OPEN ACCESS Freely available online

IJBSI International Journal of Business Studies and Innovation

ISSN 2737-5331
Volume 4, Issue 1
https://ijbsi.iikii.com.sg/
International Journal of Business Studies and Innovation

Article

The Study on the Impact of China-Thailand Trade Structure on Trade Terms

Tingjun Chang

Tan Kah Kee College, Xiamen University, Xiamen 363105, China; tingjunchang@gmail.com

Received: Feb 10, 2025; **Revised:** Feb 24, 2025**; Accepted:** Feb 28, 2025; **Published:** Mar 30, 2025

Abstract: This paper uses the Trade Intensity Index, Trade Complementarity and Competition Index, Competitive Pressure Index, and Intra-Industry Trade Index as measurement indicators to analyze the factors influencing the China-Thailand bilateral trade structure from 2005 to 2021. It then applies the Price Terms of Trade Index and Income Terms of Trade Index to assess and analyze trade terms. Subsequently, the paper selects China's Income Terms of Trade Index as the dependent variable, China-Thailand Trade Intensity Index as the main explanatory variable, and variables such as China's export openness, Thailand's export openness, actual foreign direct investment from Thailand in China, the difference in per capita GDP growth between China and Thailand, and the China-Thailand exchange rate under the RMB direct pricing method as control variables for multiple linear regression analysis. Finally, based on the test results, the paper proposes policy recommendations to promote win-win bilateral trade cooperation between China and Thailand.

Keywords: Terms of Trade, Trade Structure, Multiple Regression

1. Introduction

Since the beginning of the new century, trade between China and Thailand has become increasingly close, and bilateral trade has become an important component of the economies of both countries. With the progress of bilateral agreements in the China-Thailand WTO accession negotiations, over 90% of trade products between China and Thailand enjoy zero tariffs, and trade exchanges between the two countries have flourished with China's accession to the World Trade Organization. In December 2002, the signing of the "China-ASEAN Comprehensive Economic Cooperation Framework Agreement" marked the beginning of a fast track for China-Thailand trade. In early 2004, the bilateral "Early Harvest Program" significantly reduced tariffs on agricultural products, which had extraordinary significance for promoting bilateral trade. With the establishment of the China-ASEAN Free Trade Area on January 1, 2010, trade and economic cooperation between China and Thailand reached a new level. Following China and Thailand's announcement in 2012 of a "Comprehensive Strategic Cooperative Partnership," trade between the two nations flourished. However, due to the impact of the 2008 global financial crisis, the world economy faced increasing downward pressure, and the prices of most international bulk products declined. Global trade development stagnated. Nevertheless, bilateral trade between China and Thailand surged against the trend in 2015, showing strong growth and reaching a historical high of $75.532 billion, a 4.01% increase year-on-year (Zheng, 2016). The state of trade terms and trade structure are important factors affecting bilateral trade, especially when studying the impact of trade structure on trade terms, which can deeply reflect China-Thailand bilateral trade.

Extensive researches have been conducted on bilateral trade structure and trade terms. In the study of China-Vietnam bilateral trade structure and trade terms, Feng (2015) focused on the status of China-Vietnam bilateral trade structure and trade terms, as well as the relationship between the two. He used an empirical method to analyze the changes in trade structure and trade terms between the two countries in bilateral trade, particularly in terms of the technical content of products. After discussing the theoretical impact of trade structure, tariff levels, exchange rates, foreign direct investment, and other factors on trade terms, Feng used time series data for China-Vietnam bilateral trade to conduct econometric analysis. Using the vector error correction model, he estimated the impact of various factors on trade terms fluctuations during the sample period. The results show that while the bilateral trade structure between China and Vietnam has improved, the impact on trade terms differs for both countries. The enhancement of export product technical structure has short-term benefits for improving trade price conditions for both sides, but it is not favorable for improving income trade terms. Scholars studying the effects of China-ASEAN regional trade cooperation point out that the production and consumption effects caused by customs unions will lead to changes in net goods trade terms for the countries

involved. Trade diversion caused by the customs union leads to shifts in the reciprocal demand for products from non-member countries, thereby improving the trade terms within the union (Wang, 2006).

This research combines qualitative and quantitative methods, mainly using literature review and econometric analysis. The structure of the research, excluding the introduction, is arranged as follows:

Part 2 mainly presents and analyzes the development of China-Thailand bilateral trade through data in the form of charts, and classifies China-Thailand bilateral trade products by combining the SITC three-digit classification method and the LALL classification method to demonstrate the development of products at different technological levels in bilateral trade.

The sample period used for Part 3 is the years 2005-2021. The bilateral commerce between China and Thailand is then described by differentiating the trade terms and structure. The Trade Intensity Index, Trade Complementarity and Competition Index, Competitive Pressure Index, and Intra-Industry Trade Index are calculated to depict the trade structure. Among these, the China-Thailand Trade Intensity Index is the main explanatory variable for the empirical analysis in Part 4, and China's Income Terms of Trade Index is selected as the dependent variable.

Part 4 conducts unit root tests on the original series of all variables and cointegration tests are performed on all the original series. Since cointegration tests in Eviews only support up to four variables, this thesis selects China's Income Terms of Trade Index as the dependent variable and pairs it with the main explanatory variable, China-Thailand Trade Intensity Index, along with control variables such as Thailand's export openness and foreign direct investment inflows as Variable 1. For Variable 2, China-Thailand Trade Intensity Index is paired with control variables such as China's export openness and the per capita GDP growth rate difference. For Variable 3, China-Thailand Trade Intensity Index is paired with control variables such as China's export openness and the China-Thailand exchange rate based on RMB direct pricing. For these three sets of variables, cointegration tests are performed. The null hypothesis, which suggests a cointegration relationship between the variables, is rejected when all three sets of data pass the cointegration test. Lastly, the variables that pass the cointegration test are used for multiple linear regression. The main explanatory variable on the right-hand side of the equation is the trade structure, which is based on the Trade Intensity Index, with five control variables: China's import openness, Thailand's import openness, foreign direct investment inflows, the per capita GDP growth rate difference between China and Thailand, and the China-Thailand exchange rate based on RMB direct pricing. This methodology helps to provide an in-depth analysis of the impact of trade structure on trade terms in the China-Thailand bilateral trade context.

