EFFECTS OF MONETARY AND TRADE FREEDOM, LOGISTIC PERFORMANCE AND TRADE CREATION ON CHINA-ASEAN TRADE FLOW

By

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EFFECTS OF MONETARY AND TRADE FREEDOM, LOGISTIC PERFORMANCE AND TRADE CREATION ON CHINA-ASEAN TRADE FLOW

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July 2024

Chairman : Anitha binti Rosland, PhD
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Since 2019, ASEAN has become China's largest trade partner. China's trade intensity with ASEAN has been getting closer and closer, especially after the establishment of China-ASEAN free trade area (CAFTA). China-ASEAN bilateral commodity trade flows play a crucial role in promoting economic growth in China and in ASEAN countries. Thus, it is of great significance to study China's bilateral commodity trade flows with ASEAN. The first objective examines the role of monetary freedom and trade liberalization in promoting China-ASEAN trade flows. Based on feasible generalized least squares (FGLS) estimation and a panel data set of eight ASEAN countries in 2001-2022, it is found that ASEAN's monetary freedom and trade liberalization significantly promote China-ASEAN bilateral trade flows. The second objective analyzes the impact of logistics performance and trade facilitation improvement on China's exports and imports with ASEAN. Based on feasible generalized least squares (FGLS) estimation and a panel data set of six ASEAN countries in 2009-2019, it is found that the increase of logistics

performance and trade facilitation contributes to the trade growth of China's exports to and imports from ASEAN countries. The third objective quantifies the trade creation effect of CAFTA on China-ASEAN trade flows. By applying propensity score matching with difference-in-differences for China's trade data with ASEAN countries during 2000-2021, this research reveals that CAFTA has a significant trade creation effect on China's trade flows with ASEAN, China's exports to ASEAN and China's imports from ASEAN. The trade creation effect of CAFTA in China's imports from ASEAN is slightly larger than that in China's exports from ASEAN. In addition, it finds that the reduction of tariff rate under CAFTA significantly stimulates the trade flows between China and ASEAN countries. The empirical of this research can provide references to decision makers in both China and ASEAN to make relevant policies to reduce more trade barriers, and to promote trade flows between China and ASEAN. The trade effects value of CAFTA also provides reference value for other developing countries who do South-South trade.

Keywords: China-ASEAN trade flow, monetary freedom, trade facilitation, trade creation effect, difference-in-differences

SDG: GOAL 17: Partnerships for the Goals

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESAN KEBEBASAN MONETARI DAN PERDAGANGAN, PRESTASI LOGISTIK DAN PENCIPTAAN PERDAGANGAN TERHADAP ALIRAN PERDAGANGAN CHINA-ASEAN

Oleh

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Sejak 2019, ASEAN telah menjadi rakan perdagangan terbesar China. Intensiti perdagangan China dengan ASEAN semakin hampir, terutamanya selepas penubuhan kawasan perdagangan bebas China-ASEAN (CAFTA). Aliran perdagangan komoditi dua hala China-ASEAN memainkan peranan penting dalam menggalakkan pertumbuhan ekonomi di China dan di negara ASEAN. Oleh itu, adalah amat penting untuk mengkaji aliran perdagangan komoditi dua hala China dengan ASEAN. Objektif pertama mengkaji peranan kebebasan monetari dan liberalisasi perdagangan dalam menggalakkan aliran perdagangan China-ASEAN. Berdasarkan anggaran kuasa dua terkecil umum (FGLS) yang boleh dilaksanakan dan set data panel lapan negara ASEAN pada 2001-2022, didapati kebebasan monetari dan liberalisasi perdagangan ASEAN dengan ketara menggalakkan aliran perdagangan dua hala China-ASEAN. Objektif kedua menganalisis kesan prestasi logistik dan peningkatan kemudahan perdagangan ke atas eksport dan import China dengan ASEAN. Berdasarkan anggaran kuasa dua terkecil umum (FGLS) yang boleh dilaksanakan dan set data panel enam negara ASEAN pada 2009-2019,

didapati peningkatan prestasi logistik dan kemudahan perdagangan menyumbang kepada pertumbuhan perdagangan eksport China ke dan import dari negara ASEAN. Objektif ketiga mengukur kesan penciptaan perdagangan CAFTA ke atas aliran perdagangan China-ASEAN. Dengan menggunakan pemadanan skor kecenderungan dengan perbezaan-dalam-perbezaan untuk data perdagangan China dengan negara-negara ASEAN sepanjang 2000-2021, penyelidikan ini mendedahkan bahawa CAFTA mempunyai kesan penciptaan perdagangan yang ketara ke atas aliran perdagangan China dengan ASEAN, eksport China ke ASEAN dan import China dari ASEAN. Kesan penciptaan perdagangan CAFTA dalam import China dari ASEAN adalah lebih besar sedikit daripada eksport China dari ASEAN. Di samping itu, ia mendapati bahawa pengurangan kadar tarif di bawah CAFTA secara signifikan merangsang aliran perdagangan antara China dan negara-negara ASEAN. Empirikal penyelidikan ini boleh memberi rujukan kepada pembuat keputusan di China dan ASEAN untuk membuat dasar yang relevan untuk mengurangkan lebih banyak halangan perdagangan, dan untuk menggalakkan aliran perdagangan antara China dan ASEAN. Nilai kesan perdagangan CAFTA juga memberikan nilai rujukan untuk negara membangun lain yang melakukan perdagangan Selatan-Selatan.

