized the GTAP model, a multi-country, multi-sector general equilibrium model developed by the Global Trade Analysis Program team at Purdue University, to examine the impact of the RCEP's full implementation on Taiwan's electronic information industry. Using the standard GTAP model, simulation data were converted into multi-regional input–output tables. The KWW method was then applied to analyze the value chain data simulated by the GTAP model. This process linked the GTAP model with the global value chain, resulting in the GVC-CGE model.

3.2. Scenario

At the time, the RCEP had fully entered into force, but Taiwan was not included in the agreement. The timeline for when Taiwan might join the RCEP remained uncertain and depended on various factors. Nevertheless, it was important to analyze the evolving trends in the global value chain of Taiwan's electronic information industry through prospective research. This study examined two scenarios to simulate the impact of the RCEP on Taiwan's electronic information sector in both the short and long term:

Scenario 1: Short-term tariff concessions;

Scenario 2: Long-term tariff concessions and reductions in technical barriers to trade (TBT).

In these scenarios, tariff concessions were based on the tariff reduction schedules outlined by each RCEP member country. Specifically, short-term tariff concessions were defined as those occurring within 5 years of implementation (i.e., by 2026). Long-term tariff concessions were defined as those occurring over a 20-year period (i.e., by 2040). In the short term, technical barriers to trade were not expected to decrease, given the time required for economies and firms in the region to adapt to the RTA rules. However, in the long term, technical barriers to trade were projected to be reduced by 10%.

3.3. GTAP Analog Area Settings

On 2 June 2023, the Regional Comprehensive Economic Partnership (RCEP) fully came into effect for its signatories, including mainland China, Japan, South Korea, Australia, New Zealand, and the ten ASEAN countries (Singapore, Malaysia, Indonesia, Thailand, Vietnam, Laos, Myanmar, Cambodia, Brunei, and the Philippines). This paper focuses on Taiwan (China), Mainland China, and other member economies of the RCEP, categorizing all other countries or regions as "other rest of the world." In this study, the 141 countries or regions in the GTAP database (GTAPAgg2) were categorized into eight groups based on the RCEP member economies and the needs of the analysis. The eight groups were Mainland China, Taiwan (China), Japan, South Korea, Australia, New Zealand, ASEAN, and the rest of the world.

It is important to note that Myanmar was not listed separately in the GTAP database. Instead, it was included in the "rest of Southeast Asia" category. Since Myanmar's economic impact was minimal and did not significantly affect the overall data, it was not placed in the ASEAN category for this study. The specific settings are detailed in Table 1.

Table 1. Country/region aggregation.

No.	Country/ Region	Description
1	CHN	Mainland China (excluding Hong Kong and Macao)
2	TWN	Taiwan, China
3	JPN	Japan
4	KOR	Korea
5	AUS	Australia
6	NZL	New Zealand
7	ASEAN	Singapore, Malaysia, Vietnam, Indonesia, Philippines, Thailand, Laos, Cambodia, Brunei
8	RestofWorld	Countries and territories in GTAPAgg2 other than those set above

3.4. Data and Methods

This study uses quantitative analysis based on the GTAP 10.0 (Global Trade Analysis Project 10.0) database. The GTAP 10.0 database is a widely used global economic model and dataset developed and maintained by the Global Trade Analysis Project (GTAP). It contains data on global economic activities, particularly in the areas of trade, production, consumption, and policy. Its core function is to provide detailed global economic data that support computer models for economic analysis, especially in simulating global trade, international investment, environmental policies, and other cross-border economic issues. The database is based on 2014 as the reference year and includes data for 141 countries or regions and 65 industrial sectors. Since this version used 2014 as the base year, direct simulation could have introduced bias. To address this, the study followed the approach outlined by Ahmed et al. [64], and dynamically projected the 2014 data to 2023. This projection incorporated real GDP, population, capital stock, and data on skilled and unskilled labor estimated by the Econmap database. As the Econmap database lacked forecast data for Taiwan, the study used data for 2014–2022 provided by Taiwan's "Executive Yuan". The average growth rate of this data was calculated to perform dynamic recursion on Taiwan's relevant data in the GTAP database.

Additionally, the study calculated a weighted average based on the tariff commitment tables of each RCEP member country, with weights derived from import trade volumes among RCEP members using HS6 codes. This allowed for the calculation of tariff levels for the electronic information industry during the base period, as well as in the short term

and long term under the RCEP's full implementation. The short-term and long-term tariff rates were then compared to the base period rates to determine the levels of tariff reduction. Finally, simulations were conducted based on the defined scenarios.