2. The Development Status of China-Thailand Bilateral Trade

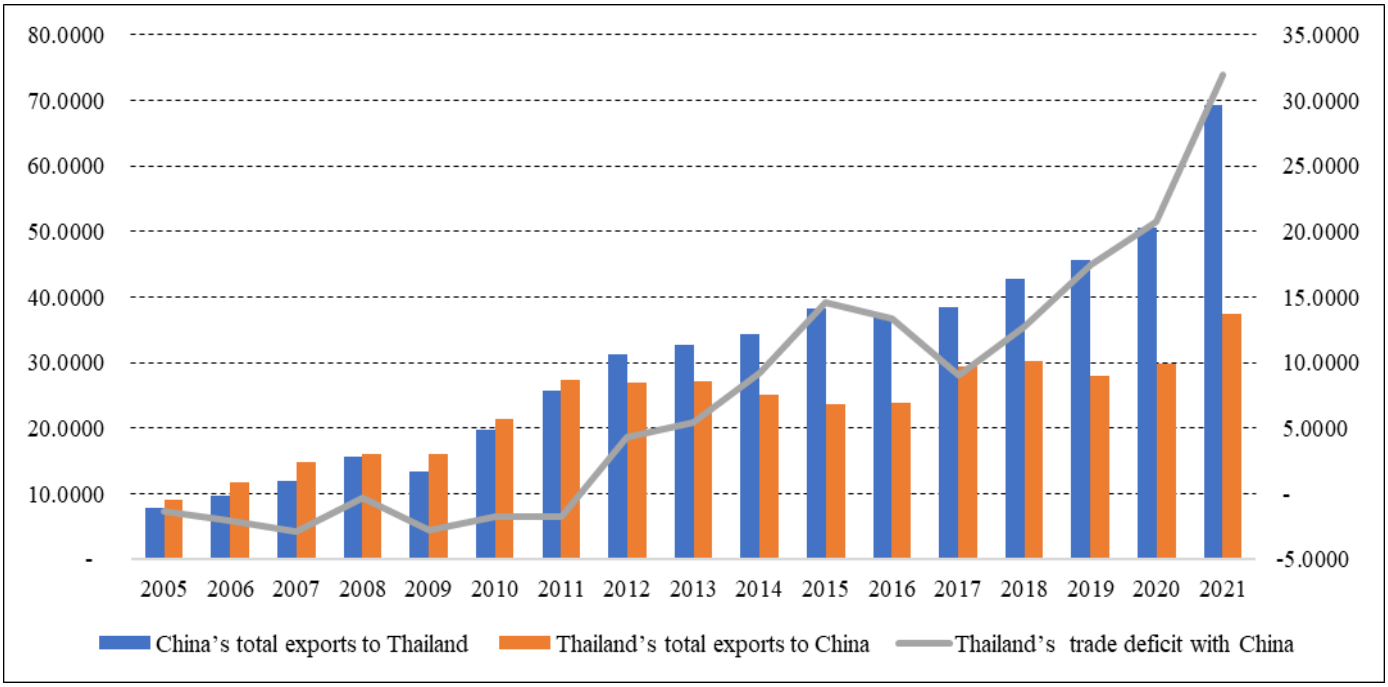
Thailand's overall exports increased steadily between 1990 and 2021, rising from $2.0064 billion in February 1991 to $24.2225 billion in March 2021. China was Thailand's top import source and its second-largest export destination. Thailand imported $5.30415 billion worth of goods from China in January 2021. The top three export commodities from Thailand were electromechanical products, plastics and rubber, and transportation equipment, accounting for 54.3% of total exports. Meanwhile, the main imported products were mineral products, base metals and their products, and electromechanical products, making up 59% of total imports. Due to technological and production endowment constraints, China and Thailand both exported a lot of primary and intermediate goods in the 20th century. China's wealth of natural resources fueled the expansion of resource-processing industries, while Thailand's advantages in agricultural product production helped to boost its planting and cattle sectors. While the percentage of capital goods exported continued to increase, both economies' reliance on exports of primary products steadily declined as they progressed. Thailand benefited from the influx of Japanese and American industries as well as Japanese finance, whereas China's growth was propelled by trade policy liberalization and industrial restructuring. As a result, the two nations' capital products' levels of international competitiveness differed significantly. China and Thailand have varied competitive and comparative advantages in various products due to their varying resource endowments and levels of development. In bilateral trade, complementarity and rivalry coexist, and trade complementarity based on natural assets is still prevalent. Therefore, deeper trade interactions can be facilitated by utilizing both countries' comparative advantages (Zhu and Jiao, 2022).

2.1. The Overall Development of China-Thailand Bilateral Trade

As shown in Fig. 1, before 2011, Thailand's total exports to China were consistently slightly higher than China's total exports to Thailand. However, after 2012, when China and Thailand announced the establishment of a "Comprehensive Strategic Cooperative Partnership," bilateral trade between the two countries flourished. China's total exports to Thailand surpassed Thailand's exports to China, with the trade gap between the two countries continuing to widen. Capital goods accounted for the majority of these exports, making up more than half of the total. After 2020, due to China's effective pandemic control measures, a large number of global trade orders shifted to China, leading to a surge in foreign trade activities and factory orders. This resulted in an increase in supply and a rise in China's export volume. Furthermore, China is Thailand's second-largest chicken export market,

therefore the trade deficit between the two nations was further exacerbated by China's tightened pandemic-related restrictions on imported meat products. Since then, the total amount of China's exports to Thailand has nearly doubled that of Thailand's exports to China in 2021.

From Thailand's point of view, the country's trade deficit with China has been steadily increasing since 2011. Thailand's overall exports to China peaked in 2018 at $30.175 billion, mostly as a result of China's quick industrialization and economic growth. Thailand, on the other hand, increased its trade deficit by importing a lot of computer components, chemical products, and electromechanical products from China despite having less capital and technological advancement than China. However, Thailand's top five exports to China include jewelry, food and drink, transportation equipment, plastic and rubber, and machinery and equipment. But by 2020, the first three categories' growth rates had sunk, with transportation equipment seeing the worst drop at -13.12%, which greatly exacerbated the growing trade deficit. However, Thailand has historical and natural advantages in agricultural production as a significant agricultural nation. In recent years, its annual growth rate for agricultural exports has stayed above 2%.



Data Source: Calculated and compiled based on the United Nations Database (various years).

Fig. 1. Development of China-Thailand Bilateral Import and Export Trade (in billion dollars).

From the Fig. 1, it can also be observed that the growth of bilateral trade volume between China and Thailand fluctuates significantly. This is mainly due to the negative impact of factors such as political instability in Thailand and financial crises on trade development. However, the establishment of the China-ASEAN Free Trade Area has also provided a vital opportunity for the growth of bilateral trade (Di, 2017).

2.2. Development of China-Thailand Bilateral Trade by Product Technology Structure Classification

As shown in Table 1, this study refers to the classification methods and organizes trade products based on the three-digit classification level of the SITC (Revision 3). The classification process follows three steps. First, all products are divided into two main categories: Primary Products (PP) and Manufactured Products (MP). Second, manufactured products are further categorized into four major groups based on their technological content, ranked from low to high: Resource-Based Products (RB), Low-Tech Products (LT), Medium-Tech Products (MT), and High-Tech Products (HT). Finally, these four major categories are further subdivided into nine subcategories (Feng, 2015).

The nine subcategories are as follows:

- Agricultural Resource-Based Products (RB1): Includes basic processed wood, railway sleepers, rubber materials (paste, sheets, blocks, *etc.*).
- Mining Resource-Based Products (RB2): Includes starch, wheat gluten, protein-like substances, adhesives, petroleum or bituminous minerals (>70% oil content).

- Textile Products (LT1): Includes fabrics, bags, leather goods, and clothing accessories.
- Other Low-Tech Products (LT2): Includes hardware parts, jewelry, ceramics, *etc*.
- Transportation Equipment (MT1): Includes motorcycles, commercial and passenger transport vehicles, and related components.
- Processed Industrial Products (MT2): Includes chemical reagents, synthetic fibers, and agricultural chemicals such as pesticides and fertilizers.
- Engineering Machinery (MT3): Includes circuit devices, industrial machine tools, internal combustion engines, circuit equipment, panels, and boards.
- Electronic Products (HT1): Includes data processing and communication equipment, office and automation equipment, cathode valves and pipelines, rotary power plants, and their components.
- Other High-Tech Products (HT2): Refers to precision instruments and components, aerospace equipment, and parts and accessories of machines in groups 751 and 752.

