Thailand's Participation in Global Value Chain under Changing International Economic Landscape: The Case of RCEP and CPTPP

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ABSTRACT

This paper investigates Thailand's position in Global Value Chains (GVCs) and analyzes supply chain linkages in the RCEP, CPTPP and its potential expansion, including India, the United States, the United Kingdom, and China. Employing the GVCs framework, the study addresses data constraints and unveils a moderate increase in Thailand's backward linkage from 1995 to 2018, while its forward linkage remains steady. The intra-bloc GVC analysis underscores robust supply chain connections within RCEP and CPTPP blocs. As an ASEAN member, Thailand deepens its GVC participation via the RCEP bloc, and joining CPTPP could fortify Thailand's global trade linkages position. Subsequently, VECM results validate the existence of long-term relationships, and VEC Granger Causality results reveal short-term causal relationships within the supply chain of Thailand's production and its trading partners, based on monthly data from January 2011 to July 2023. These evidences further ascertain Thailand's supply chain linkages with its trade partners, notably highlighting robust linkages between Thailand and China. Although backward linkages prove resilient across all trading partners, forward linkages suggest unstable supplies of Thai products. Two policy implications emerge: Thailand's weakened position in GVC and supply chain links underscore the urgent need for Thailand to upgrade its domestic production capabilities, enhancing economic integration especially to attract foreign direct investment and hence, improve the country's competitiveness. Additionally, taking part in CPTPP trading bloc can be crucial for Thailand to strengthen its GVC participation and moving up the value chain via efficiency and productivity enhancement, especially with the potential

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inclusion of China in CPTPP. The dominance of Chinese economy in the region elaborates greater supply chain benefits relative to the US or UK taken into consideration the size of the economy, possibility of technology transfer and catching up, and the geographical location.

Keywords: GVC, Supply Chain, RCEP, CPTPP, Thailand, VECM

Background and Significance of the Research Problem

Globalization has ushered in the era of dominant Global Value Chains (GVCs), crucial for global trade and investment (Petersburg, 2013; UNCTAD, 2013)), involving various stages spread across different countries. Despite the evolution of the global trade landscape with widespread WTO participation, recent geopolitical events like the 2018 US-China trade war and the COVID-19 impact have spurred a shift towards de-globalization. This shift emphasizes the need to diversify global production risks, leading to new economic integrations, notably RCEP (Regional Comprehensive Economic Partnership) and CPTPP (Comprehensive and Progressive Trans-Pacific Partnership), both substantial multilateral FTAs. China's consideration of joining CPTPP (KasikornResearchCenter, 2021), and the UK's application for membership underscore the impact of these agreements on global trade dynamics in the era of GVCs.

Thailand's production and export challenges, rooted in structural economic issues (KKPResearch, 2021), contrast with the competitive advantages offered by trade agreements. The absence of Thailand in the CPTPP, where proactive participant Vietnam thrives, highlights positive FTA contributions. Vietnam's role as a production hub in the vast CPTPP market attracts foreign investors (Hoang & Hoan, 2019). Participation in GVCs brings benefits for developing countries, as highlighted by Ye et al. (2015). Thailand, currently in a lower GVC tier (Zhao, 2018), lags due to domestic costs and FTA disadvantages compared to Vietnam and other ASEAN nations.

Thailand's FTA landscape has significantly evolved since its ASEAN Free Trade Area (AFTA) agreement in 1992. It currently boasts 15 FTAs with 19 partners, covering over 63.5% of total trade. The most recent and noticeable, the RCEP agreement, effective since 2022, encompasses nearly 60% of Thailand’s trade. While RCEP, with China's participation, represents a potentially large impact, CPTPP also commands economic significance, covering 27.7% of Thailand’s trade and poised for expansion with new members. Both RCEP and CPTPP are considered as integral components to Thailand's supply chain, serving as sources of intermediate goods for imports and destination markets for exports. Intra-regional trade shows the crucial role of RCEP and

CPTPP to the Thai economy amidst changing international trade landscape. About 52.3% and 27.9% of Thailand's export is to RCEP and CPTPP market respectively. More than half of Thailand's imports (58.4%) is from its RCEP trading partners and about 25.4% is from CPTPP trading partners.

Analyzing GVCs involves frameworks like the Inter-Country Input-Output Table (ICIO Table), especially Koopman et al. (2014) decomposition of total exports. Borin and Mancini (2017) extend this, focusing on each trading partner and sector. Nagengast and Stehrer (2016) introduce source-based and sink-based approaches to track value-added components. Chang and Nguyen (2019) apply the source-based approach to analyze CPTPP countries' GVC patterns. This study revisits value-added proportions in gross exports, comparing RCEP and CPTPP with potential new members. The Revealed Comparative Advantage Index (RCA) approach (Balassa, 1965), notably Zhou et al. (2019) new RCA, enhances GVC analysis by considering value chain specialization and trade value added.

Numerous empirical studies reveal stronger linkages within GVCs and regional trade agreements. For instance, Cheng et al. (2016) highlight China's robust GVC ties with its trading partners, while Nagengast and Stehrer (2014) demonstrate increased intra-EU trade. Zhou et al. (2019) analyze China's GVC position and suggest potential benefits of GVC participation for a China-EU FTA. A few studies on Thailand's economic integration have also contributed to the investigation on factors influencing GVC participation such as González (2017), Korwatanasakul and Paweenawat (2020). Padilla et al. (2019) break down ASEAN's GVC, finding the region excels as a value-added provider. Athukorala and Kohpaiboon (2014) analyze TPP and RCEP trade patterns, revealing East Asia's reliance on global production sharing. Kohpaiboon and Jongwanich (2022) assess RCEP's rules of origin agreement and concludes the it is more favor to GVC operations than any other FTAs.

Furthermore, empirical studies have investigated the formation of GVCs and the possible benefits of claim long up value chain under regional trade agreements, notably RCEP and CPTPP, focusing on their impact on production supply chains and elucidating the competitive dynamics of countries and industries. For instance, Ingot and Laksani (2019) highlight Indonesia's dominance in low-tech GVC participation within RCEP, while Kumar (2020) observes India's limited involvement despite increased linkages. The studies also spotlight diverse effects of tariff reductions, with Korea benefiting and the US and Europe experiencing modest declines. Choi (2019) uncovers varying GVC effects based on regional clusters, and Lee and Cheong (2017) stress stronger trade linkages in RCEP compared to TPP. Chang and Nguyen (2019) emphasize

CPTPP countries' robust interdependence and integration into global value chains. Wei and Yu (2021) showcase China's gains from regional agreements and potentially benefits from rationalized production throughout regional value chain among CPTPP member. Lu (2019) study on the textile and apparel supply chain within the RCEP indicates enhanced regional integration and highlights the negative impact on exports to non-RCEP member countries.