The study constructed international standard input–output tables using the GTAP simulation dataset. It employed the export decomposition model developed by Koopman et al. [65], and applied the accounting method proposed by Wang et al. for measuring the international division of labor position after value-added decomposition [66]. See Equations (1)–(3) for details.

In Table 2, Z^{SS} denotes the portion of production in country S used by country S for intermediate inputs, Y^{SR} represents the portion of production in country S used by country R for final consumption, X^S refers to the total output in country S, and VA^S reflects the value-added component in country S.

$$\begin{aligned} E_{s^*} = & \left\{ V_{\mathrm{s}} \sum_{r \neq s}^{G} B_{\mathrm{ss}} Y_{sr} + V_{\mathrm{s}} \sum_{r \neq s}^{G} B_{\mathrm{sr}} Y_{rr} + V_{\mathrm{s}} \sum_{r \neq s}^{G} \sum_{t \neq s,r}^{G} B_{\mathrm{sr}} Y_{rt} \right\} \\ & + \left\{ V_{\mathrm{s}} \sum_{r \neq s}^{G} B_{\mathrm{sr}} Y_{rs} + V_{\mathrm{s}} \sum_{r \neq s}^{G} B_{\mathrm{sr}} A_{rs} (I - A_{ss})^{-1} Y_{ss} \right\} \\ & + V_{\mathrm{s}} \sum_{r \neq s}^{G} B_{\mathrm{sr}} A_{rs} (I - A_{ss})^{-1} E_{s^*} \\ & + \left\{ \sum_{t \neq s}^{G} \sum_{r \neq s}^{G} V_{\mathrm{t}} B_{\mathrm{ts}} Y_{sr} + \sum_{t \neq s}^{G} \sum_{r \neq s}^{G} V_{\mathrm{t}} B_{\mathrm{ts}} A_{sr} (I - A_{rr})^{-1} Y_{rr} \right\} \\ & + \sum_{t \neq s}^{G} V_{\mathrm{t}} B_{\mathrm{ts}} A_{sr} \sum_{r \neq s}^{G} (I - A_{rr})^{-1} E_{r^*} \end{aligned} \tag{1}$$

Table 2. Basic types of multi-regional input–output tables.

Output / Input		Intermediate Demand				Final Demand				Total Output
		S	**R**	...	**T**	**S**	**R**	...	**T**	
Intermediate input	S	Z^{SS}	Z^{SR}	...	Z^{ST}	Y^{SS}	Y^{SR}	...	Y^{ST}	X^S
	R	Z^{RS}	Z^{RR}	...	Z^{RT}	Y^{RS}	Y^{RR}	...	Y^{ST}	X^R
	...	...	...	...	...	...	...	...	...	...
	T	Z^{TS}	Z^{TR}	...	Z^{TT}	Y^{TS}	Y^{TR}	...	Y^{TT}	X^T
Value-added		VA^S	VA^R	...	VA^T			...		
Total Input		$(X^S)^T$	$(X^R)^T$	...	$(X^T)^T$			...		

A total of nine elements are included in Equation (1). Of these, the three items in the first bracket represent exports of value added. The first term is *DVA_FIN*, which represents domestic value added absorbed directly by importing countries. Item 2 is *DVA_INT*, which represents domestic value added absorbed directly by the importing country through exports of intermediate goods. The 3rd term, *DVA_INTrex*, denotes the domestic value added used by the importing country and exported to third countries. The sum of items 4 and 5 in the 2nd bracket is *RDV*, which denotes the value added returned domestically from exports, including value added in imports of final and intermediate goods in the source country. Item 6 is *DDC*, which denotes the pure double-counting term in the domestic accounts. The third bracketed items 7 and 8 represent foreign value added in the source country's GDP, and item 7 is *FVA_Imp*, which represents value added absorbed directly by the importing country. Item 8 is *FVA_oth* and represents foreign value

added absorbed by third countries. Item 9 is FDC, representing the pure double-counting component of the foreign account.

$$GVCparticipation_{ir} = \frac{IV_{ir}}{E_{ir}} + \frac{FV_{ir}}{E_{ir}} \quad (2)$$

$$GVCposition_{ir} = ln\left(1 + \frac{IV_{ir}}{E_{ir}}\right) - ln\left(1 + \frac{FV_{ir}}{E_{ir}}\right) \quad (3)$$