Table 1. Classification standards for trade products by technology structure.

Product Category			SITC Rev. 3 Product Code
PP			001, 011, 012, 016, 017, 022, 025
			277, 278, 291, 292; 321, 322, 325
MP	RB	RB1	023, 024, 035, 037, 048, 056, 058
			248, 251; 411, 421, 422, 431; 625, 633
		RB2	232, 281, 282, 283, 284, 285, 286, 287
			516, 522, 523, 531; 621, 629, 661
	LT	LT1	611, 612, 613, 651, 652, 654, 655
			831, 842, 843, 844, 845, 846, 848
		LT2	592; 642, 665, 666, 674, 677, 679
			821, 892, 893, 894, 895, 896, 897
	MT	MT1	713, 781, 784, 785, 791
		MT2	266, 267, 272
			786, 793
		MT3	711, 714, 721, 722, 723, 724, 725
			811, 812, 873, 882, 883, 884, 885
	HT	HT1	712, 716, 718, 751, 752, 759, 761, 764
		HT2	524, 541, 542, 582; 871, 872, 874, 881

As shown in Table 2, the following trade product structure is classified using the LALL classification method, with sample data from 2005, 2010, 2020, and 2021 to analyze the development of China's export trade structure to Thailand.

Primary products and low-tech manufacturing industries (such as textiles, clothing, and footwear) have remained relatively stable in recent years. The most significant change occurred in other low-tech manufacturing products, whose share of China's total exports to Thailand surged from 11.37% in 2005 to 19.45%. The share of high-tech manufacturing-electrical and electronics dropped significantly over two decades, from 31.10% in 2005 to 18.83% in 2021. From a product perspective, the trade structure in 2005 was imbalanced, with high-tech manufacturing accounting for the majority. However, by 2021, other low-tech manufacturing, medium-tech manufacturing (engineering), and high-tech manufacturing (electrical and electronics) formed a more balanced three-way distribution.

Table 2. Development of China's export trade structure to Thailand.

Year	2005	2010	2015	2020	2021
Primary Products	7.08%	7.49%	9.58%	7.43%	6.52%
Resource-Based Manufacturing: Agricultural	2.72%	4.26%	4.42%	5.46%	5.58%
Resource-Based Manufacturing: Other	7.12%	7.47%	6.44%	5.63%	5.48%
Low-Tech Manufacturing: Clothing and Footwear	5.61%	7.95%	7.97%	7.34%	7.06%
Low-Tech Manufacturing: Other Products	11.37%	16.30%	15.28%	18.99%	19.45%
Medium-Tech Manufacturing: Automotive	1.50%	2.04%	3.11%	2.61%	3.24%
Medium-Tech Manufacturing: Industrial Crafts	16.78%	9.30%	9.07%	8.68%	9.48%
Medium-Tech Manufacturing: Engineering	13.85%	17.03%	18.87%	19.94%	19.72%
High-Tech Manufacturing: Electronics and Electrical	31.10%	22.36%	22.46%	20.38%	18.83%
High-Tech Manufacturing: Other	2.13%	5.74%	2.70%	2.12%	3.13%
Unclassified Products	0.74%	0.07%	0.10%	1.41%	1.50%

As shown in Table 3, Thailand's export trade structure to China is analyzed using the same sample period for comparison. The data reveals that from 2005 to 2021, Thailand's exports to China were primarily composed of primary products. Meanwhile, high-tech manufacturing: electronics and electrical dropped significantly from 37.14% of total exports in 2005 to around 10% in 2021. China's rapid industrial upgrading and trade policy reforms are the primary cause of this drop. These measures have drawn large amounts of foreign investment into the Chinese market, which has fueled technological improvements and the accumulation of both human and physical capital. Thailand, on the other hand, has been heavily reliant on Japanese financial inflows and American and Japanese companies. Thailand's technological development has been comparatively sluggish because of its heavy reliance on foreign investment and technology. Although Thailand's resource-based manufacturing exports to China have been trending upward, there is still a sizable difference in the two nations' ability to compete internationally for capital goods (Zhu and Jiao, 2022).

Table 3. Development of Thailand's export trade product structure to China.

Year	2005	2010	2015	2020	2021
Primary Products	24.54%	19.47%	23.19%	22.20%	20.77%
Resource-Based Manufacturing: Agricultural	6.13%	10.68%	12.99%	17.98%	17.14%
Resource-Based Manufacturing: Other	5.52%	12.01%	12.01%	9.54%	12.16%
Low-Tech Manufacturing: Clothing and Footwear	2.09%	1.71%	1.87%	2.03%	1.96%
Low-Tech Manufacturing: Other Products	3.68%	1.38%	2.66%	2.49%	2.55%
Medium-Tech Manufacturing: Automotive	0.72%	0.33%	1.56%	5.88%	3.99%
Medium-Tech Manufacturing: Industrial Crafts	13.68%	14.13%	15.47%	13.27%	17.42%
Medium-Tech Manufacturing: Engineering	5.40%	7.39%	9.44%	9.72%	9.13%
High-Tech Manufacturing: Electronics and Electrical	37.14%	31.88%	16.10%	13.34%	11.41%
High-Tech Manufacturing: Other	0.65%	1.00%	4.70%	3.54%	3.22%
Unclassified Products	0.45%	0.02%	0.01%	0.01%	0.26%

3. Analysis of the Structure and Conditions of China-Thailand Bilateral Trade

This study uses the Trade Complementarity Index, Trade Competition and Complementarity Index, Competitive Pressure Index, and Intra-Industry Trade Index to reflect the structure of China-Thailand bilateral trade. The data source is the United Nations database.