Empirical studies on GVCs in Thailand, spanning from early 2000s to recent years, reveal diverse facets. Early research (Kohpaiboon, 2005, 2009, 2015; Kohpaiboon et al., 2010) emphasizes the multifaceted role of MNEs in export-driven industrialization beyond FDI. Focusing on industries like automotive and processed food, studies highlight contributions such as marketing channels, technological support, and market competitiveness. GVC discussions gained prominence since 2010, with studies indicating Thai MNCs' global expansion for GVC standing (Pananond, 2013) and FTAs influencing GVC development (Mukherjee & Goyal, 2016). GVC analysis broadens to explore specific industries, showcasing Thailand's position in semiconductor manufacturing and the structural transformation driven by technology and innovation. Studies also examine the global value chain depth of industries like cassava, electronics, and automotive (Intarakumnerd, 2017; Kaplinsky et al., 2011; Sucharitakul et al., 2018). Recent analyses, using input–output modeling (Durongkaveroj, 2022; Kohpaiboon, 2019; Kuroiwa, 2017), highlight the intricate relationship between domestic value added, export performance, and participation in global manufacturing networks. These findings collectively illuminate the dynamic role of Thailand in the evolving landscape of global value chains.

Therefore, as the dynamics of global GVCs evolve, strategies for participating in trade groups may influence changes in the Thai production chain. This study investigates the impact on Thailand's trade supply chain, aiming for a comprehensive understanding of shifts in supply chain dynamics. The objective is to determine Thailand's position in GVCs concerning RCEP, CPTPP, and potential new CPTPP members, with the findings expected to provide valuable insights for policymakers. his research can assist in free trade area negotiations and help sustain Thailand's comparative advantage in production and exports.

Research Objectives

1. To measure the position of Thailand in GVCs.

2. To analyze the significance of supply chain linkages in the RCEP and CPTPP economic groups for Thailand.

Scope of Research

This study is structured in two parts. Firstly, it shows the GVCs, focusing on Thailand's position within GVCs and regional trade blocs, specifically RCEP and CPTPP. The analysis utilizes the ICIO table from the World Input Output Database (WIOD) and the OECD-WTO Trade in Value Added (TiVA) (2021 edition), exploring six scenarios: 1) RCEP (15) with full trade liberalization among 15 RCEP members: Cambodia, Lao PDR, Myanmar, Vietnam, Malaysia, Singapore, Thailand, Brunei, Philippines, Indonesia, Japan, China, South Korea, Australia and New Zealand, 2) RCEP (15) and India's proposed entry to RCEP, 3) CPTPP (11) with full trade liberalization among 11 CPTPP members (Vietnam, Malaysia, Singapore, Brunei, Japan, Australia, New Zealand, Chile, Peru, Mexico, Canada), 4) CPTPP (11) plus the United States, 5) CPTPP (11) plus the United Kingdom and Thailand, 6) CPTPP (11) plus the United Kingdon, Thailand and China.

In the second analysis, this study explores the relationship between Thailand's production sectors and their supply chains using monthly data from January 2011 to July 2023. Data, including the Manufacturing Production Index (MPI) from the Office of Industrial Economics (OIE) and import/export data from the Ministry of Commerce (MOC), were collected. Import and export data, categorized using the fifth revision of the Classification by Broad Economic Categories (BEC Rev.5) by the United Nations Statistics Division (UNSD), were examined. The study focuses on the export and import series of intermediate and finished goods, categorizing them into groups. The analysis covers seven trade group partners: 1) RCEP, 2) India, 3) CPTPP, 4) the US, 5) the UK, 6) China, and 7) the UK+China, aligned with the BEC Rev.5 of UNSD.

Research Methodology

The Decomposition of the Value-added of Export

In this study, the measure of country's Global Value Chain (GVC) participation is estimated following (Borin and Mancini (2017) (BM) source-based decomposition framework similar to what was applied by Chang and Nguyen (2019). The framework decomposes bilateral exports between country s and country r into domestic value added (DVA) and foreign value added (FVA). DVA includes exported as domestic value added (component 1^* to 5^*) and domestic double counted (component 6^*), while FVA includes exported as foreign value added (components 7^* to $9b^*$), and foreign double counted (components $9c^*$ and $9d^*$).

By assuming the world consisting of N countries and G sectors, Y_{sr} is the demand vector of final goods produced in country s and consumed in country r (of dimension $G \times 1$). A is the global matrix of input coefficients (of dimension $NG \times NG$)), so that $B \equiv (I - A)^{-1}$ is the global

Leontief inverse matrix. In addition, V_s is the value-added shares embedded in each unit of gross outputs produced by country s (of dimension $1 \times G$), E_{sr} is the vector of bilateral gross exports from country s to country r (of dimension $G \times 1$), and u_G is a $1 \times G$ unit row vector.