Kata Kunci: Aliran perdagangan China-ASEAN, kebebasan monetari, kemudahan perdagangan, kesan penciptaan perdagangan, perbezaan dalam perbezaan

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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Date: 13 March 2025

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ASEAN	Association of Southeast Asian Nations
CAFTA	China-ASEAN free trade area
CG	China's GDP per capita
CMF	China's monetary freedom index
COML	common language
CONT	contiguity
CP	China's population
CTF	China's trade freedom index
DID	difference-in-differences
DISC	distance
EU	The European Union
FGLS	feasible generalized least squares
FTA	free trade agreement
GDP	Gross Domestic Product
LPI	logistics performance index
LPIP	logistics performance index of China's trade partners
MF	monetary freedom of China's trade partners
OLS	ordinary least squares
PSM	propensity score matching
PTA	preferential trade agreement
RMB	Renminbi, the currency of China
TC	trade costs
TF	trade freedom of China's trade partners
TFI	trade facilitation index
TFRC	China's import tariff rates on its trade partners

TFRP	trade partners' import tariff rates on China
TFS	trade facilitation index of China's trade partners
TG	trade partner's GDP per capita
IM	China's import value from its partners
TII	trade intensity index
TP	trade partner's population
TV	total bilateral trade value
EX	China's export value to its partners
US	The United States
WTO	The World Trade Organization

CHAPTER 1

INTRODUCTION

In this part, the introduction of this research is presented, including research background, research problems, research questions, research objectives, research significance, and research organization.

1.1 Background of the Study

Trade is a critical driver of economic growth, enabling nations to access larger markets, specialize in production, and leverage comparative advantages (Makki & Somwaru, 2004; Frankel & Romer, 2017; Irwin, 2024; . Through trade, countries can enhance efficiency, productivity, and innovation, contributing to overall economic development (Afonso, 2001; Ali et al., 2021). In the case of China, trade has played a pivotal role in its rapid economic rise, particularly following its accession to the World Trade Organization (WTO) in 2001 (Andersen et al., 2014). Over two decades, China's GDP expanded nearly tenfold, accompanied by a significant increase in total trade volume.

China's trade relationship with the Association of Southeast Asian Nations (ASEAN) has grown substantially, with ASEAN becoming China's largest trade partner in 2019 (General Administration of Customs of China, 2020). The establishment of the China-ASEAN Free Trade Area (CAFTA) in 2010 further accelerated bilateral trade flows. By 2022, China’s trade with ASEAN accounted for a significant share of its total trade, with strong trade intensity indicating a deepening economic relationship. Despite this growth, factors influencing these trade flows, such as monetary freedom,

trade liberalization, logistics performance, trade facilitation, and free trade agreement remain under-explored, necessitating a detailed analysis of their impacts.

1.1.1 China-ASEAN Trade and Economic Growth

Figure 1.1 illustrates the correlation between trade and economic growth in China and in eight ASEAN countries. It shows that in China and in all the eight ASEAN countries, trade and economy has an obvious increase during the past decades and there is a positive association between trade and economic growth. This supports that both in China and ASEAN, trade plays a crucial role in promoting their economic growth. Figure 1.2 shows China's total trade and China's trade with ASEAN. It can be seen that China's total trade has increased significantly over the past decades, and China-ASEAN trade value is also continuously increasing fast. China-ASEAN trade flows play a more and more important role in China's trade growth and economic growth, and are crucial to the economic growth of ASEAN.

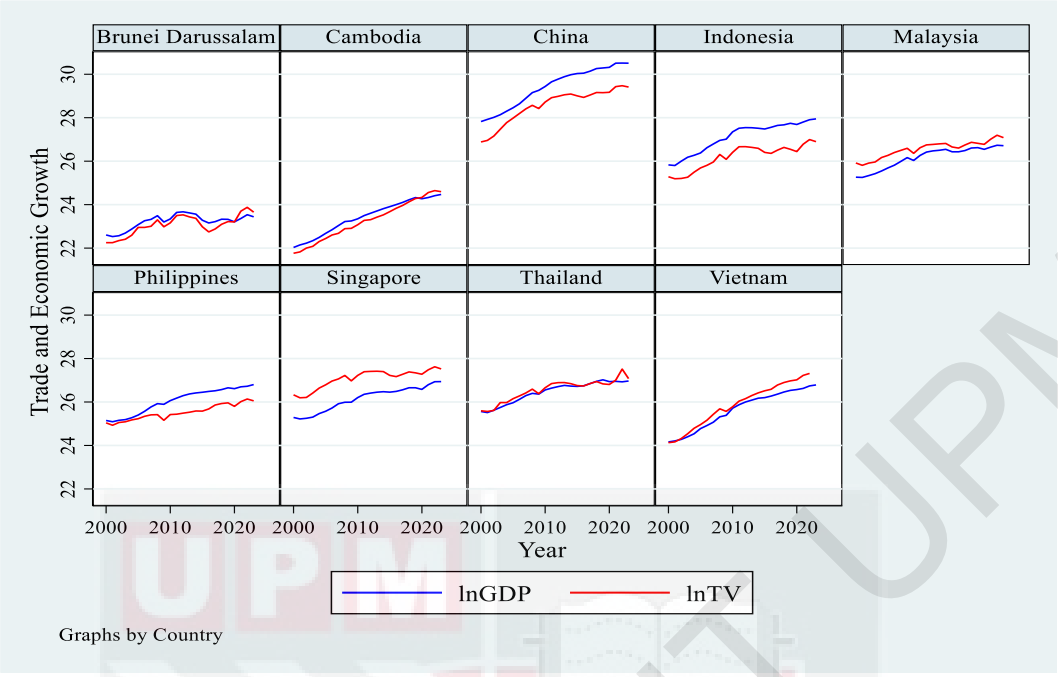

Figure 1.1 : Trade and Economic Growth of China and ASEAN
(Source: the World Bank and the UN Comtrade)