IV_{ir} represents the domestic value added of intermediate goods from sector i of country r, which are exported by an importing country to a third country and used by the third country in producing its final demand. It measures the value added in these intermediate goods, which are produced in one country, exported, and then absorbed by the third country. FV_{ir} denotes the foreign value added in the total exports of sector i of country r. E_{ir} represents the total value added exported by sector i of country r. The ratio IV_{ir}/E_{ir} is the forward participation index in the global value chain (GVC) for sector i of country r. This index shows the proportion of indirect value-added exports relative to total value-added exports in that sector. A higher forward participation index indicates that the sector is more upstream in the GVC. Conversely, FV_{ir}/E_{ir} denotes the GVC backward participation index for sector i in country r. A higher backward participation index means the sector is further upstream in the GVC. $GVC\_Participation_{ir}$ measures the degree of a sector's participation in the international division of labor, with a larger index indicating greater participation. $GVC\_Position_{ir}$ measures the sector's position within the upstream and downstream segments of the GVC. A larger position index indicates a more upstream position, while a smaller index indicates a more downstream position. Analyzing the GVC position should be conducted in conjunction with $GVC\_Participation_{ir}$ and $GVC\_Position_{ir}$ indicators.

4. Results

4.1. Changes in Value Chain Participation of Electronic Information Industry in Taiwan (China) and RCEP Economies

Based on the dataset obtained from the GTAP shock, this paper calculates the GVC participation index and position index for the electronic information industry in Taiwan and RCEP member economies. As shown in Figure 1, developed economies generally exhibit higher forward participation compared to developing economies. Specifically, Taiwan (China), Japan, and South Korea—economies with prominent electronic information industries—have higher forward participation. These economies are positioned upstream in the value chain, focusing on production technology and mid- to high-end intermediate goods.

Mainland China and ASEAN economies show higher backward participation, indicating that their electronic information industries are positioned downstream in the global value chain, focusing on processing and assembly. Among ASEAN economies, Singapore and Malaysia, located in the middle and upper reaches of the value chain, primarily supply mid- to high-end intermediate goods, resulting in higher forward participation compared to Mainland China.

Australia and New Zealand exhibit modest forward and backward participation in the electronic information industry, with forward participation notably higher than backward participation. These resource-rich economies lack technological advantages in this sector but contribute to the GVC by exporting raw materials. Consequently, their higher forward participation reflects their integration into the GVC through resource endowments.

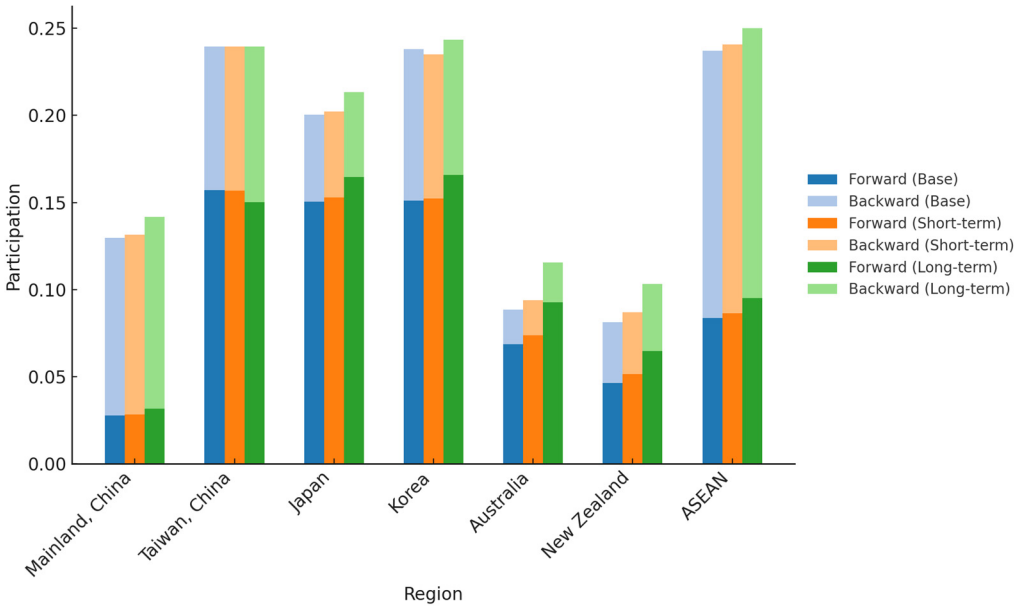

Figure 1. GVC participation index of electronic information industry in classified regions. Source: Calculated from the dataset obtained from the GTAP shock.