$$
\begin{aligned}
u_G E_{sr} = {} & \overset{1a^*}{V_s(I-A_{ss})^{-1}Y_{sr}} + \overset{1b^*}{V_s(I-A_{ss})^{-1}A_{sr}(I-A_{ss})^{-1}\left[\sum_{j\neq r}^{N} A_{rj}B_{js}Y_{sr}\right]} + \overset{1c^*}{V_s(I-A_{ss})^{-1}A_{sr}(I-A_{ss})^{-1}\left[\sum_{j\neq r}^{N} A_{rj}\sum_{k\neq s,r}^{N} B_{js}Y_{sk}\right]} \\
& .+V_s(I-A_{ss})^{-1}A_{sr}(I-A_{ss})^{-1}\left[\overset{2a^*}{Y_{rr}} + \overset{2b^*}{\textstyle\sum_{j\neq r}^{N} A_{rj}B_{jr}Y_{rr}} + \overset{2c^*}{\textstyle\sum_{j\neq r}^{N} A_{rj}\sum_{k\neq s,r}^{N} B_{jk}Y_{kk}}\right] \\
& .+V_s(I-A_{ss})^{-1}A_{sr}(I-A_{ss})^{-1}\left[\overset{3a^*}{\textstyle\sum_{j\neq s}^{n} Y_{rj}} + \overset{3b^*}{\textstyle\sum_{j\neq r}^{N} A_{rj}\sum_{l\neq s,r}^{N} B_{js}Y_{sr}}\right. \\
& \left.\overset{3c^*}{.+\textstyle\sum_{j\neq r}^{N} A_{rj}\sum_{k\neq s,r}^{N} B_{jk}Y_{kr}} + \overset{3d^*}{\textstyle\sum_{j\neq r}^{N} A_{rj}\sum_{k\neq,r,l}^{N}\sum_{k\neq s,r}^{N} B_{jk}Y_{kl}}\right] \\
& .+V_s(I-A_{ss})^{-1}A_{sr}(I-A_{ss})^{-1}\left[\overset{4a^*}{Y_{rs}} + \overset{4b^*}{\textstyle\sum_{j\neq r}^{N} A_{rj}B_{jr}Y_{rs}} + \overset{4c^*}{\textstyle\sum_{j\neq r}^{N} A_{rj}\sum_{k\neq s,r}^{N} B_{jk}Y_{ks}}\right] \\
& .+V_s(I-A_{ss})^{-1}A_{sr}(I-A_{rr})^{-1}\overset{5^*}{\textstyle\sum_{j\neq r}^{N} A_{rj}B_{js}Y_{ss}} + \overset{6^*}{V_s(I-A_{ss})^{-1}}\overset{7^*}{\textstyle\sum_{t\neq s}^{N} A_{st}B_{ts}E_{sr}} \\
& .+\overset{8^*}{\textstyle\sum_{t\neq s}^{N} V_t(I-A_{tt})^{-1}A_{ts}(I-A_{ss})^{-1}}\left[\overset{9a^*}{Y_{sr}} + A_{sr}(I-A_{rr})^{-1}Y_{rr}\right] \\
& .+\textstyle\sum_{t\neq s}^{N} V_t(I-A_{tt})^{-1}A_{ts}\overset{9b^*}{(I-A_{ss})^{-1}}A_{sr}(I-A_{rr})^{-1}\sum_{j\neq r}^{N} Y_{rj} \\
& .+\textstyle\sum_{t\neq s}^{N} V_t(I-A_{tt})^{-1}A_{ts}\overset{9c^*}{(I-A_{ss})^{-1}}A_{sr}\overset{9d^*}{(I-A_{rr})^{-1}}\sum_{j\neq r}^{N} A_{rj}\sum_{k}^{N}\sum_{l}^{N} B_{jk}Y_{kl} \\
& .+\textstyle\sum_{t\neq s}^{N} V_t(I-A_{tt})^{-1}\left[\sum_{j\neq t,s}^{N} A_{tj}B_{js}E_{sr} + A_{ts}(I-A_{ss})^{-1}\sum_{j\neq r}^{N} A_{st}B_{ts}E_{sr}\right] \qquad (1)
\end{aligned}
$$

Where B_{ts} is the country−t to country−s section in the global Leontief matrix B, which relates to the requirement of total input from each sector of country t to produce one unit of final demand in each sector of country s, and A_{sr} is the country−s to country−r section in the inter-country input coefficient matrix A, which relates to the direct input requirement from each sector of country s to produce a unit of gross output in each sector of country r. Note that the targeting of source-based approach considers the first time a DVA that leaves its country of origin or the first time a FVA as re-exported. It uses the local Leontief matrix $(I-A_{ss})^{-1}$, pre-multiplied by the value-added share vector V_s. Meanwhile, it allows for all possible forward linkages by which such VA components can be routed (that includes repeated through the same country's origin or the same re-exporter), as captured by the global Leontief matrix B before the final demand vector Y.

Denoted that grow exports from country s to r divided to the part of DVA and FVA;

Table 1 Element Descriptions of Equation (1)

Elements	Descriptions	
DVA		1a* in final good exports directly absorbed by bilateral importers; 2a* in intermediate exports absorbed by direct importers as local final goods;
	in intermediate exports absorbed by bilateral importers	1b* as domestic final goods after additional processing stages; 2b*as local final goods only after further processing stages; 3c* as final goods from third countries;
	in intermediate exports absorbed by third countries	1c* as domestic final goods after additional processing stages; 2c* as local final goods; 3a*as final goods from direct bilateral importers; 3b*as final goods from direct bilateral importers only after further processing stages; 3d*as final goods from other third countries;
	in intermediate exports absorbed at home	4a*as final goods of the bilateral importers; 4b* as final goods of the bilateral importers after further processing stages; 4c* as final goods of a third country; 5* as domestic final goods;
	double-counted	6* originally produced at home;
FVA		7* in exports of final goods; 8* in exports of intermediate goods directly absorbed by the importing country r;
	in exports of intermediate goods re-exported by r	9a* via final goods exports; 9b* via intermediate goods exports;
	double-counted	9c*and 9c* originally produced abroad.

Source: Authors' Study

To sum up, equation (1) bilateral gross exports from country *s* to country *r* divides into DVA and FVA. The DVA can be consolidated in exports of either final goods or intermediate goods that combine four components. First component is directly in bilateral importers. Second component is in bilateral importers after further processing stages in other countries. Third component is by third countries, and the last component both that reflected and absorbed at home. Meanwhile, the FVA can be consolidated in exports by $\mathbf{s}$ of final goods and of intermediate inputs directly absorbed by the importing country $\mathbf{r}$, or in intermediate goods exports to $\mathbf{r}$ which are further processed and re-exported by the importing country $\mathbf{r}$.

GVC Participation

To identify the backward linkage and forward linkage including the pattern and trend across the RCEP and CPTPP member countries, the applied decomposition framework by BM is employed in the way similar to Chang and Nguyen (2019) calculation of the Vertical Specialization (VS) index introduced by Hummels et al. (2001) and Koopman et al. (2014). The model is specified by the following three equations as

Backward Linkages of country s:

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

The VS index by Hummels et al. (2001) quantifies the proportion of imported inputs incorporated into a country's gross exports, thereby precisely tracing the foreign content embedded in trade flows. Therefore, the analysis of this study considers the VS indicator as a fraction of foreign contents (foreign value added and foreign double counted) to the country's gross exports. A higher fraction of such foreign contents indicates greater reliance on international sourcing in the production of its gross exports, suggesting stronger backward linkages.

Countries participated in the GVCs:

$$GVC_s^{KWW} = \sum_{r \neq s}(1c^*_{sr} + 2c^*_{sr} + 3a^*_{sr} + 3b^*_{sr} + 3d^*_{sr} + 4^*_{sr} + 5^*_{sr} + 6^*_{sr} + 7^*_{sr} + 8^*_{sr} + 9^*_{sr})/E_{s^*} \quad (3)$$

The measure GVC_s^{KWW}, proposed by Koopman et al. (2010), goes beyond considering foreign contents. It also incorporates domestic contents in gross exports that are not absorbed by bilateral importers. This encompasses domestic contents in gross exports that are absorbed by third countries after undergoing further processing in bilateral importing countries, as well as those that return home and are absorbed by the exporting country itself. Hence, it considers both backward (upstream) and forward (downstream) linkages, offering a comprehensive perspective on a country's engagement in global value chains.