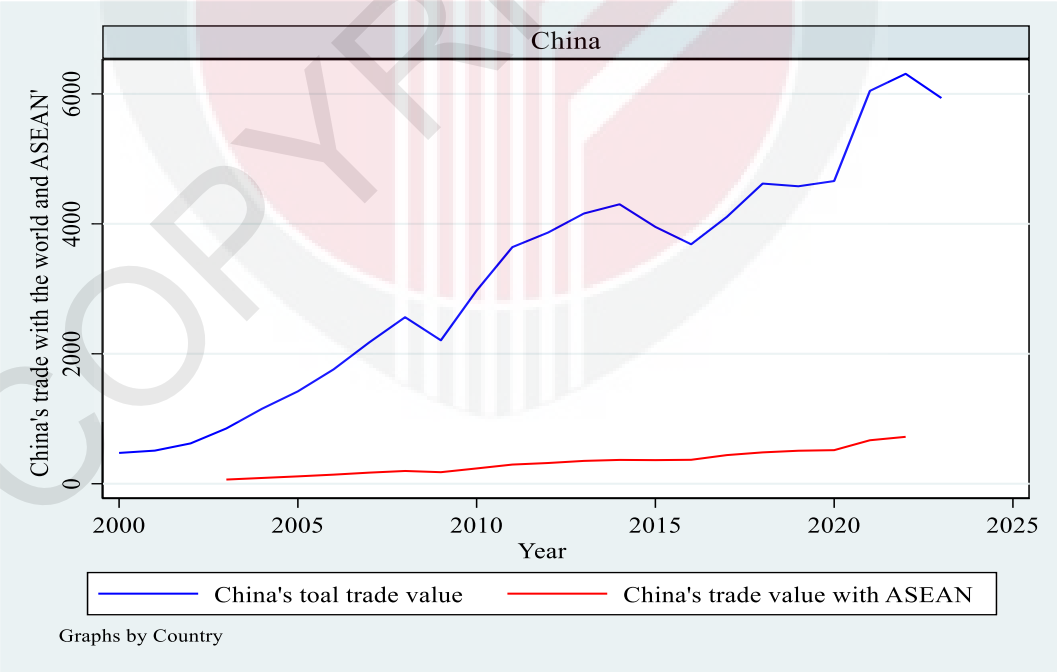

Figure 1.2 : China's total trade and China's trade with ASEAN
(Source: the UN Comtrade; unit: billion US$)

The following Figure 1.3 shows China's merchandise trade with ASEAN countries for the past twenty years. It is also clear to see that the trade flows between China and ASEAN are growing tremendously. Over the past twenty years, the average growth rate of China's exports to ASEAN is 18%. The average growth rate of China's imports from ASEAN 16% over the past twenty years. China's exports to ASEAN show a higher value than China's imports from ASEAN, indicating that China has a trade surplus with ASEAN over the decades.

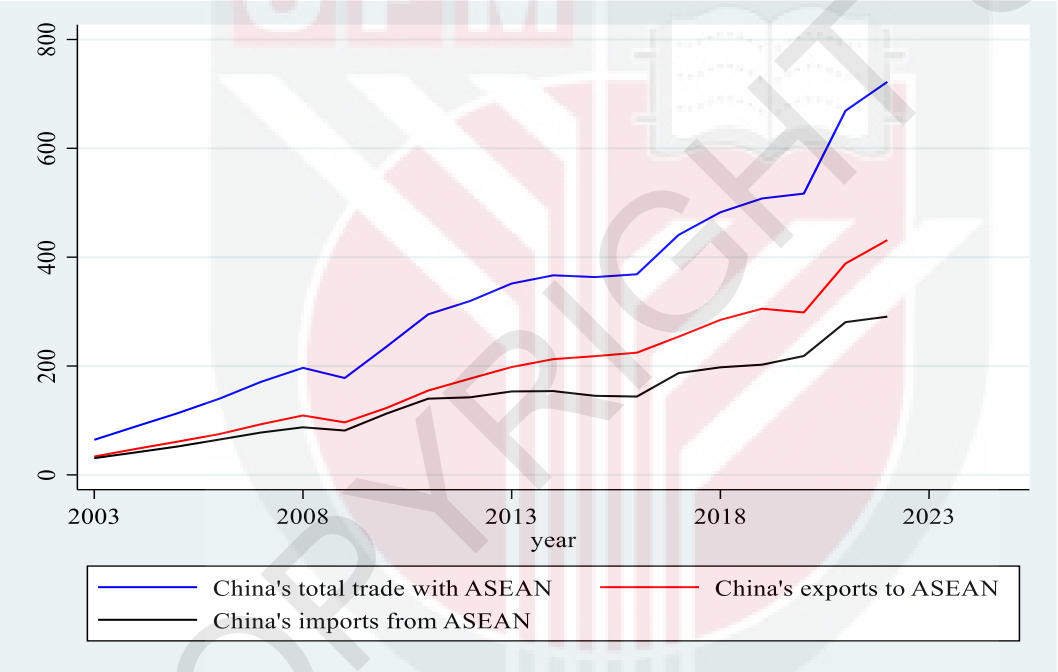

Figure 1.3 : China's Trade Flows with ASEAN
(Source: the UN Comtrade; unit: billion US$)

Table 1.1 reports China's total trade value with ASEAN countries. By 2022, the ranking of China's trade volume with ASEAN countries is Vietnam, Malaysia, Indonesia, Thailand, Singapore, Philippines, Myanmar, Cambodia and Laos. Overall, during 1998-2022, China's trade volume with all ASEAN countries has large growth.

Especially after 2010 (the establishment of CAFTA), the growth is tremendous. However, China's trade volume with Myanmar, Laos and Cambodia is still small, which still has large potentials to improve more.