3.1. An Empirical Analysis of the Structure of China-Thailand Bilateral Trade

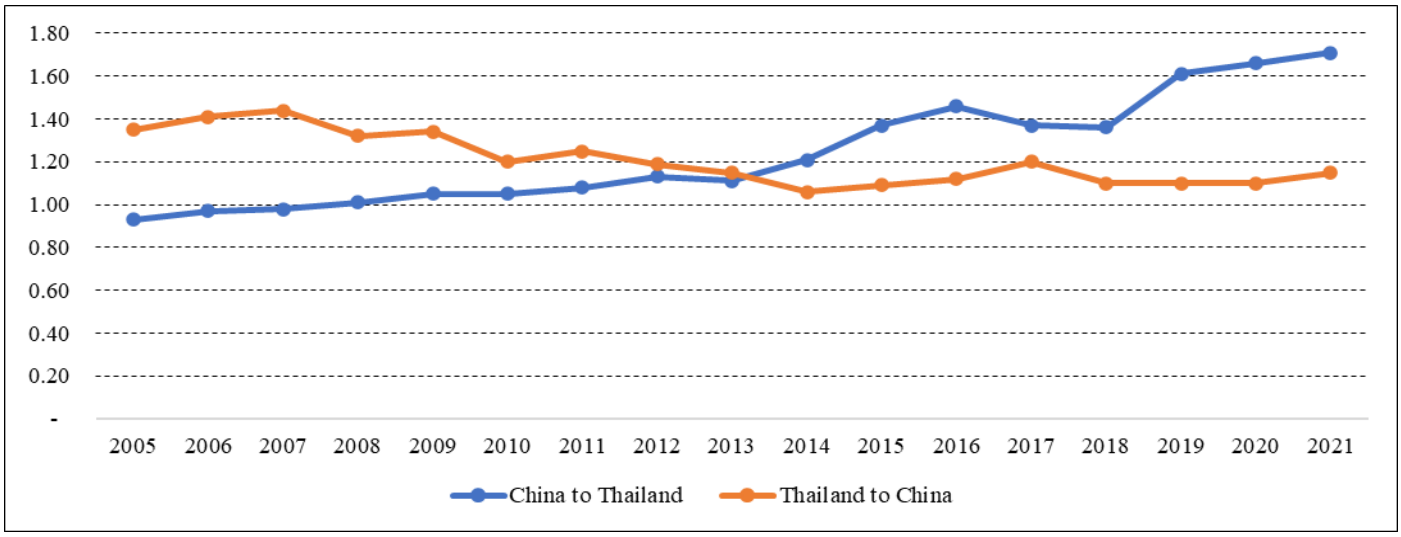
3.1.1. Reflecting the Bilateral Trade Structure using the Trade Integration Index

The Trade Integration Index reflects the degree of interdependence between the two countries in trade and its changes. It is defined as the ratio of a country or region's export share to a specific trade partner to that trade partner's share in the global import market. The formula is as follows:

$$TCD_{zt}=(X_{zt}/X_z)/(M_t/M_w) \quad \textbf{(1)}$$

In equation (1), z represents China, and t represents Thailand. X_{zt} refers to China's total exports of all products to Thailand. X_z refers to China's total exports of all products to the world. M_t refers to Thailand's total imports of all products from the world. M_w represents the total global imports of all products. With 1 as the benchmark, a higher value indicates a closer trade relationship between the two countries in international trade, while a lower value suggests a weaker trade connection.

As shown in Fig. 2, from China's perspective, the Trade Integration Index reflects China's dependence on the Thai market for its exports. Conversely, Thailand's Trade Integration Index with China represents China's dependence on importing Thai goods. The former is referred to as China's Export Trade Integration Index, while the latter is China's Import Trade Integration Index. China's Import Trade Integration Index was continuously higher than its Export Trade Integration Index prior to 2013, as shown in Fig. 2. Thailand posted a $10.79 billion trade imbalance with China in 2013, an increase of 1.4%, according to Thai Customs statistics. Thailand's largest trading partner is now China, which surpassed Japan to become the country's largest export market and second-largest import market. China's Export Trade Integration Index with Thailand showed a varying upward trend from 2005 to 2021, demonstrating an overall increase in China's reliance on the Thai market for its goods. In contrast, there has been a varying negative trend in China's Import Trade Integration Index with Thailand. Since 2019, the disparity between the two indices has kept growing.



Data Source: Calculated and compiled based on the United Nations Database (various years).

Fig 2. China-Thailand Bilateral Trade Integration Index.

This tendency was caused by a number of important factors:

- Thailand's main export commodities to China, including plastic, rubber, and electromechanical products, saw a decline in demand as a result of China's rapid economic expansion and structural transformation.
- The impact of the COVID-19 pandemic, where the outbreak was successfully contained by China's prompt governmental response. Chinese industries swiftly restarted output despite the global economic downturn, boosting China's export share. Thailand's widening trade deficit with China was largely caused by this.

China and Thailand have a robust trade relationship is clear from the analysis above. However, Thailand's reliance on Chinese goods has been expanding at a quicker rate than China's reliance on Thai imports.

3.1.2. Reflecting the Bilateral Trade Structure Using the Trade Competition-Complementarity Index and the Competitive Pressure Index.

This paper follows the methodology of Xie and Lai (2011) and builds upon LALL's (2000) classification based on the three-digit SITC (Rev. 3) standard. It adopts the Trade Competition-Complementarity Index and Competitive Pressure Index as defined by Fan *et al.* (2006) to measure the bilateral trade structure between China and Thailand. The formulas are as follows:

$$CCI_{zti} = 2\sum min\,(X_{ci}, X_{ti}) / \sum (X_{ci} + X_{ti}) \quad \textbf{(2)}$$

$$CSI_{zti} = \sum min\,(X_{ci}, X_{ti}) / \sum (X_{ti}) \quad \textbf{(3)}$$

In Equation (2), CCI_{zti} represents the Trade Competition-Complementarity Index between country *z* and country *t* for product category *i*. It refers to the set of all sub-products under category *i*, which, in this study, consists of 260 types of goods classified under the three-digit SITC (Rev. 3) system or product categories divided by technological levels according to LALL's classification standard. The index value falls within the range of [0,1], where a value closer to 0 indicates lower competition and higher complementarity in the selected product category, while a value closer to 1 signifies greater competition and weaker complementarity.

There is an inherent imbalance in the competitive pressure between China and Thailand as a result of their significant trade volume difference. In order to further evaluate the bilateral trade structure, this study additionally uses the Competitive Pressure Index (Equation 3) in addition to the Trade Competition-Complementarity Index. The Competitive Pressure Index for product category *i* between countries *z* and *t* is denoted as CSI_{zti}. A number nearer 1 indicates that country *z* puts more competitive pressure on country *t* in product category *i*, and vice versa. Its value range is [0,1].

As shown in Table 4, China and Thailand exhibit high competition and weak complementarity in PP primary products and RB1 agricultural resource-based products, such as processed wood, railway sleepers, and rubber materials (latex, sheets, and blocks); and MT1 transport equipment including motorcycles, commercial and passenger transport vehicles, and related parts. Although there is the highest complementarity among all product categories, competition is the weakest in LT1 textile products, such as fabrics, bags, leather goods, and clothing accessories. Additionally, there has been less rivalry in this area and more complementarity between 2005 and 2021. For low-tech (LT), medium-tech (MT), and high-tech (HT) products, including MT3 engineering machinery (*e.g.*, electrical circuit devices, industrial machine tools, and internal combustion engines) and HT2 high-tech products (such as precision instruments, aerospace equipment, and machine parts from groups 751 and 752), the index values are close to 0, indicating significantly lower competition and higher complementarity. Additionally, the downward trend in these values over time suggests a growing complementarity between China and Thailand in these product categories.

Table 4. Trade Competition-Complementarity Index for various product categories between China and Thailand.