Taiwan's electronic information industry demonstrates higher forward participation than other economies, including Mainland China, indicating its upstream position in the GVC. Taiwan's industry is heavily involved in product design and the production of key components, with notable technological advantages in areas such as integrated circuits (ICs), semiconductors, and wafers.

The forward participation of Taiwan's electronic information industry has significantly declined, while backward participation has slightly increased. Long-term changes are notably larger than short-term ones. This trend indicates that Taiwan's electronic information industry, which primarily supplies medium- and high-end intermediate goods to other economies, is becoming increasingly involved in backward participation within the global value chain (GVC). Despite these changes, overall GVC participation in Taiwan's electronic information industry remains stable due to its deep integration and reliance on the East Asian value chain.

However, Taiwan's exclusion from the Regional Comprehensive Economic Partnership (RCEP) means it misses out on the benefits of this comprehensive trade agreement. In the short term, Taiwan's position in the value chain remains strong, thanks to its technological advantages and protections under the Information Technology Agreement (ITA). Yet, as trade costs for intermediate goods in the RCEP region decrease over the long term, firms in RCEP member economies are likely to increase intra-regional procurement of electronic components, reducing imports from Taiwan. This shift could erode Taiwan's profitability in the electronic information sector and lead to a shortage of specialized personnel and technological resources. Consequently, Taiwan may experience reduced economies of scale, lower competitiveness, and potential industrial hollowing-out as companies seek investment opportunities within RCEP member economies to take advantage of tariff and non-tariff benefits.

The data in Figure 1 indicate that reducing RCEP tariffs and non-tariff measures increases the participation of each member economy's electronic information industry in global value chains (GVCs). This suggests that the RCEP helps member economies better integrate into the global production system of the electronic information industry. However, the RCEP may negatively affect Taiwan, as the long-term reduction in tariffs and non-tariff measures has a greater impact on Taiwan than the short-term reductions, diminishing

its GVC participation in the electronic information sector. Mainland China, Japan, South Korea, Australia, New Zealand, and ASEAN all experience some increase in their electronic information industries' forward participation, with long-term gains surpassing short-term ones. Mainland China, Australia, New Zealand, and ASEAN also see varying degrees of increased backward participation, while Japan and South Korea experience slight decreases in this area. Japan's decrease in backward participation is minimal, while South Korea's is more pronounced. This suggests that, as the RCEP's openness grows, South Korea's electronics and information industry becomes more integrated into the GVC division of labor through increased forward participation.

4.2. Changes in the Value Chain Position of the Electronic Information Industry in Taiwan (China) and RCEP Economies

Figure 2 illustrates how the position of the global value chain (GVC) in the electronic information industry has shifted across different economies as a result of the RCEP. Over time, the impact of the RCEP on the GVC position of the electronic information industry varies among economies.

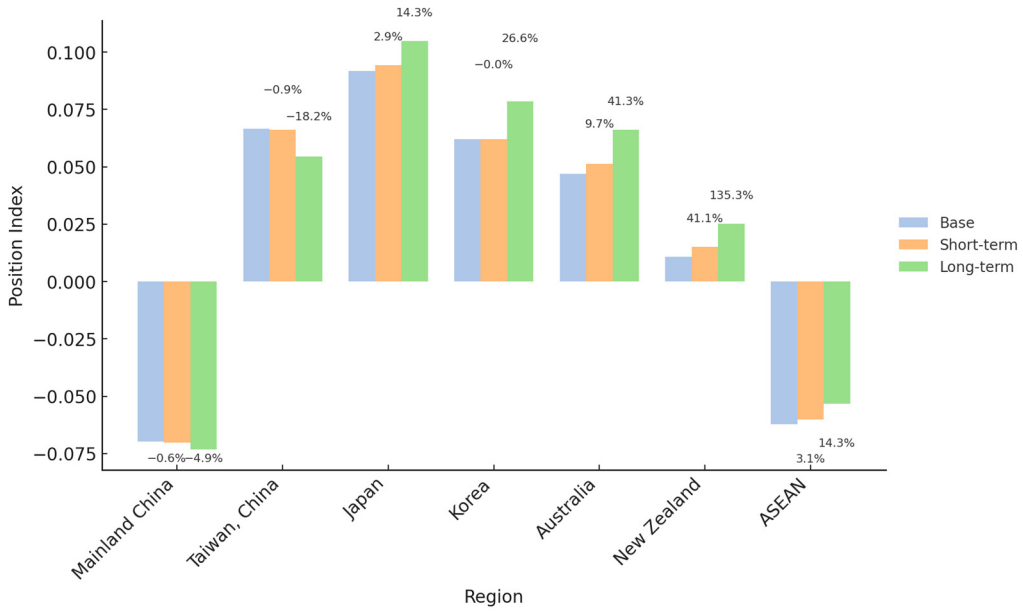

Figure 2. Changes in the value chain position of the electronic information industry by region. Source: Calculated from the dataset obtained from the GTAP shock.