Forward Linkages of country s:

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

The measure GVC_s^{BM}, proposed by Borin and Mancini (2017), isolates the domestic value-added components that cross country borders only once (and are directly absorbed by bilateral importers), categorizing them as “traditional trade.” These components correspond to components 1a* and 2a* in the BM decomposition. A country's gross exports, excluding these two components, are then considered its GVC-related trade flows.

Where E_{s^*} is the total bilateral gross exports of country s. The *VS* index is a subset of the GVC^{KWW} indicator, which is further a subset of the GVC^{BM} index. Therefore, the size increases that mean a larger measure of GVC.

Vector Error Correction Model (VECM)

In this methodology, the evaluation of supply chain linkage utilizes monthly trade data, offering a dynamic representation of changes from the past to the present. This approach differs from the GVCs data obtained from the OECD's TIVA database, which releases data annually, with the latest version available up to 2022.

To answer whether there is a statistically significant relationship between Thailand production output and supply chain, the existence of long-run equilibrium relationship is examined by cointegration test, the same methodology is applied by Yang (2022). The Johansen cointegration technique is applied to observe the long-run relationship and then vector error correction model (VECM) is utilized to investigate the short-run adjustment mechanism. To confirm the relations between the variables, this research tests the Granger causality/block exogeneity Wald test has been performed under VECM. If all variables are first-difference stationary and cointegrated, a VECM is developed, enabling the examination of both short- and long-run causality. The VECM model for Manufacturing Production Index (MPI) is expressed as

$$\Delta MPI_t^{TH} = \varphi_1 + \sum_{i=1}^{T} \propto_{1i} \Delta MPI_{t-i}^{TH} + \sum_{i=1}^{T} \beta_{1i} \Delta Exports_{t-i}^{TH-k} + \sum_{i=1}^{T} \gamma_{1i} \Delta Imports_{t-i}^{TH-k} + \sum_{i=1}^{T} \delta_{1i} \Delta Exports\_Fin_{t-i}^{TH-k} + \varepsilon_1 ECT_{t-i}^{TH-k} + \mu_{1t} \quad (5)$$

Where φ, α, β, γ and δ are coefficient that reflects the short-run aspects of the relationships between the independent variables and the target variable. The variable TH represents the country of Thailand, and *k* is country groups including RCEP, India, CPTPP, the US, the UK, China and UK+China. The optimal lag is indicated by T and ECT is correction term. The ε is error correction term coefficient that shows fast the dependent variable adjust to the equilibrium. At time t, MPI_t^{TH} is the manufacturing production index of Thailand, $Exports_t^{TH-k}$ is the exports intermediate goods from Thailand (TH) to each country group (k), $Imports_t^{TH-k}$ is the imports of intermediate goods to Thailand (TH) from each country group (k) and $Exports\_Fin_t^{TH-k}$ is the exports of finished goods from Thailand (TH) to each country group (k).

Granger Causality Test

The Granger causality/block exogeneity Wald test was performed based on the VECM developed earlier for existence short-run causality relationship between variables included in the model. Following the methodology outlined by Yang (2022), this approach is employed to

identify causes and effects relationship of variables in the model which further have different implications on a country's GVC position analysis. Moreover, this method also facilitates the determination of the causal relationship in the reverse direction. It is applied to the four variables (MPI, Exports, Imports, and Exports-Fin) to examine causality and its direction among the variables, as outlined by Gujarati and Sangeetha (2007).

$$\Delta \mathrm{MPI}_t^{\mathrm{TH}} = \sum_{i=1}^{T} \propto_{1i} \Delta \mathrm{Exports}_{t-i}^{\mathrm{TH}-k} + \sum_{i=1}^{T} \gamma_{1i} \Delta \mathrm{Imports}_{t-i}^{\mathrm{TH}-k} + \sum_{i=1}^{T} \delta_{1i} \Delta \mathrm{Exports\_Fin}_{t-i}^{\mathrm{TH}-k} + e_{1t} \quad (6)$$

$$\Delta \mathrm{Exports}_t^{\mathrm{TH}} = \sum_{i=1}^{T} \propto_{1i} \Delta \mathrm{MPI}_{t-i}^{\mathrm{TH}} + \sum_{i=1}^{T} \gamma_{1i} \Delta \mathrm{Imports}_{t-i}^{\mathrm{TH}-k} + \sum_{i=1}^{T} \delta_{1i} \Delta \mathrm{Exports\_Fin}_{t-i}^{\mathrm{TH}-k} + e_{2t} \quad (7)$$

$$\Delta \mathrm{Imports}_t^{\mathrm{TH}} = \sum_{i=1}^{T} \propto_{1i} \Delta \mathrm{MPI}_{t-i}^{\mathrm{TH}-k} + \sum_{i=1}^{T} \beta_{1i} \Delta \mathrm{Exports}_{t-i}^{\mathrm{TH}-k} + \sum_{i=1}^{T} \delta_{1i} \Delta \mathrm{Exports\_Fin}_{t-i}^{\mathrm{TH}-k} + e_{3t} \quad (8)$$

$$\Delta \mathrm{Exports\_Fin}_t^{\mathrm{TH}} = \sum_{i=1}^{T} \propto_{1i} \Delta \mathrm{MPI}_{t-i}^{\mathrm{TH}-k} + \sum_{i=1}^{T} \beta_{1i} \Delta \mathrm{Exports}_{t-i}^{\mathrm{TH}-k} + \sum_{i=1}^{T} \gamma_{1i} \Delta \mathrm{Imports}_{t-i}^{\mathrm{TH}-k} + e_{4t} \quad (9)$$

In the model specified above, MPI_t , $\mathrm{Exports}_t$, $\mathrm{Imports}_t$ and $\mathrm{Exports\_fin}_t$ are the four dependent variables in the model; e_{1t}, e_{2t}, e_{3t} and e_{4t} are disturbance terms which assumed to have no contemporaneous covariance; t denotes time period and i indicates optimal lag length; α, γ and δ are coefficient that reflects the short-run aspects of the relationships between the independent variables and the target variable. The variable TH represents the country of Thailand, and k is country groups including RCEP, India, CPTPP, the US, the UK, China and UK+China. The hypotheses to be tested are: H0: $\propto_1 = 0$ against H1: $\propto_1 \neq 0$, H0: $\gamma_1 = 0$ against H1: $\gamma_1 \neq 0$ and H0: $\delta_1 = 0$ against H1: $\delta_1 \neq 0$.