Table 1.1 : China's Total Trade Value with ASEAN Countries

Year	Indonesia	Malaysia	Philippines	Thailand	Singapore	Cambodia	Laos	Myanmar	Vietnam
1998	3.63	4.27	2.03	3.67	8.18	0.16	0.03	0.58	1.25
1999	4.83	5.28	2.29	4.22	8.56	0.16	0.03	0.51	1.22
2000	7.46	8.04	3.14	6.62	10.82	0.22	0.04	0.62	2.47
2001	6.72	9.43	3.57	7.05	10.93	0.24	0.06	0.63	2.82
2002	7.93	14.27	5.26	8.56	14.03	0.28	0.06	0.86	3.26
2003	10.23	20.13	9.40	12.65	19.35	0.32	0.11	1.08	4.64
2004	13.47	26.26	13.33	17.34	26.68	0.48	0.11	1.15	6.74
2005	16.79	30.70	17.56	21.81	33.15	0.56	0.13	1.21	8.20
2006	19.06	37.11	23.41	27.73	40.86	0.73	0.22	1.46	9.95
2007	25.00	46.39	30.62	34.64	47.14	0.93	0.26	2.08	15.12
2008	31.52	53.56	28.64	41.29	52.48	1.13	0.40	2.63	19.46
2009	28.39	51.97	20.54	38.19	47.86	0.94	0.75	2.90	21.05
2010	42.75	74.25	27.76	52.94	57.08	1.44	1.09	4.44	30.09
2011	60.55	90.02	32.25	64.73	63.71	2.50	1.30	6.50	40.21
2012	66.23	94.83	36.38	69.75	69.27	2.92	1.72	6.97	50.44
2013	68.35	106.08	38.05	71.24	75.90	3.77	2.73	10.20	65.48
2014	63.54	102.01	44.46	72.62	79.74	3.76	3.62	24.97	83.64
2015	54.23	97.26	45.64	75.46	79.52	4.43	2.77	15.10	95.85
2016	53.54	86.94	47.24	75.73	70.53	4.76	2.35	12.29	98.28
2017	63.33	96.14	51.31	80.14	79.27	5.79	3.02	13.47	121.99
2018	77.34	108.58	55.65	87.51	82.76	7.38	3.47	15.23	147.83
2019	79.76	124.05	60.96	91.75	90.04	9.43	3.92	18.70	161.99
2020	78.46	131.48	61.22	98.65	89.24	9.55	3.58	18.89	192.29
2021	124.57	176.96	82.05	131.19	93.92	13.67	4.34	18.65	230.21
2022	148.53	201.56	86.49	133.77	113.06	15.78	5.62	24.78	231.82

(Source: the National Bureau of Statistics of China; unit: billion US dollar)

1.1.2 China-ASEAN Trade Intensity

In this part, this research analyzes the merchandise trade intensity between China and ASEAN, and makes a comparison of China and ASEAN's trade intensity with their trade partners. One way to measure a country's trade intensity is to calculate the trade intensity index. China's trade intensity with ASEAN and other main trade partners, and ASEAN's trade intensity with China and other main trade partners are calculated here. When the trade intensity index (TII) is smaller than 1, it shows the trade intensity between the two trading countries is low and loose. When the value is larger than 1, it means there is strong trade intensity between the two trading

countries (Ekor et al., 2015). The calculation of trade intensity is based on the data from the UNCTAD.

From Figure 1.4 and Appendix 2, it can be seen that over the past twenty years, China's merchandise trade intensity with ASEAN is strong (the index is all above 1.0) and has been increasing continuously from 1.22 in 2001 to 2.04 in 2020. In the beginning of 2000s, China's trade intensity with Japan and South Korea is stronger than that with ASEAN, but after the establishment of CAFTA in 2010, China's trade intensity with ASEAN has been growing higher than with Japan and with South Korea, and much higher than with the U.S.. After 2016, ASEAN becomes China's most trade intensive partner.

Figure 1.5 illustrates ASEAN's trade intensity with its main trade partners. It shows that ASEAN has the highest trade intensity with Japan. ASEAN's trade intensity with China is also high, just second only to with Japan. But in 2021, ASEAN's trade intensity with China is closer to ASEAN's trade intensity with Japan, with an intensity index of 1.88 and 1.92 respectively. Overall, ASEAN's trade intensity with China has been improved largely over the past years, and the intensity index has always been very strong. As a whole, ASEAN's high trade intensive partners are Japan, China, South Korea, and the U.S. The increasing merchandise trade intensity between China and ASEAN indicates that China-ASEAN bilateral trade is more and more important for the both China and ASEAN. In this following sections, the main factors which affect China-ASEAN bilateral trade flows will be introduced.

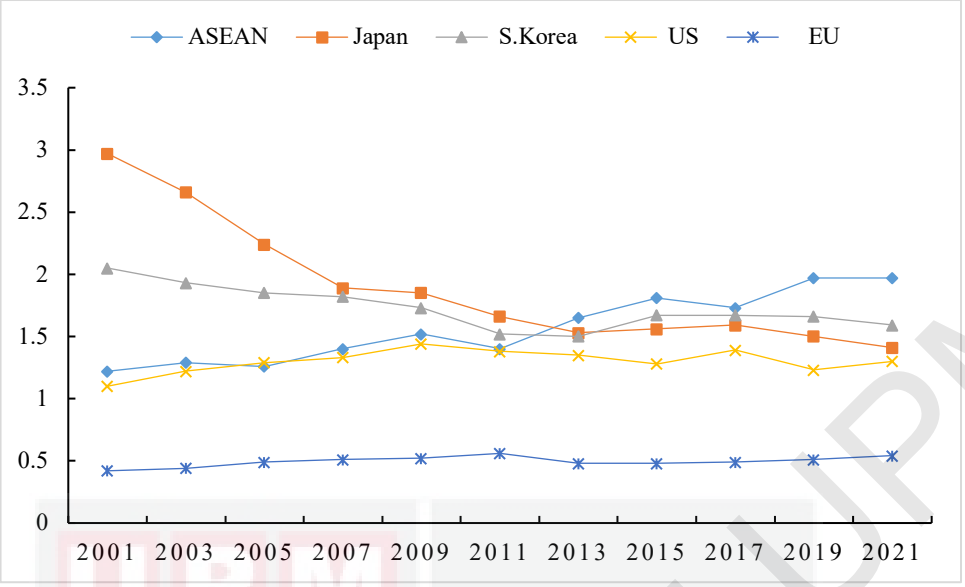

Figure 1.4 : China's Trade Intensity with Its Main Partners
(Source: UNCTAD)