In the short term, Taiwan's position in the global value chain (GVC) has remained relatively stable. However, over the long run, Taiwan's status in the GVC is expected to decline significantly. While Taiwan's technological advantages have shielded it from the immediate effects of the RCEP, the electronic information industry in Taiwan is likely to face negative consequences over time. As trade costs decrease and investment shifts within the RCEP region, the production division of the electronic information industry is becoming more specialized within this region. Consequently, the value chain links between Taiwan's electronic information industry and RCEP member economies are expected to weaken. Additionally, intra-regional cooperation within the RCEP electronic information industry is likely to increase, resulting in a noticeable downward trend in Taiwan's GVC position over time.

Increased cooperation within the value chain of the electronic information industry is expected to enhance the value added by intermediate goods in RCEP member economies, leading to an overall improvement in their value chain positions. Forecasts indicate that the value chain position of the electronic information industry in Japan, South Korea,

Australia, New Zealand, and ASEAN economies has increased to varying degrees, with more significant gains observed in the long term compared to the short term. In contrast, the value chain position of Mainland China's electronic information industry shows a downward trend, with a more pronounced decline in the long term.

This phenomenon occurs because the reduction in RCEP tariffs and non-tariff measures affects different industries and member economies in varying ways. The electronic information industry, being a key sector for RCEP members, experiences different advantages in each economy depending on their position in the production process. While the reduction in trade costs within the region promotes the functioning of the value chain, it also risks "low-end lock-in" for Mainland China's electronic information industry, which may struggle to move beyond lower-value segments.

Countries such as Japan, South Korea, Singapore, Malaysia, Australia, and New Zealand, which have technological or resource advantages, are likely to see improvements in their GVC positions under a more open regional trade framework. In contrast, Mainland China and ASEAN economies, which are more dependent on downstream activities in the value chain, may find it challenging to shift away from their current roles. Taiwan's electronic information industry, facing a deteriorating external environment, may experience a decline in competitiveness in high-value segments. As a result, its value chain position could gradually be overtaken by some RCEP member economies.

5. Discussion

5.1. Theoretical Implications

This study estimates the impact of the RCEP on the global value chain (GVC) of the electronic information industry in Taiwan (China), and other RCEP economies. The main contributions of this study are as follows:

First, the RCEP boosts member economies' involvement in the global value chain of the electronic information industry, and Taiwan's participation in this global value chain has also seen a slight improvement. This aligns with previous studies. The RCEP can not only enhance forward participation of member economies in the electronic sector's value chain, but also encourage most non-member economies to engage more deeply in the RCEP's value chain [32]. Regional trade agreements can foster deeper regional integration, which contributes to the formation of global value chains within regional clusters [67]. Deep regional integration not only increases trade flows among member economies, but also facilitates trade between member economies and non-member economies [68].

Second, the reduction in tariff and non-tariff measures under the RCEP strengthens the global value chain position of member economies. However, the global value chain position of Taiwan's electronic information industry is expected to decline. The long-term effects are anticipated to be more significant than the short-term impacts. This is consistent with previous research, which indicates that RCEP tariff reductions can enhance member economies' positions in global value chains [54]. Although COVID-19 has revealed the vulnerability of global value chains (GVCs) to sudden shocks [69], the reshaping of these chains cannot occur quickly enough [70]. The value chain pattern in mainland China and ASEAN economies, which involves importing parts and components for processing and assembly from economies with higher technological capabilities in the electronics and information industries, such as Japan, is difficult to change in the short term [32]. Member economies can use regional trade agreements to promote industrial upgrading and technological advancement [71], which leads to enhancements in the value chain [72]. However, this type of upgrading may take a considerable amount of time.