For example, according to Equation 6, if the result shows a probability of less than 5% is means that H0 is rejected and H1 is accepted or the is Exports, Imports and Exports-Fin has granger cause MPI.

The concept of variable relationships is depicted through backward linkages, emphasizing Thailand's reliance on imported inputs. In contrast, forward linkages characterize Thailand as a manufacturing hub for intermediate or finished goods intended for export. Notably, Thailand engages in both the import and export of goods within the same industry, whether they are intermediate or finished products, a phenomenon termed intra-trade linkage.

Table 2 Assumption of Variable Relationships

Dependent / Explanatory	MPI	Exports (EX)	Imports (IM)	Exports of finished (EX-fin)
MPI		Forward linkage	Backward linkage	Forward linkage
Exports (EX)	Forward linkage		Intra-trade	No meaning
Imports (IM)	Backward linkage	Intra-trade		Intra-trade
Exports of finished (EX-fin)	Forward linkage	No meaning	Intra-trade	

Source: Authors' Study

Analysis and Empirical Result

GVCs participation

This study uses the source-based approach to measures of GVC trade, and the decomposition in equation (1) can identify the DVA components in a trade flow that crosses national borders only once. As a result, a GVC index based on BM can be constructed by equation (2) and (4).

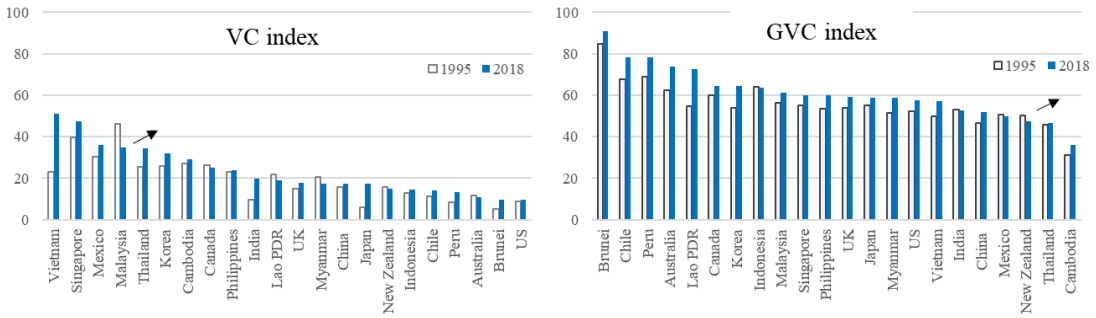

Figure 1 Thailand's Participation in GVC Compares to RCEP and CPTPP Countries (1995, 2018)

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

Source: Authors' Study

In examining Thailand's position in GVCs (1995 and 2018), Figure 1 shows its VS index increased from 25.32% to 34.58%, reflecting increased integration of foreign inputs in exports. In contrast, Thailand's GVC participation remained relatively stable, increasing from 45.72% to 46.48%. This study employs the same measure for other major exporters, including RCEP, CPTPP, and potential new members. Notably, Japan, Brunei, India, the US, and Peru had the lowest fraction of foreign content in gross exports (less than 10% in 1995). While their VS increased over 1995–2018, it remained the lowest among countries, indicating increased involvement in GVC through downstream linkages. In 1995, Thailand had a moderate VS index, significantly

relying on foreign goods in total exports by 2018. However, this didn't alter Thailand's GVC role. In contrast, Vietnam's VS index grew from 22% to 51% between 1995 and 2018, signifying increased downstream integration. Vietnam's GVC participation surged from 49.96% in 1995 to 57.11% in 2018, showcasing substantial progress in GVC involvement despite starting with a low degree of foreign content in exports and a high GVC level.

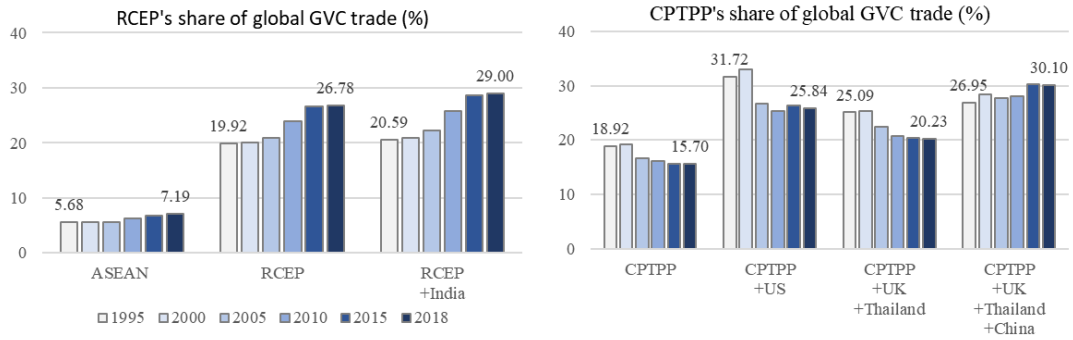

Figure 2 Trade Volumes of RCEP and CPTPP Compared to Other Trade Blocs (1995, 2000, 2005, 2010, 2012, 2018)

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

Source: Authors' Study

In assessing RCEP and CPTPP in GVCs, this section outlines the involvement of various trade groups. Figure 2 reveals that RCEP and CPTPP significantly influence global and GVC trade, with RCEP accounting for 27.67% of global gross exports and 26.78% of GVC trade in 2018. If India joins RCEP, its global share would increase by at least 2%. The US would contribute an additional 10.39% to gross exports and 10.14% to GVC trade; the UK and Thailand together add 4.83% to gross exports and 4.52% to GVC trade; and the CPTPP+UK+Thailand+China bloc is comparable in size to RCEP, reflecting the study's grouping, considering that RCEP includes key economies like China and South Korea not in the CPTPP.

Secondly, the study explicitly investigates whether these GVC exports consist of products sourced from within the trade bloc or outside trade bloc. This breakdown is illustrated in Figure 3. The overall GVC ratio for each bloc is calculated by dividing the exports in GVC of each bloc to the world by the gross export of each bloc to the world. The GVC within the bloc is computed by dividing the exports in GVC of each bloc to its bloc (or intra-trade of GVC) by the gross export of each bloc to its bloc (or intra-trade). Similarly, the GVC outside the bloc is calculated the same method. The CPTPP leads in GVC participation at 60.71%, surpassing other blocs in 2018.

However, RCEP excels in intra-bloc GVC at 67.65% in 2018, up from 61.06% in 1995, emphasizing the significance of intra-trade for RCEP members. A substantial gap in GVC between within the bloc and total or within the bloc and outside the bloc indicates robust supply chain connections within the bloc. RCEP exhibits the largest gap at 18.4% in 2018, followed by RCEP+India (10.4% in 1995 to 16.8% in 2018) and ASEAN (8.2% to 10.15%). The CPTPP bloc shows comparable GVC linkage, increasing from 4.5% to 6.4%, akin to CPTPP+UK+Thailand (1.7% to 5.7%) and CPTPP+UK+Thailand+China (3.7% to 11.1%).