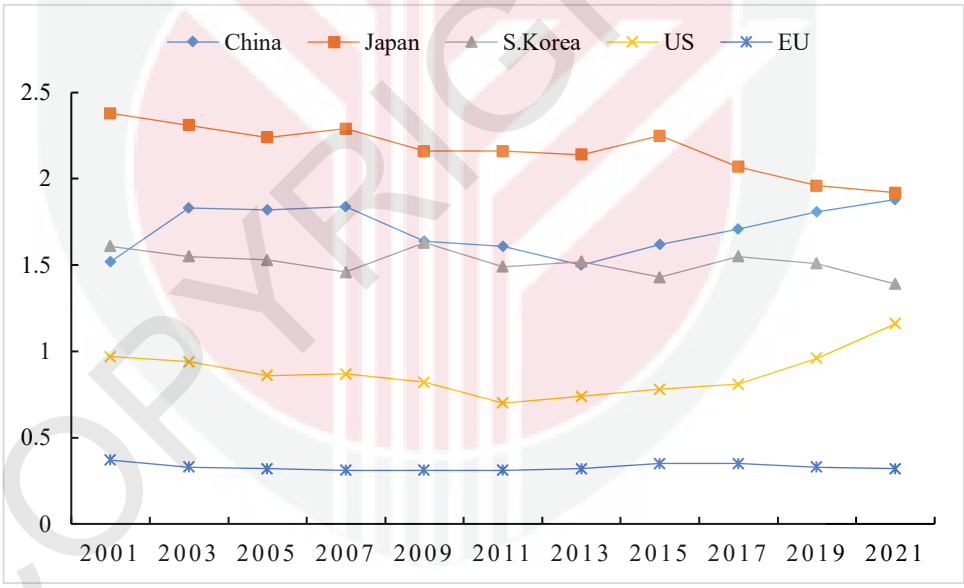

Figure 1.5 : ASEAN's Trade Intensity with Its Main Partners
(Source: UNCTAD)

1.1.3 Monetary Freedom, Trade Liberalization and Trade Flows

Monetary freedom is a key component of economic freedom. It indicates a country's currency stability and government intervention extent in price control. Monetary freedom reflects the degree to which individuals and businesses can engage in transactions without facing significant inflation or government-imposed price distortions (the Heritage Foundation, 2024). Monetary freedom index is calculated using weighted average inflation rate and price controls.

Based on the explanation of the Heritage Foundation, high monetary freedom implies low inflation rate and minimal government intervention in price controls. A country with stable and predictable inflation can allow individuals and businesses to plan long-term economic activities without the concern of rapidly fluctuating prices. Price controls can create imbalances in trade negotiations. A country with minimal government intervention indicates that there is a market-driven system in the economy, and no control or interference in prices, which allows market supply and demand to determine prices efficiently. The removal of price control can ensure balanced trade relationships and promote trade flows (Ciccone et al., 2020). High monetary freedom fosters an environment where transactions can occur without distortions caused by inflation or restrictive government policies. It is beneficial to overall healthy economic growth (Leibovici, 2019).

Increased monetary freedom with reduced inflation and stable pricing, facilitates trade growth, because stable monetary policies enhance trust in a country's economic environment, making it more attractive for trade (Sonora, 2008). Higher monetary freedom can reduce exchange rate volatility, which supports stable trade

relationships (Eichengreen and Taylor, 2003). Less government intervention and stable monetary conditions) can make it easier for domestic markets to absorb foreign goods. This is because lower inflation and stable prices increase consumers' purchasing power and reduce the costs of imported goods. Monetary freedom can influence export competitiveness as a stable and predictable currency encourages foreign buyers (Sonora, 2014). Monetary freedom indicates eliminated government-imposed price distortions, which ensures that goods and services are traded at market-determined prices. Open economies with monetary freedom have more effective monetary policies, which promotes trade liberalization and trade flows (Leibovici and Santacreu, 2015).

This research employs monetary freedom as one of the main explanatory variables to analyze the bilateral trade flows between China and ASEAN countries. Figure 1.6 shows the scatter plot illustration about the correlation between monetary freedom and China-ASEAN bilateral trade flows. It is clear to see that there is a positive relationship between monetary freedom and China-ASEAN bilateral trade flows.