Finally, the impact of the RCEP varies among member economies. For instance, the RCEP negatively affects economies with a low to mid-range position in the global value

chain of the electronic information industry, such as mainland China. This is consistent with earlier research. Regional trade agreements (RTAs) increase market size and attract more foreign direct investment (FDI) [73]. However, this effect varies across different regions and industries [74]. The reduction in tariffs and non-tariff barriers within RTAs positively impacts trade creation, with this effect being more pronounced in trade between low-income countries [75].

5.2. Practical Implications

This study examines the status of Taiwan's core industries in the context of Asia-Pacific economic integration. It provides an important perspective on how Taiwan engages economically within a complex international political environment. The practical significance of the research findings is as follows:

First, this study highlights that the RCEP has influenced the participation and positioning of Taiwan's electronic information industry within the global value chain, leading to negative impacts on the industry. The evolving global economy continues to challenge economic globalization, particularly with rising concerns about associated risks, which have significantly slowed international economic openness [76]. Globalization has shifted to slowbalization [77]. During this period, a prominent trend has been the emergence of new regional trade agreements. The Regional Comprehensive Economic Partnership (RCEP), currently the largest regional trade agreement globally, is expected to become the most significant trade agreement in the Asia-Pacific region [78]. This study underscores the importance of Taiwan actively promoting cooperation with Asia-Pacific economies. Although the Economic Cooperation Framework Agreement (ECFA) between Taiwan (China) and Mainland China primarily covers traditional industries, Taiwan can use the agreement to strengthen cooperation with Mainland China in high-tech sectors such as the electronic information industry. This would provide Taiwan with a more stable political environment, both domestically and internationally. A stable regional environment will enhance Taiwan's competitiveness in the global supply chain and secure more international cooperation opportunities for the island. Furthermore, the Asia-Pacific region should continue to strengthen economic cooperation at the regional level to benefit more economies.

Second, the study indicates that the long-term effects of the RCEP are more significant than its short-term effects. Under the RCEP's institutional framework, the degree of trade liberalization among its 15 member economies is gradually increasing. Consequently, in the long run, the forward participation index and position index of Taiwan's electronic information industry in the global value chain have declined significantly. While reconstructing the value chain structure of the electronic information industry in the short term is challenging, RCEP economies such as Japan, South Korea, and Malaysia are actively striving to enhance their positions in the global value chain. As a result, Taiwan may face greater competitive pressure, which could negatively impact its ability to maintain its position in the global value chain. To address these challenges, Taiwan should focus on strengthening its internal industrial integration, particularly at the technological level within the electronic information industry. By integrating resources and technologies, Taiwan can bolster its competitive position in the global value chain and further enhance its leadership in semiconductor and information technology sectors.

Finally, this study highlights that the RCEP has had varying impacts on its member economies. While the RCEP has generally benefited these economies, its effects on specific industries vary considerably. Economies with lower starting points in the electronics and information industries are especially vulnerable to the "low-end lock-in" phenomenon. Mainland China should actively promote technological exchanges and cooperation with Taiwan's electronics and information industries. This will not only aid the development of

China's electronics and information sectors, but also provide opportunities for technological innovation in Taiwan's industries. Through technical cooperation between the two sides, Taiwan (China) and Mainland China can jointly advance high-tech industries, creating mutual benefits and a win–win situation for both economies.

5.3. Limitations and Recommendations

Although this paper contributes to the existing literature, it has certain limitations.

First, while this study clarifies the impact of the RCEP on the global value chain of the electronic information industry, it does not delve into this impact in depth. Future research could explore this topic more thoroughly by investigating how the RCEP affects the global value chains of various subsectors within the electronics and information industry, such as semiconductors, consumer electronics, and display panels. Additionally, examining the "spaghetti bowl" effect of overlapping regional trade agreements (RTAs) could provide a more comprehensive understanding of the complexities faced by the electronics and information industry.

Second, this study uses the GVC-CGE model to estimate the global value chain of the electronic information industry. While the Global Trade Analysis Project (GTAP) model is effective for quantitative policy analysis, the GVC-CGE model relies on assumptions such as perfect competition and rational economic behavior, which may not fully align with real-world conditions. Furthermore, the current validation approach does not provide sufficient explanatory power for the model results. Future research could enhance model validation by incorporating case studies, conducting sensitivity analyses, or integrating network analysis methods with large-scale real data and machine learning algorithms.

Finally, this study focuses specifically on Taiwan's electronics and information industry due to its strong trade ties with RCEP member economies and its global leadership position. Future research could extend this analysis to include additional economies, offering a more comprehensive perspective on the topic.

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