Year	2005	2008	2011	2014	2017	2020	2021
PP	0.551	0.615	0.658	0.492	0.517	0.494	0.502
MP	0.233	0.201	0.195	0.165	0.177	0.154	0.140
RB	0.451	0.483	0.524	0.435	0.447	0.455	0.395
RB1	0.586	0.600	0.638	0.540	0.583	0.590	0.582
RB2	0.341	0.408	0.437	0.359	0.338	0.357	0.266
LT	0.136	0.112	0.103	0.074	0.079	0.069	0.064
LT1	0.109	0.075	0.063	0.049	0.049	0.050	0.050
LT2	0.172	0.152	0.148	0.099	0.107	0.084	0.074
MT	0.320	0.250	0.255	0.251	0.263	0.218	0.201
MT1	0.725	0.646	0.591	0.637	0.647	0.502	0.409
MT2	0.297	0.202	0.259	0.214	0.224	0.215	0.204
MT3	0.255	0.193	0.191	0.186	0.192	0.161	0.15
HT	0.198	0.151	0.124	0.106	0.115	0.099	0.084
HT1	0.2	0.154	0.125	0.104	0.111	0.094	0.083
HT2	0.178	0.130	0.117	0.117	0.149	0.144	0.093

Regarding mutual competitive pressure, China has an overwhelming absolute competitive advantage over Thailand across various product categories. During the sample period, all data for China's competitive pressure index remained nearly at one. In contrast, Thailand's competitive pressure index against China has been steadily declining. The substantial export scale difference between China and Thailand-China has more economies of scale in the global market-is one of the main causes. Nonetheless, Thailand continues to impose comparatively greater competitive pressure on agricultural resource products (RB1), including rubber materials (latex, sheets, blocks, *etc.*), processed wood, and railroad sleepers. As well as in transportation equipment (MT1), including motorcycles, commercial vehicles, passenger transport vehicles, and related components. This is mainly due to Thailand's tropical monsoon climate, which enables the large-scale production of rubber and other wood materials. However, Thailand has seen decreased competition in the transportation equipment (MT1) market in recent years. There are two primary reasons for this. First, the pandemic-induced drop in industry productivity and second, the increase in labor expenses brought on by Thailand's recent economic growth. Because of this, Thailand has found it difficult to keep a significant competitive edge in labor-intensive industries while exporting to China.

3.1.3. Reflecting Bilateral Trade Structure with the Intra-Industry Trade Index

The interchange of unique items within the same industry between two trade partners is known as the Intra-Industry Trade Index (IIT). According to statistics, it shows how both nations simultaneously import and export goods from the same industry, demonstrating the complementarity of demand for bilateral trade. The higher the classification level, the more convincing the intra-industry trade index. In this study, the SITC Rev.3 three-digit classification is adopted. The formula is as follows:

$$IIT_i = （1 - \backslash X_i - M_i \backslash / X_i + M_i ） * 100\% \quad \textbf{(4)}$$

Equation 4 indicates that the IIT value falls between 0 and 1. A value nearer 1 denotes a greater level of intra-industry commerce, whilst a value of 0 implies no intra-industry trade between the two trading partners. Table 5 illustrates how the intra-industry trade index for primary products (PP) between China and Thailand increased and then decreased between 2005 and 2021. The intra-industry trade level peaked between 2015 and 2016. The intra-industry trade level for manufactured products (MP) was generally higher than that of primary products (PP) during the sample period, reaching a fully integrated intra-industry trade level in 2014. The most significant contributors were resource-based products (RB2), textile products (LT1), and other low-tech products (LT2). The intra-industry trade index for RB2 followed a U-shaped pattern, first declining and then rising while maintaining a generally high level. In contrast, the intra-industry trade index for LT1 and LT2 showed a declining trend over time. For transportation products (MT1), intra-industry trade dropped to its lowest point between 2005 and 2015, but in the first and last ten years of the sample period, it maintained a relatively high level.

Table 5. Intra-Industry Trade Index for Various Product Categories between China and Thailand.

Year	2005	2008	2011	2014	2017	2020	2021
PP	0.41	0.49	0.38	0.57	0.64	0.65	0.54
MP	0.76	0.79	0.86	1.00	0.99	0.93	0.87
RB	0.69	0.70	0.66	0.65	0.63	0.81	0.86
RB1	0.50	0.65	0.59	0.59	0.50	0.66	0.76
RB2	0.85	0.74	0.74	0.69	0.82	0.91	1.00
LT	0.75	0.51	0.45	0.49	0.45	0.33	0.34
LT1	0.84	0.62	0.49	0.41	0.43	0.37	0.38
LT2	0.65	0.43	0.43	0.54	0.47	0.31	0.32
MT	0.94	0.89	0.97	0.83	0.82	0.79	0.69
MT1	0.53	0.27	0.41	0.36	1.00	0.78	0.98
MT2	0.86	0.99	0.81	0.94	0.95	0.98	0.86
MT3	0.94	0.79	0.76	0.64	0.68	0.54	0.48
HT	0.57	0.52	0.64	0.82	0.84	0.78	0.82
HT1	0.53	0.44	0.55	0.75	0.82	0.76	0.75
HT2	0.45	0.38	0.46	0.75	0.94	0.96	0.61

3.2. An Empirical Analysis of the Bilateral Terms of Trade between China and Thailand

Generally speaking, terms of trade refer to price terms of trade, but this study includes both price terms of trade and income terms of trade to better reflect changes in a country's welfare level. The following sections will use these two indicators to analyze

the bilateral terms of trade between China and Thailand. Terms of trade are the conditions under which a country exchanges its export goods for imported goods, representing the ratio of exchange in international trade.

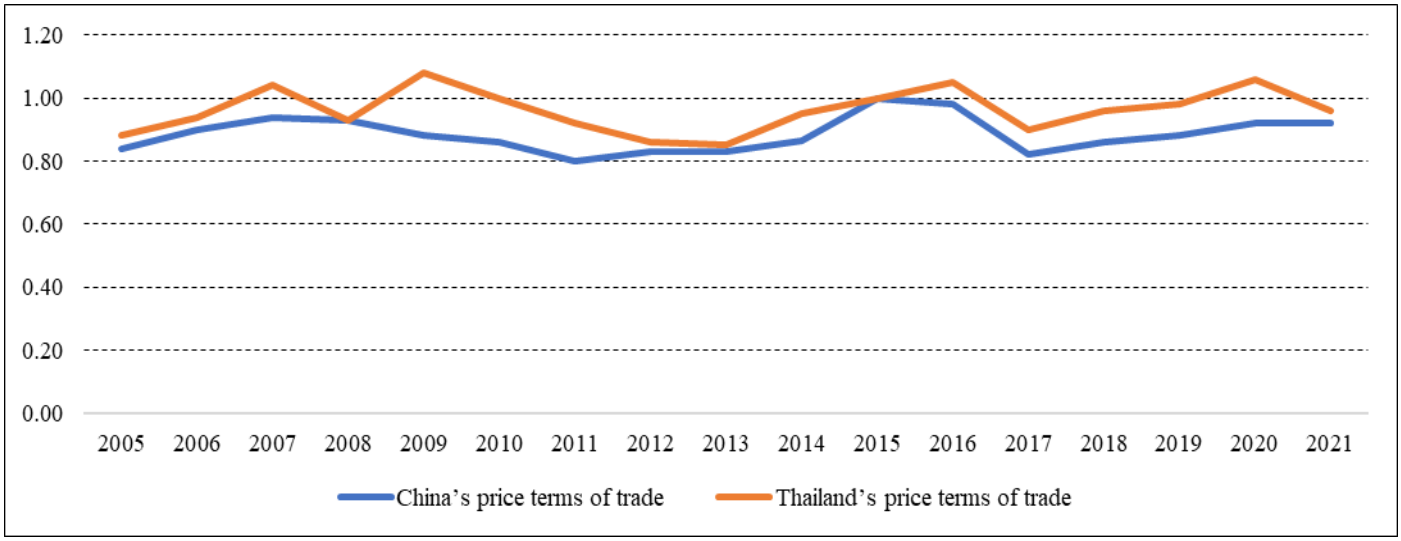
3.2.1. Price Terms of Trade Status (NBTT)