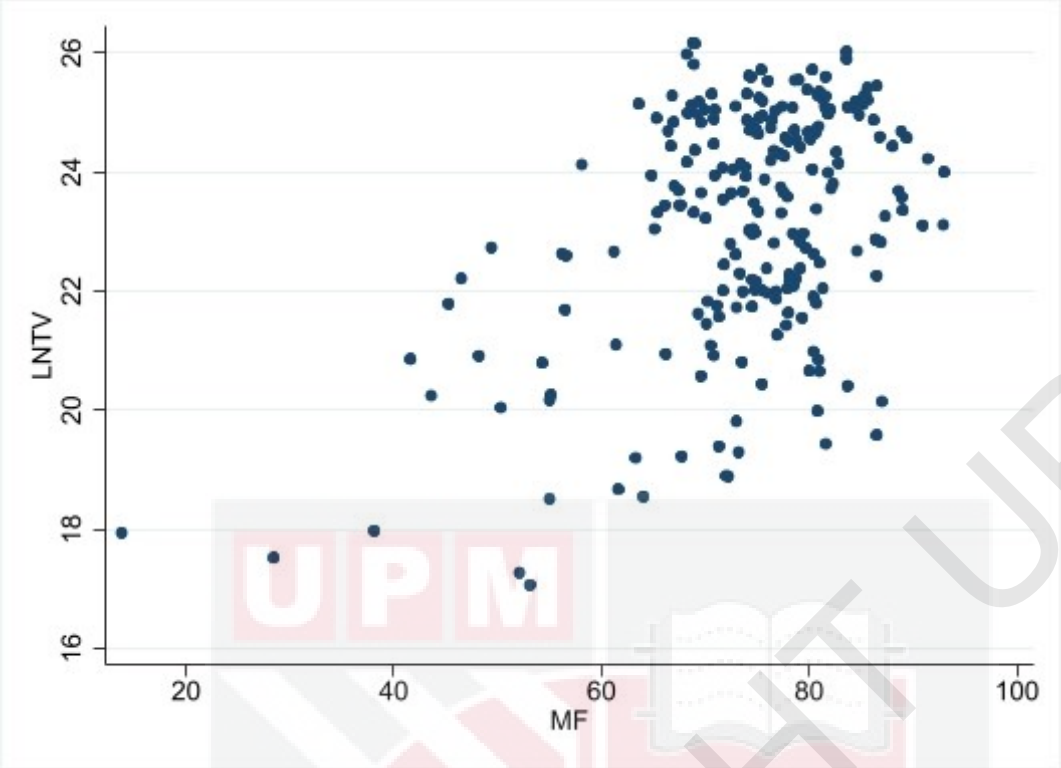

Figure 1.6 : Correlation between Monetary Freedom and China-ASEAN Trade Flows
(Source: Author's calculation)
MF: monetary freedom; LNTV: logarithm of trade value

Another main explanatory variable in this research is trade liberalization. Trade Liberalization refers to the removal or reduction of trade barriers, including tariff trade barriers and non-tariff trade barriers. It's a process aimed at promoting free trade by making it easier for businesses to create and sustain international markets (Wacziarg and Welch, 2008). In this research, trade freedom index is employed to indicate trade facilitation degree. The Heritage Foundation measures trade freedom index of each country by evaluates the degree to which government policies allow for free trade of goods and services without undue interference, such as tariffs, quotas, or other barriers. High trade freedom index indicates a country's economy is highly open to international trade, with low tariffs and minimal non-tariff barriers (the Heritage Foundation, 2024).

Trade liberalization, indicated by trade freedom index in this research, is often associated with increased competition and enhanced economic efficiency, as it opens up domestic markets to foreign players. This exposure to international markets can lead to more options for consumers, lower prices, and innovation due to increased competition (Shu and Steinwender, 2019; Coelli, 2022). Trade liberalization enables nations to focus on producing goods and services in areas where they are more competitive, improving overall efficiency and increasing trade flows (Krueger, 1997). Open trade policies under trade liberalization can attract FDI by providing foreign firms with easier access to international markets, which subsequently fosters trade through multinational operations (Yanikkaya, 2003). Liberalization broadens market access for businesses and allows them to reach international consumers. This also leads to more competition in international market, which in turn pushes firms to innovate, improve quality and reduce costs, and increases productivity and competitiveness in export sectors (Winters et al.,2004). By lowering or removing tariffs, quotas, and regulatory barriers, trade liberalization reduces the cost of importing and exporting goods, making international trade more economically viable (Wacziarg and Welch, 2008). Reduced trade barriers facilitate the integration of firms into global value chains, where intermediate goods and services flow seamlessly across borders, increasing overall trade volumes (Baldwin, 2012). Trade liberalization can lead to increased foreign-exchange reserves and motivate exports by providing equal incentives for domestic sales and exports. The shift towards a neutral trade regime plays a pivotal role in enhancing a country's export performance (Choksi et al., 2019).

In this research trade liberalization is indicated by trade freedom index reported by the Heritage Foundation. Figure 1.7 illustrates the scatter plot of the correlation between trade freedom index and China-ASEAN bilateral trade flows. It is clear to see there the correlation between trade liberalization and China-ASEAN bilateral trade flows is positive.