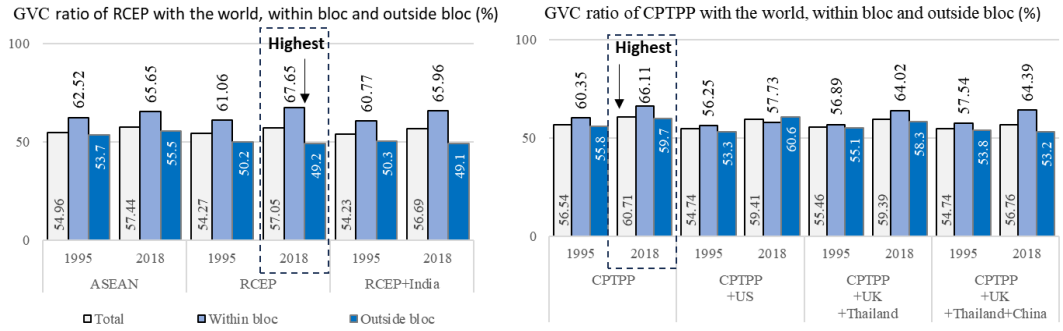

Figure 3 Participation of RCEP and CPTPP Members in GVC (1995, 2018)

Note: The measures are defined in equation (4) for GVC^{BM}

Source: Authors' Study

Additionally, it is important to note that the calculations are based on 2018, predating the implementation of both the CPTPP and RCEP. With the adoption of these trade agreements, it's reasonable to expect a further increase in GVC connectedness within the CPTPP and RCEP blocs. Figure 3 highlights the significance of the US, UK, Thailand, and China in CPTPP GVC linkages, despite non-membership. Including India in RCEP or the US, UK, Thailand, and China in CPTPP boosts overall GVC trade, especially intra-bloc exports. The CPTPP+UK+Thailand+China bloc shows a strong intra-bloc GVC connection within the bloc (64.39% in 2018) exceeding its gross trade ratio (56.76%). In contrast, the CPTPP+US bloc's GVC ratios for exports within bloc (57.73%) and outside the bloc (60.6%) are similar.

Thailand, as an ASEAN member, has a higher intra-bloc GVC ratio than global and external bloc ratios. As ASEAN evolves into RCEP, its larger bloc deepens GVC participation. If Thailand joins the CPTPP, although the linkage within the group may not be as robust as in ASEAN, these countries will establish a stronger GVC link with the world than ASEAN. Particularly, if Thailand joins CPTPP+UK+Thailand, a group excluding China and the US but with a GVC ratio for global trade of 59.39% in 2018.

Results of VECM

Before engaging in regression modeling, it's essential to ensure the stationarity of variables. The Augmented Dickey-Fuller (ADF) and Phillips–Perron (PP) tests (Granger & Newbold, 1974) confirm that Thai production (MPI), imports of intermediate goods (IM), and exports of intermediate (EX) and finished goods (EX-fin) are all integrated of order 1 (I(1)) (Table 3). Optimal lag length for VAR models is performed as specified in Table 4. According to the information criteria, the optimal lag length is determined based on the majority of criteria that recommend selecting the most suitable lag. The results of all models have presented that the lag length for VECM was between 2 and 5 lags.

Table 3 Unit Root Test Results

Country	Variables	Level		First Difference	
		ADF	PP	ADF	PP
	MPI	-3.2938**	-8.7601***	-4.0277***	-44.8724***
	EX_RCEP	-2.3286	-5.8678***	-14.8975***	-29.0692***
RCEP	IM_RCEP	-2.4655	-3.8811***	-21.4002***	-24.8792***
	EX_RCEP_fin	-2.5143	-5.3448***	-4.4744***	-48.4698***
	EX_India	-2.6749*	-2.6611*	-9.2932***	-31.8817***
India	IM_India	-2.6389*	-2.6857*	-9.667***	-26.5918***
	EX_India_fin	-3.7451***	-3.5306***	-9.6122***	-35.6257***
	EX_CPTPP	-3.1157**	-7.0083***	-14.4267***	-38.8709***
CPTPP	IM_CPTPP	-2.8627*	-4.5474***	-12.2668***	-25.491***
	EX_CPTPP_fin	-3.8832***	-8.053***	-14.1505***	-31.5548***
	EX_US	-0.2577	-1.4474	-14.9401***	-31.404***
US	IM_US	-4.1598***	-6.7036***	-13.2707***	-31.2354***
	EX_US_fin	-0.6093	-3.4363**	-19.9731***	-48.2009***
	EX_UK	-3.3883**	-8.0606***	-14.1388***	-66.2641***
UK	IM_UK	-4.5222***	-7.6799***	-11.3812***	-29.1296***
	EX_UK_fin	-5.4242***	-8.2436***	-13.7988***	-50.1209***
	EX_China	-4.2057***	-5.4502***	-12.4736***	-25.0466***
China	IM_China	-1.8667	-2.6419*	-23.5792***	-33.1598***
	EX_China_fin	0.2473	-4.3617***	-4.1884***	-28.7803***
	EX_UK+China	-4.1698***	-5.6524***	-12.6743***	-26.1981***
UK+China	IM_UK+China	-1.9562	-2.8239*	-23.7424***	-33.214***
	EX_UK+China_fin	0.5277	-4.5508***	-4.1995***	-30.4542***

Table 3 (Continued)

Note: MPI is the manufacturing production index of Thailand, EX is the exports intermediate goods from Thailand to each country group, IM is the imports of intermediate goods to Thailand from each country group and EX_fin is the exports of finished goods from Thailand to each country group (***) Significant at the 1%, (**) Significant at the 5%, (*) Significant at the 10%.
Source: Authors' Calculate

Seven models are presented, followed by Johansen Cointegration tests for each. The tests assess long-term equilibrium relationships between MPI, EX, IM, and EX-Fin using Trace and Max-Eigenvalue statistics. Results indicate significant relationships among variables at the 5% level. Table 4 shows cointegration relationships, with RCEP and India models having none, and the UK model exhibiting full rank.