The following is the calculating formula:

$$NBTT_i = {}^{P_{xi}}/_{P_{mi}} \quad \textbf{(5)}$$

In bilateral trade between China and Thailand, the pricing terms of trade index for the i^{th} product category is represented by $NBTT_i$. The export price index and import price index of the i^{th} product category are indicated by P_{xi} and P_{mi}, respectively. The number of imported items that can be traded for one unit of exported goods is indicated by this index, which shows the relative change in export prices relative to import prices. If, during the sample period, the quantity of imported goods exchanged per unit of exported goods increases or decreases compared to the base period, it is considered an improvement or deterioration in the terms of trade. In this study, the year 2015 is used as the base period.

In bilateral trade, since one party's imports are equivalent to the other party's exports, the price terms of trade index for one party is the reciprocal of the other. Moreover, an improvement in one party's price terms of trade inevitably leads to the deterioration of the other (Wu and Chen, 2011). All things considered, China's price terms of trade exhibit a varying rising trend, peaking in 2015 (Fig. 3). China's trade terms index, however, continued to lag behind Thailand's for the course of the sample period. China's pricing terms of trade index, using 2015 as the base date, was continuously below 1, which indicates that it received less than one unit of goods in return for each unit it exported.This indicates a continuous deterioration in China's trade terms. In contrast, Thailand's trade terms index was closer to 1, and in certain years, such as 2007, 2009-2010, 2016-2017, and 2020, it even exceeded 1, signifying an improvement in trade conditions compared to the base period.



Data source: Calculated and plotted based on the United Nations Database (various years).

Fig. 3. Sino-Thai Bilateral Price Terms of Trade conditions.

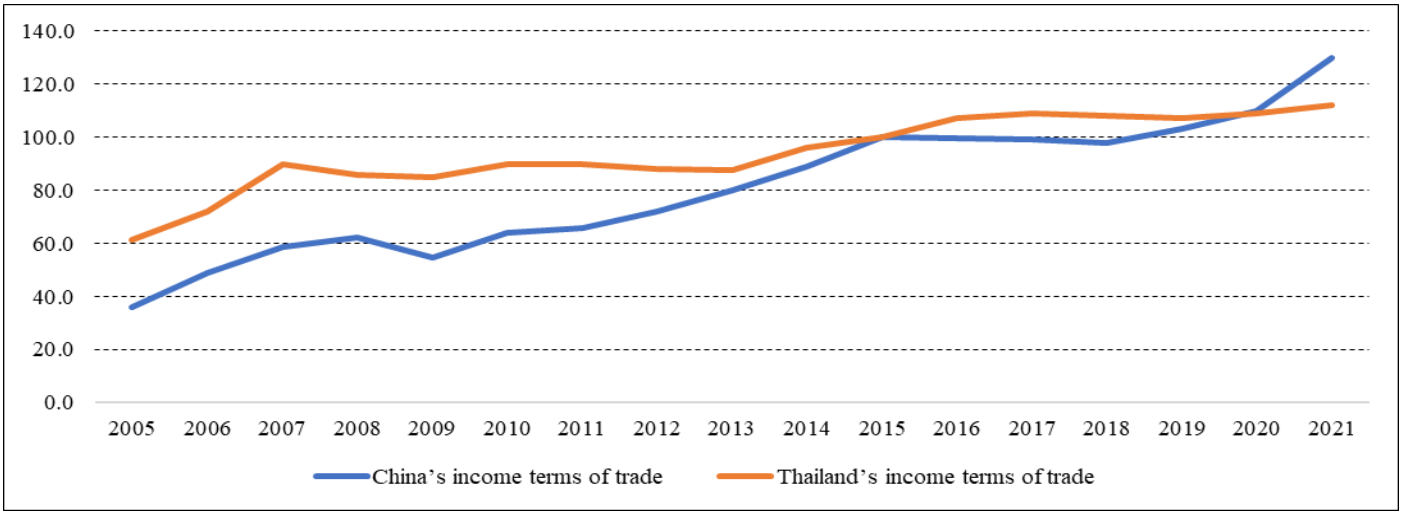
3.2.2. Conditions of the Income Terms of Trade (ITT)

The following is the calculation formula (Equation 6) for the Income Terms of Trade:

$$ITT_i = NBTT_i * QX_i \quad \textbf{(6)}$$

And the export quantity index is denoted by QX_i. The income terms of trade index is calculated by multiplying the export quantity index by the price terms of trade index. This index reflects the impact of trade on national welfare levels-an increase in the index indicates an improvement in national welfare, while a decrease signifies a decline. The revenue terms of trade between Thailand and China are shown in Fig. 4. Both nations' income terms of trade significantly improved during the sample period, as

seen in Fig. 4, suggesting that bilateral trade raised their welfare levels. However, China's income terms of trade index grew at a significantly faster rate than Thailand's, achieving a notable surpassing of Thailand in 2020. This was mainly due to China's rapid growth in trade volume and its swift response to major unexpected events. On the other hand, the global economic slowdown brought on by the financial crisis in 2008 led both nations' income terms of trade indexes to temporarily decrease. But China was less hit by the crisis than Thailand, which is why, after 2008, China's income terms of trade index grew at a substantially faster rate than Thailand's.



Data source: Calculated and plotted based on the United Nations Database (various years).

Fig. 4. Sino-Thai Bilateral Price Terms of Trade conditions.

4. An Empirical Analysis of the Relationship Between China-Thailand Bilateral Trade Structure and Trade Terms

4.1. Selection of Variables, Model, and Data Sources

This paper distinguishes trade conditions into price trade conditions and income trade conditions as explanatory variables. The raw data used for calculations are sourced from the United Nations database and UN COMTRADE. The selected explanatory variable is primarily trade structure, measured using the trade dependence index.The exchange rate, foreign direct investment (FDI), level of openness, and the difference in Thailand's and China's yearly per capita GDP growth rates are the control variables.

Changes in revenue and import-export commerce are impacted by exchange rate swings. While depreciation has the reverse impact, currency appreciation might help the balance of payments but is harmful to exporters. Trade conditions-one of the dependent variables chosen for this study-deteriorate as a result of currency depreciation, which is defined as an increase in the value of imported goods and a decrease in the price of exported goods. The degree of openness affects not only FDI but also tariffs, quotas, and other trade-related factors, influencing both trade structure and trade conditions. The difference in per capita GDP growth between China and Thailand indicates whether the development gap between the two countries is widening or narrowing. Foreign direct investment affects a country's technological level and capital flow, changing its comparative advantages and the structure of import-export goods, thereby impacting trade conditions. Per capita GDP affects consumption demand and levels, thereby influencing the structure of imports and exports. Changes in product structure, in turn, lead to corresponding changes in trade conditions. These are the reasons for selecting exchange rate, FDI, openness, and the per capita GDP growth rate difference as control variables.