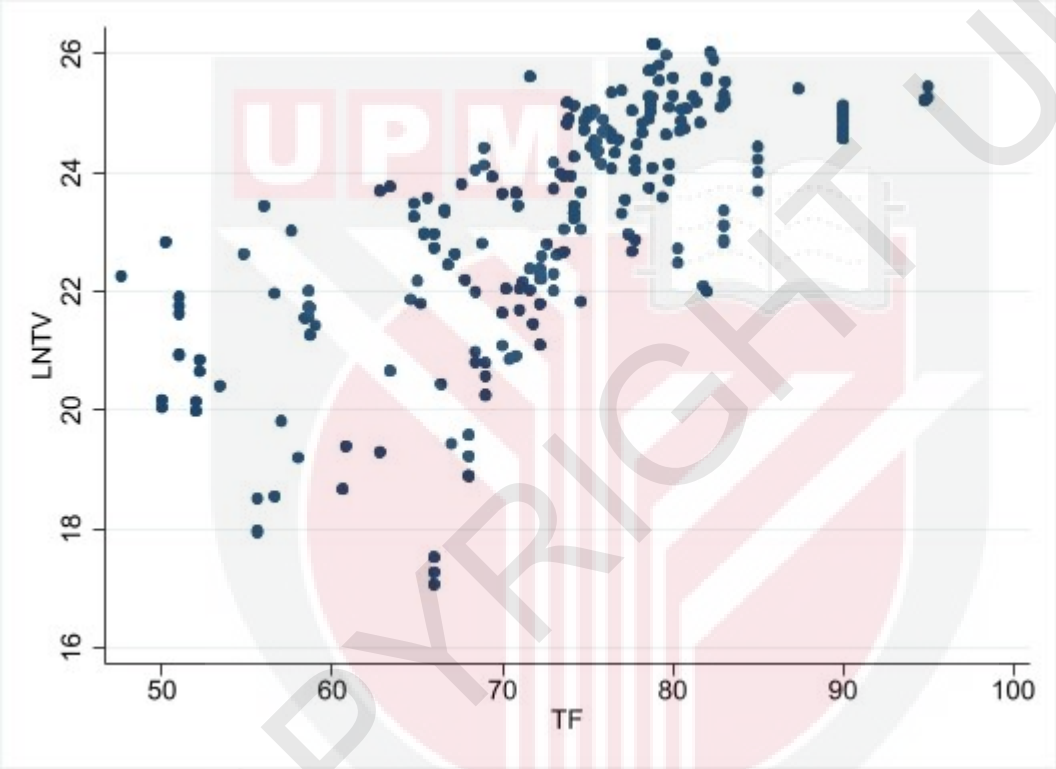

Figure 1.7 : Correlation between Trade Freedom and China-ASEAN Trade Flows
(Source: Author's calculation)
TF: trade freedom; LNTV: logarithm of trade value

1.1.4 Logistics Performance, Trade Facilitation and Trade Flows

One important factor affecting trade flows in which many researchers show growing interest is logistics performance. Logistics Performance refers to the efficiency and effectiveness of logistical operations within a supply chain. It includes transportation efficiency, delivery reliability, cost management, and customer satisfaction.High

logistics performance means well-coordinated supply chain activities, which can improve productivity (Chow et al., 1994; Fugate et al., 2010). In global trade, the World Bank measures the logistics performance index of countries with six dimensions, namely, customs efficiency, infrastructure quality, ease of arranging shipments, logistics competence, tracking and tracing, and timeliness (the World Bank, 2024).

Understanding how well supply chain operations work to facilitate international trade requires a thorough understanding of the link between logistics performance and trade flows. Having a logistics system that works efficiently can boost trade and make a company more competitive in global marketplaces (Hausman et al., 2013). The importance of logistics responsiveness, efficiency, and reliability in facilitating seamless trade transactions and supply chain management (Gani, 2017). Efficient logistics practices support timely delivery, smooth cargo transportation, and trade facilitation—all of which boost trade activity and economic expansion (Çelebi, 2019). The Logistics Performance Index (LPI) provided by the World Bank is used to evaluate logistical performance measures, which can determine trade competitiveness, supply chain efficiency, and the overall influence on trade dynamics in international marketplaces (Martí et al., 2014). Differences in logistics performance can affect trade patterns, market access, and trade integration (Adelajda Zaninović et al., 2021).

This research selects logistics performance as one of the main explanatory variables which affect China-ASEAN bilateral trade flows. Figure 1.8 shows the scatter plot illustration about the correlation between logistics performance and China-ASEAN

bilateral trade flows. It can be seen that the logistics performance improvement is positively associated with China-ASEAN bilateral trade flows.

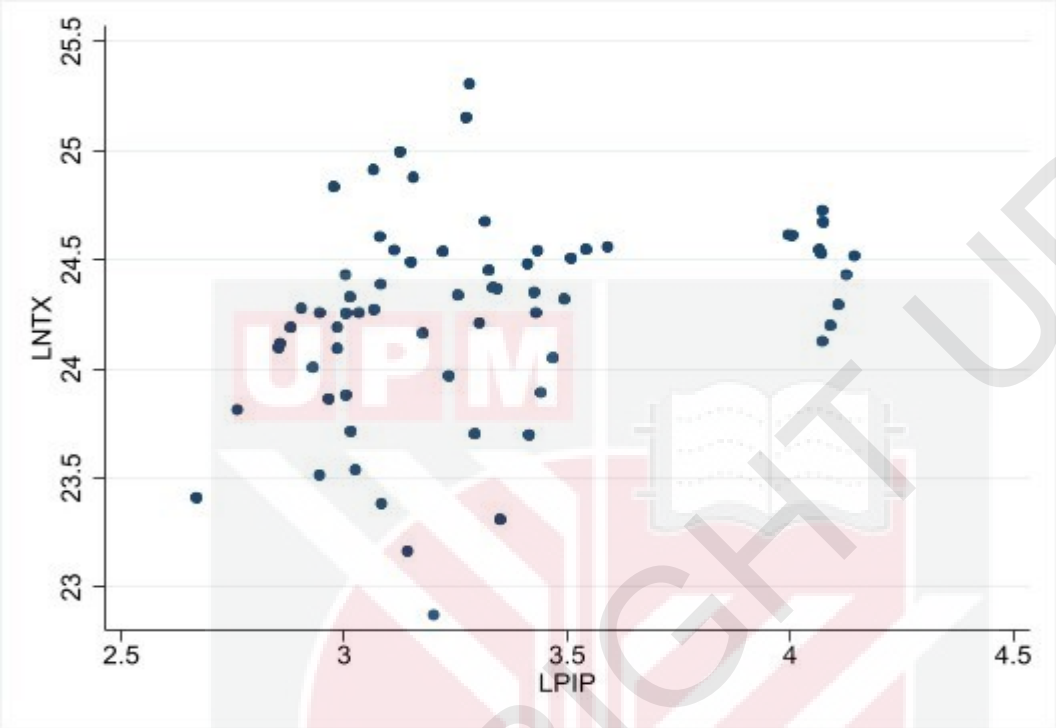

Figure 1.8 : Correlation between Logistics Performance and China-ASEAN Trade Flows
(Source: Author's calculation)
LPIP: logistics performance index; LNTX: logarithm of trade value