Table 4 Results of Lag Selection and Results of Johansen Cointegration Tests

Model	Model		Number of lag length selection	Number of cointegration
	Dependent	Explanatory		
1.RCEP			5	No
2.India			4	No
3.CPTPP		- EX	3	1
4.US	MPI	- IM	3	3
5.UK		- EX-fin	2	4*
6.China			3	2
7.UK+China			3	1

Note: No means no cointegration in the model, *full rank or number of cointegrating vectors equal number of variables. So, all the variables must be stationary in the first place, which implies a VAR in the levels.
Source: Authors' Calculate

In all VECM models presented in Table 5, negative and significant ECT coefficients indicate adjustment towards long-run equilibrium, even in the RCEP, India, and UK models where cointegration results show no long-run relationship. These results highlight a convergent cointegrating relationship among MPI, EX, IM, and EX-fin with trade group partners. Specifically, RCEP, India, CPTPP, the US, the UK, China, and the UK+China models exhibit pronounced

convergent relationships at a 1% significance level, with respective values of -0.2993, -0.1717, -0.2889, -0.2486, -0.3302, -0.1691, and -0.1857. Interpreting these values reveals the speed of adjustment toward long-run equilibrium, with the RCEP model suggesting a monthly adjustment speed of approximately 29.93%. The UK's supply chain link demonstrates the fastest adjustment at 33.0%, while China's link shows a slower adjustment at 16.9%. Notably, the China and the UK+China VECM models exhibit higher R-squared values at 0.572 and 0.574, implying that approximately and 57.2% and 57.4% of the fluctuations in Thai manufacturing production can be explained by the VECM model.

When examining the significance of coefficients to confirm that the variables response to each together when there is a change to one variable in the long run and that the signs of coefficients are negative to illustrate a conversion to the long-run equilibrium relationship. the results are categorized into two groups. The first group corresponds to the increase of Thai exports of intermediate goods (EX), resulting in a decline in Thai production (MPI) within the CPTPP and US models, as production factors are diverted for export. Meanwhile, the second group, marked by an increase in Thai exports of finished goods (EX-fin), influences MPI in the opposite direction within the China and UK+China models, likely influenced by China's dominance. This is because finished goods serve as production inputs in Thailand.

Table 5 Results of VECM Long Run of MPI

Model	Coefficient of Cointegrating Equation					ECT[1]	R-squared
	MPI (-1)	EX (-1)	IM(-1)	EX_fin(-1)	C		
1.RCEP[2]	-0.0000	-0.0000	0.0000	0.0000***	-135.3008	-0.2993***	0.5521
2.India[2]	1.0000	-0.0000	0.0000***	0.0000***	-112.3143	-0.1717***	0.4228
3.CPTPP	1.0000	0.0000***	-0.0000	-0.0000	-97.0403	-0.2889***	0.4831
4.US	1.0000	0.0000***	0.0000	-0.0000	-125.6705	-0.2486***	0.4266
5.UK[3]	1.0000	0.0000	-0.0000	0.0000***	-118.3767	-0.3302***	0.3911
6.China	1.0000	-0.0000	-0.0000	0.0000***	-71.4874	-0.1691***	0.5724
7.UK+China	1.0000	-0.0000	-0.0000	0.0000***	-91.6977	-0.1857***	0.5744

Notes: [1]ECT is Error Correction Term, [2]No Cointegration, [3]Full rank, (***) Significant at the 1%.

Source: Authors' Calculate (See Calculation Details in Appendix)

Results of VEC Granger Causality for short-run causality

Table 6 presents short-run causality among the variables in these models, as identified through VEC Granger Causality/Block Exogeneity Wald tests. The p-values, at 1%, 5%, and 10% significance levels, reject the null hypothesis of 'no short-run causality,' indicating the existence

of causal relationships among the variables. The causality analysis, using the VECM model, classifies relationships into three types: no causality, bi-directional causality, and uni-directional causality. In bi-directional causality, the explanatory variable influences the dependent variable, and vice versa, suggesting a simultaneous response from both variables.

All models have identified numerous short-run relationships. In general, Thailand's supply chain reveals robust bi-directional short-run and backward linkages across all trade groups. This indicates not only one-way effects but also reciprocal interactions between Thailand and its trade partners, particularly involving MPI and Imports. When comparing the supply chain relationships of Thailand among trade groups, it is evident that Thailand and China have the strongest ties, with seven relationships, followed by the UK+China with the same number of relationships, emphasizing the influential connection between Thailand and China. In descending order, RCEP and India have six relations, CPTPP has five relations, the UK has four relations, and the US has the weakest with three relations. These findings suggest that Thailand has stronger supply chain linkage with Asian countries compared to others, such as CPTPP, the US, and the UK.

Table 6 Results of VEC Granger Causality for Short-run Causality

Variable / VECM	Dependent: MPI			Dependent: EX			Dependent: IM			Dependent: Ex-fin		
	EX[1]	IM[1]	EX-fin[1]	MPI[1]	IM[1]	EX-fin[1]	MPI[1]	EX[1]	EX-fin[1]	MPI	EX[1]	IM[1]
	(F)	(B)	(F)	(F)	(I)	(No)	(B)	(I)	(I)	(F)	(No)	(I)
1.RCEP[2]	Bi	Bi	Uni	Bi			Bi		Uni			
2.India[2]		Bi	Uni	Uni	Uni		Bi					Uni
3.CPTPP		Bi	Bi	Uni			Bi			Bi		
4.US			Uni			Uni	Uni					
5.UK[3]		Bi				Uni	Bi					Uni
6.China	Uni	Bi				Uni	Bi		Bi	Uni		Bi
7.UK+China	Uni	Bi				Uni	Bi		Bi	Uni		Bi

Notes: Uni is uni-directional causality, Bi is bi-directional causality, Empty blanket is no causality; (F) is forward linkage, (B) is backward linkage, (I) is intra-industry trade, (No) is no meaning of indirect effect; [1]Explanatory variable, [2]No Cointegration, [3]Full rank

Source: Authors' Calculate

The Asian models exhibited a comparatively higher number of relationships than other models. Particularly, the model involving China within RCEP, alongside China and the UK+China, exclusively showed both forward and backward linkages with uni-directional and bi-directional

short-run relationships, all involving MPI, Exports, and Imports. This suggests that Thailand and RCEP are integral components of the supply chain, displaying a two-way relationship between Exports-MPI and Imports-MPI. Additionally, there is a uni-directional relationship, signifying a one-way impact between two pairs of variables. In the supply chain relationship between Thailand and China, Thailand and the UK+China exhibit identical linkages with seven pairs of variables, showing robust backward and intra-trade linkages. In the Thailand-India supply chain, India serves as a backward linkage for Thailand with bi-directional impact via Imports-MPI. Additionally, there is forward linkage and uni-directional impact, with Exports-fin influencing MPI, MPI and Imports impacting Exports, and Imports impacting Exports-fin.