4.2. Unit Root Test

The unit root test is used to find out if a time series has a unit root. The series is categorized as a non-stationary time series if a unit root is present. In regression analysis, non-stationarity may result in erroneous regression. Table 6 presents the test results obtained using Eviews10. The results indicate that after performing unit root tests on multiple time series from 2005 to 2021, including China's Price Terms of Trade Index, Thailand's Price Terms of Trade Index, and China's Income Terms of Trade Index, only China's Price Terms of Trade Index, Trade Competition Complementary Index, Competitive Pressure Index, Foreign Direct Investment Inflows, and the Real GDP Per Capita Differential rejected the null hypothesis at the original series level. Because the

ADF test values (T-test values) for these variables were less than the crucial values at the significance levels, it was determined that they were stationary within the 5% and 1% confidence intervals.

In order to reject the null hypothesis with a P-value < 0.05, Thailand's Price Terms of Trade Index and Thailand's Income Terms of Trade Index needed first-order logarithmic differencing, proving that they are first-order integrated (I(1)). At the same time, China's Export Openness Index and its Income Terms of Trade Index were second-order integrated (I(2)), requiring second-order logarithmic differencing to reject the null hypothesis at the 1% significance level.

Only the original series of China's Price Terms of Trade Index, Trade Competition Complementary Index, Competitive Pressure Index, Foreign Direct Investment Inflows, and Real GDP Per Capita Differential appear to be stationary, according to these findings. When dealing with multiple non-stationary time series, the presence of a cointegration relationship among the variables determines whether a regression model can be established; if not, spurious regression may occur, which means that similar trends in their time series data may result in a high R-squared value, giving the false impression that the regression relationship is statistically significant. To address this problem, a cointegration test will be performed in the next section.

Table 6. Statistical characteristics of Unit Root for variables.

Variables	Exogenous Variables	Coefficient	T-test value	P-value
China's Price Terms of Trade Index	Constant$^{\#}$	-3.0810**	-3.5289	0.0222
Thailand's Price Terms of Trade Index	Constant, Trend$^{\#\#}$	-3.7597**	-4.2081	0.0238
China's Income Terms of Trade Index	Constant, Trend$^{\#\#\#}$	-4.8000*	-5.1317	0.0060
Thailand's Income Terms of Trade Index	Constant, Trend$^{\#\#}$	-4.8000*	-6.1209	0.0013

Note: *, **, and *** indicate significance levels of 1%, 5%, and 10%, respectively; #, ##, and ### represent the original series, log first-order difference, and log second-order difference, respectively.

4.3. Cointegration Test

The unit root test on the original series may indicate non-stationarity; however, their linear combination may exhibit a stable equilibrium relationship. Therefore, this section conducts a cointegration test on the aforementioned non-stationary series. Since Eviews10 supports a maximum of four variables in the cointegration test, this study conducts three sets of cointegration tests. The dependent variable, China's income terms of trade index, is paired separately with the primary explanatory variable, trade structure measured by the trade dependence index, while the control variables include the exchange rate, foreign direct investment, degree of openness, and the annual average growth rate difference in per capita GDP.

As shown in Table 7, Variable 1 represents the cointegration test conducted using the China Income Terms of Trade Index, China-Thailand Trade Integration Index, Thailand Export Openness, and Foreign Direct Investment (FDI) inflows. Variable 2 includes the China Income Terms of Trade Index, China-Thailand Trade Integration Index, China Export Openness, and the GDP growth rate differential as variables for cointegration testing. Variable 3 consists of the China Income Terms of Trade Index, China-Thailand Trade Integration Index, China Export Openness, and the China-Thailand exchange rate based on the direct quotation method using the Chinese yuan. In each group of variables, the China Income Terms of Trade Index was selected as the dependent variable in the multivariate regression, representing trade conditions.

According to the findings, the trace statistic (30.99) for Variable 1 is higher than the 5% critical value (29.80), demonstrating the presence of a cointegration relationship and rejecting the null hypothesis when there is only one cointegration relationship. The null hypothesis is rejected and the existence of a cointegration relationship is confirmed for Variable 2, whose P-value is 0.03, which is less than 0.05 and indicates that there are no more than three cointegration relationships. In a similar vein, Variable 3's P-value of 0.01-less than 0.05-rejects the null hypothesis and confirms the existence of a cointegration relationship when there is only one cointegration relationship.

Based on these results, in the next study, the China Income Terms of Trade Index will be used as the dependent variable, while the China-Thailand Trade Dependence Index will serve as the main explanatory variable. The GDP Growth Rate Differential (GDPD), Thailand's Import Openness (EXOPT), China's Import Openness (EXOPZ), Foreign Direct Investment Inflows (FDIM), and the China-Thailand exchange rate (HLZ) utilizing the direct quotation method with the Chinese yuan will all be considered control variables. The multivariate regression analysis will incorporate these factors.

Table 7. Cointegration test results.

Variable1	Trace Statistic	Critical Value	P-Value

At most zero cointegration relationships exist	85.65	47.86	0.00
At most one cointegration relationship exist.	30.99	29.80	0.04
At most two cointegration relationships exist	8.24	15.49	0.44
At most three cointegration relationships exist	0.36	3.84	0.55
Variable2			
At most zero cointegration relationships exist	70.69	47.86	0.00
At most one cointegration relationship exist	29.90	29.80	0.05
At most two cointegration relationships exist	11.81	15.49	0.17
At most three cointegration relationships exist	4.88	3.84	0.03
Variable3			
At most zero cointegration relationships exist	68.06	47.86	0.00
At most one cointegration relationship exist	34.74	29.80	0.01
At most two cointegration relationships exist	12.11	15.49	0.15
At most three cointegration relationships exist	1.75	3.84	0.19

4.4. Multiple Regression

The dependent variable in this section is the China Income Terms of Trade Index (SRZ). The main explanatory variable for trade structure is the China-Thailand Trade Integration Index (JHDZT). Furthermore, the following are included as control variables for multiple regression analysis: foreign direct investment inflows to China (FDIM), China's import openness (EXOPZ), Thailand's import openness (EXOPT), the exchange rate (HLZ, the China-Thailand exchange rate quoted directly in RMB), and the China-Thailand per capita real GDP growth rate difference (GDPD). Equation 7 is the regression formula:

$$SRZ = C_0 + C_1 JHDZT + C_2 HLZ + C_3 FDIM + C_4 EXOPT + C_5 EXOPZ + C_6 GDPD + \varepsilon \quad \textbf{(7)}$$

The regression findings, as displayed in Table 8, demonstrate that the corrected R-squared is near 1, indicating a good degree of model fit. With a corresponding p-value of 0.0000 and an F-statistic of 77.8992, both are below the significance level of 0.05. Therefore, the null hypothesis is rejected, suggesting that the overall significance of the established analytical model is strong and the analysis results are reliable.

The analysis results show that the t-statistic of the variable JHDZT (China-Thailand trade integration index) is 4.4986, with a p-value of 0.0011, which is less than the 5% significance level. As a result, the null hypothesis is rejected, suggesting that this component significantly affects China's income terms of trade index. Furthermore, as expected, China's income terms of trade index is positively impacted by HLZ (the China-Thailand exchange rate using RMB as the direct quotation currency), FDIM (China's utilized foreign direct investment from Thailand), China-Thailand export openness, and the average annual GDP growth rate differential between China and Thailand.

The results demonstrate that China's trade integration index with Thailand has a highly significant impact on China's income terms of trade. Specifically, a one-unit change in the trade structure, as represented by the trade integration index, leads to a 48.4745-fold change in the same direction in China's income terms of trade index. Similarly, all explanatory and control variables have a positive effect on China's income terms of trade.

Table 8. Multiple regression results of the China Income Terms of Trade Index.

Variables	Coefficient	t-Statistic	P-Value
Constant	-62.7634	-2.2668	0.0468
China-Thailand Trade Integration Index	48.4745	4.4986	0.0011
Thailand Export Openness	34.0532	0.5419	0.5997
China Export Openness	15.5140	2.6064	0.0262
Foreign Direct Investment Inflow	3.4007	0.0268	0.9792
Annual Average Real GDP Growth Rate Differential	0.0712	0.1148	0.9109
China Exchange Rate	8.5599	1.9364	0.0816
R^2		0.9791	
Adjusted R^2		0.9665	
F-test value		77.8992	
P-value (F-test value)		0.0000	

5. Policy Recommendations for the Coordinated Development of China-Thailand Bilateral Trade

5.1. Jointly Build a Free Trade Zone and Improve Infrastructure

Deeper collaboration between China and Thailand has been strongly supported by the Belt and Road Initiative plan. However, both nations should increase their degree of trade liberalization and openness as economic globalization continues to progress. They should cooperate to boost bilateral investment, enhance infrastructure development, and create a free trade zone.

5.2. Explore New Areas of Cooperation and Optimize Industrial Structure

There are significant commercial complementarities between Thailand and China. In order to improve industrial added value and lower the trade deficit, Thailand should increase its investments in the agriculture sector, where it has a comparative advantage. However, by exporting high-end manufacturing products to Thailand that are part of the global value chain, enhancing product quality, and bolstering the sustainability and complementarity of China-Thailand manufacturing trade, China should expedite the modernization and transformation of its eastern manufacturing sector (Zhu and Jiao, 2022).

Furthermore, China and Thailand should enhance bilateral cooperation in complementary economic industries, establish a collaborative industrial chain, and shift away from an extensive expansion model that relies solely on the import of primary resources. For instance, given China's significant imports of Thai rubber, China could "go global" by participating in Thailand's deep-processing rubber industry and related manufacturing investments to increase added value (Wang, 2011).

5.3. Leverage Resource Endowment Advantages and Deepen Complementary Trade Cooperation Potential

By utilizing the competitive and complementary qualities of their domestic businesses, both nations should optimize their respective resource endowment advantages. Future trade and economic cooperation should aggressively encourage cooperation on products where Thailand has a strong competitive advantage and where both nations exhibit complementary characteristics in order to allay Thailand's worries about the possible economic and industrial impact of Sino-Thai bilateral trade.For instance, China could increase imports of Thailand's sugar and sugar products, malt, and starch (Zheng, 2016).

5.4. Improve Government Intervention Mechanisms

Government macroeconomic regulation plays a crucial role in economic development. The extent of government intervention in the economy should be carefully controlled to minimize negative impacts. For example, China and Thailand should establish an efficient and scientific communication mechanism at the policy level to enhance business exchanges and reduce information asymmetry. Additionally, both nations should emphasize collaboration in legal and regulatory frameworks, optimizing the legal environment, improving legislative and regulatory systems, and fostering the long-term development of bilateral trade (Monchanok, 2020).

6. Conclusion

First, Thailand has had a trade deficit for a long time, and it has been growing steadily, according to an examination of the size and growth rate of Sino-Thai bilateral commerce as well as the product structure categorized by SITC three-digit categories. Thailand has been expanding its exports to and imports from China, although the growth rate has been very erratic. Moreover, Thailand mainly imports high-tech Chinese industrial products, whereas its exports to China consist of lower-value-added products. Secondly, the measurement of the trade complementarity index between China and Thailand indicates a strong trade complementarity between the two countries (Wang, 2021). Finally, based on the calculation of the trade competition-complementarity index, this study examines the impact of trade structure on trade conditions by using China's income terms of trade index as a proxy for trade conditions and China's trade integration index with Thailand as a proxy for trade structure. The trade integration index is the primary explanatory variable in the multiple regression analysis, while the income terms of trade index is the dependent variable. The exchange rate between China and Thailand, foreign direct investment inflows into China, the openness of China's and Thailand's exports, and the difference in the per capita GDP growth rate between the two nations are also included as control variables. The findings indicate that China's income terms of trade are significantly impacted by the trade integration index. In particular, China's income terms of trade index increases 48.4745 times for every unit change in the trade integration index. Similarly, all explanatory and control variables have a positive impact on China's income terms of trade.

Therefore, improving bilateral trade conditions can be achieved by adjusting the trade structure while taking into account the effects of exchange rates, foreign direct investment inflows, and export openness in both countries, as well as the GDP growth rate differential.

Funding: This research received no external funding.

Data Availability Statement: The data come from the United Nations database and UN COMTRADE (https://unctadstat.unctad.org/datacentre/).

Conflicts of Interest: The author declares no conflict of interest.

References

1. Di, Q. (2017). *A study on the evaluation of China and Thailand bilateral trade development* (Master's thesis). Yunnan University of Finance and Economics, Kunming, China.
2. Fan, G., Chi, H. K., & Yao, Z. Z. (2006). Analyzing the foreign trade structure based on technologies of traded goods. *Economic Research Journal, 8*, 70–80.
3. Feng, F. (2015). *A study on Sino-Vietnam bilateral trade structure and terms of trade: An empirical analysis based on product technique content classification* (Master's thesis). Nanjing University, Nanjing, China.
4. Monchanok, M. (2020). *The development of trade facilitation between China and Thailand and its influence on bilateral trade* (Master's thesis). Tianjin University of Finance and Economics, Tianjin, China.
5. Wang, L. (2006). *A study on the effects of China and ASEAN trade cooperation* (Master's thesis). Nanjing Agricultural University, Nanjing, China.
6. Wang, Z. Z. (2021). *An empirical study on the influencing factors and potential of China-Thailand bilateral trade* (Master's thesis). Yunnan University of Finance and Economics, Kunming, China.
7. Wu, D. T., & Chen, P. (2011). The problem of calculating the price index of terms of trade and its solution. *International Economics and Trade Research, 27*(4), 58–62.
8. Xie, R., & Lai, M. Y. (2011). Research on Sino-Australia trade relationship based on product technique content classification. *The Frontier Research Report on the Discipline of International Trade, 5*, 42–51.
9. Zheng, G. F. (2016). Analysis of the complementarity and competitiveness of Sino-Thai bilateral trade and policy recommendations. *Foreign Economic Relations & Trade, 8*, 7–10.
10. Zhu, Q. P., & Jiao, X. S. (2022). Research on development and countermeasures of China-Thailand bilateral trade. *Foreign Economic Relations & Trade, 4*, 31–34.