Other models exhibit a relatively lower number of supply chain relationships with Thailand, including CPTPP, the US, and the UK. The Thailand-CPTPP supply chain features both backward and forward linkages with bi-directional impacts via Imports-MPI and Exports-fin-MPI, while MPI has a significant one-way impact on Exports. The Thailand-UK supply chain demonstrates backward linkage with bi-directional effects between Imports-MPI and uni-directional effects via Exports-fin on Exports and Imports on Exports-fin. The US exhibits the weakest supply chain relationship with Thailand, characterized by uni-directional linkages both forward and backward. This involves Exports-fin influencing both MPI and Exports, and MPI influencing Imports.

Conclusion and Policy Implication

This paper investigates Thailand's position in GVCs and explores supply chain linkages under the RCEP and CPTPP regional economic integration. Utilizing the GVCs framework and VECM with Granger causality test, the study addresses data limitations with the former's reliance on annual TIVA data causing a one or two-year lag and the latter's use of monthly trade data for more current results.

Key findings from the GVCs framework regarding Thailand's position in GVCs between 1995 and 2018 indicate a moderate increase in Thailand's VS index (backward linkage), indicating enhanced integration of foreign inputs. However, its GVC participation (forward linkage) remained relatively steady. In contrast, Vietnam exhibited significant progress in both forward and backward integration. Thailand's involvement in the global supply chain, via trade and investment, seems to be lower compared to Vietnam's, as indicated in Zhao (2018), where Thailand had lower value chain participation indices than Vietnam (Figure 2). This variation can be partially several attributed to Vietnam's aggressively pursue economic integration over the

past decade which leads to competitive advantage in production costs, attracting foreign as well as local investments in industries and hence, extensively moving up it's position in global production chains. Vietnam's ascent as a production hub commenced with its WTO accession in 2007 and was further accelerated by the Vietnam-South Korea FTA in 2015, along with the Vietnam-EU FTA in 2020. These findings confirm the study by Ye et al. (2015), which highlights the benefits of GVC participation in developing countries.

The study further examines the impact of RCEP, CPTPP, and potential new members on GVCs, highlighting their substantial influence on global and GVC trade. The intra-bloc GVC analysis emphasizes robust supply chain connections within RCEP and CPTPP blocs, with implications for non-member nations like the US, UK, Thailand, and China. The research suggests that, as an ASEAN member, Thailand is deepening its GVC participation, and joining CPTPP could provide additional benefits for stronger global trade linkages. This is consistent with previous studies, Mukherjee and Goyal (2016) and Pananond (2013) for instance, that trade bloc integration such as FTA, and other terms of economic cooperation can contribute significantly in a country's involvement in GVCs, and thus productivity as well as competitiveness enhancement.

Results from the VECM confirm significant long-run relationships among Thai production (MPI), imports of intermediate goods (IM), and exports of intermediate (EX) and finished goods (EX-fin), with the exception of RCEP, India and the UK models. Negative and significant ECT coefficients across the models indicate an adjustment toward long-run equilibrium, highlighting convergent cointegrating relationships between Thailand's production and trade with its partners. In essence, change in Thailand's production corresponses to both intermediate and finished goods trade which once again demonstrates how the country participate in GVC. Consequently, a shock on trading partners' exports and imports could resulted in some adjustment of Thailand manufacturing production. In this perspective, diversification of trade could have an essential role for Thailand international trade resilient by mitigation of external risks. Among the models, the CPTPP, the US, China, and the UK+China models show distinct convergent relationships, with the CPTPP model exhibiting the highest speed of adjustment toward long-run equilibrium and the China model showing the lowest speed. The China and the UK+China models demonstrate higher R-squared values, indicating a greater explanatory power for fluctuations in Thai manufacturing production, underscoring the close linkages of Thailand's supply chain with China and China-inclusive trade groups.

Furthermore, VEC Granger Causality results short-run causal relationships among variables in the models. Thailand's supply chain exhibits strong bi-directional short-run and backward linkages

across all trade groups, with the strongest connections observed between Thailand and China, followed by the UK+China. While RCEP and India show significant relations, CPTPP, the UK, and the US display weaker linkages. Asian models, particularly those involving China within RCEP, demonstrate a higher number of relationships, underscoring their integral role in Thailand's supply chain. Uni-directional and bi-directional linkages, along with backward and intra-trade connections, emphasize the complexity of Thailand's supply chain dynamics across Asian trade groups.

Thailand has, over past decades, served as a production hub and a base for multinational corporations (MNCs) in sectors such as automotive and electrical appliances, playing a significant role in GVCs through both forward and backward linkages. Empirical evidence from both methodologies consistently indicates that Thailand possesses strength in backward linkages within the supply chain. This highlights a reliance on sourcing foreign inputs through imports from Thailand’s trade partners, notably China and groups in which China is involved, as opposed to other nations. However, there remains uncertainty in Thailand's forward linkages, signaling an unstable supply of Thai products through exports to various trade partners. This suggests a potential decline in Thailand's position in the global supply chain for both intermediate and finished products.

Two policy implications emerge: Firstly, Thailand has weakened its position in GVC and supply chain links for the production of intermediate and finished goods, relying significantly on imported inputs. This indicates a dependence on foreign sources for goods production, emphasizing the urgent need to enhance Thailand's domestic production efficiency and capabilities to prevent further deterioration in its position. Thailand's integration into global supply chains hinges on attracting foreign investors in more advanced technology industries like automobiles, electronics, and appliances. This would seamlessly rationalized embed Thai production into the global chain, leveraging a network of investment reliant on production base on factors from various countries via exports and imports of intermediate goods. Secondly, with a focus on RCEP and CPTPP, these policies carry significant importance as linkages with GVC, especially if new potential members are added. Notably, the inclusion of China in CPTPP demonstrates a more substantial and impactful supply chain effect on Thailand compared to the addition of the US or UK. This underscores the potential benefits for Thailand in aligning with GVCs and establishing a robust supply chain, particularly through its association with CPTPP and the inclusion of China.

This study examines Thailand's overall production chain with its trading partners, indicating a lack of evidence regarding the significant role of RCEP in Thailand's production and trade, despite its importance in the country's competitiveness and productivity improvement. For a public policy perspective, some recommendations for further research could delve into specific sub-industries like automotive manufacturing, electrical appliances, electronics, and food production, as these are the major economic sectors for Thailand and are all facing huge challenges in technological progress and structural change. Additionally, incorporating Foreign Direct Investment (FDI) into the model can help trace the supply chain loop influenced by foreign direct investment. Such analyses could elucidate some explicit links in the production chain, facilitating the development of industry-specific policies aligned with each trade group.

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