Trade facilitation refers to measures aimed at simplifying and streamlining trade procedures, reducing trade costs, and improving the efficiency of cross-border transactions. Efficient trade facilitation measures can lead to increased trade volumes, expanded market access, and improved competitiveness for businesses. By reducing trade barriers, enhancing customs procedures, and promoting transparency in trade regulations, trade facilitation can create a conducive environment for trade expansion and economic development (Zaki, 2015). However, how to define and measure trade facilitation is important and complex. Wilson et al. (2005) proposed four categories

to measure trade facilitation, namely, port infrastructure, customs environment, regulatory environment, e-business infrastructures. The connection between trade facilitation and trade flows is not simple as a country's trade flow changes not only depend on its own trade policy reforms, but also depend on its trade partners' policy reforms.

Streamlining customs processes and improving trade infrastructure can increase trade volumes, encourage trade diversification, and improve trade performance all around (Sá Porto et al., 2015). Trade facilitation policies and reforms can raise trade competitiveness, lower trade costs, and improve trade efficiency, which in turn promotes trade flows (Sakyi and Afesorgbor, 2019). Effective trade procedures are significant in promoting trade expansion, indicating trade facilitation policies might affect trade flows, market access, and trade dynamics (Ali and Shakoor, 2020). Trade facilitation efforts bolster trade integration with regional and international markets, decreased trade obstacles, and improved trade efficiency (Yu and Luu, 2020). Efficient trade procedures can affect the selection of transportation modes, logistics effectiveness, and total trade flows (Avetisyan and Hertel, 2021).

Since trade facilitation measures are a crucial aspect of international trade flows, this research selects trade facilitation as one of the main explanatory variables to study China-ASEAN bilateral trade flows. Figure 1.9 shows the scatter plot illustration about the correlation between trade facilitation and China-ASEAN bilateral trade flows. It can be seen that the trade facilitation improvement is positively associated with China-ASEAN bilateral trade flows.

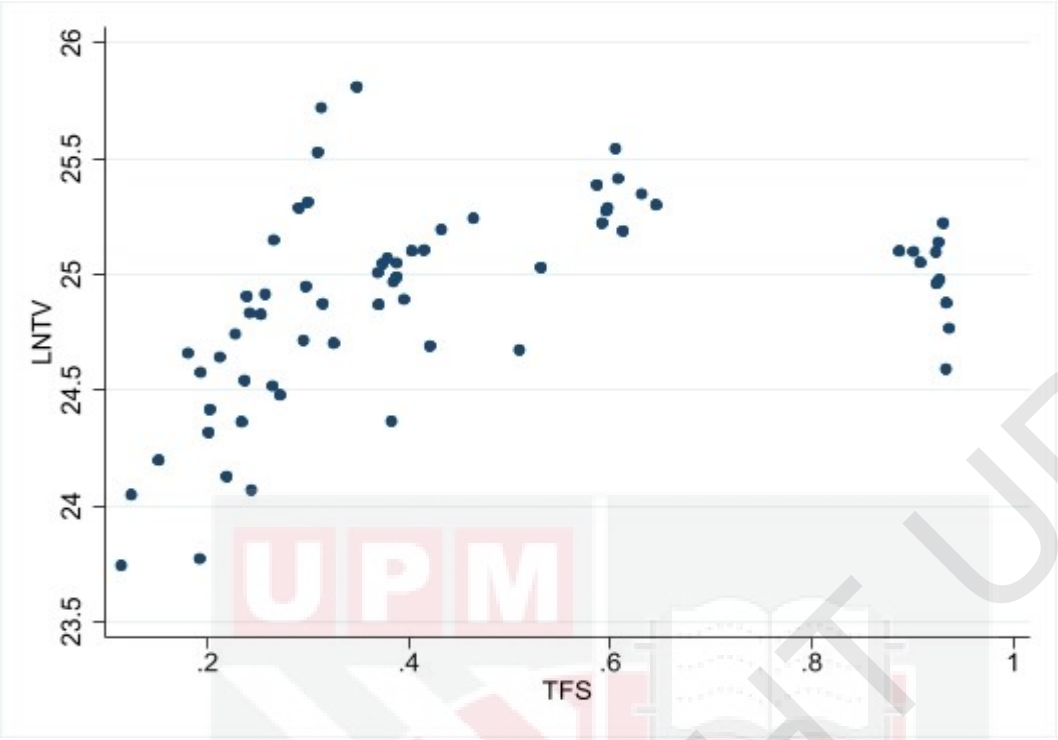

Figure 1.9 : Correlation between Trade Facilitation and China-ASEAN Trade Flows
(Source: Author's calculation)
TFS: trade facilitation; LNTV: logarithm of trade value

1.1.5 China-ASEAN Free Trade Area

One important main explanatory variable to study China-ASEAN trade flows in this research is China-ASEAN free trade area (CAFTA). China-ASEAN Free Trade Area (CAFTA) is a free trade agreement between China and the ten member states of the Association of Southeast Asian Nations (ASEAN). CAFTA is established to promote economic integration and cooperation between China and ASEAN countries. This FTA came into full effect on January 1, 2010. The aim of CAFTA is to eliminate tariff on goods, facilitate trade in services, and promotes investment flows between China and ASEAN nations (Chin and Stubbs, 2011; Chiang, 2019). In terms of both population and economic output, it is among the world's greatest free trade areas.

After enacting the reform and opening up programme in 1978, China saw extremely rapid economic growth during the ensuing 40 years, during which time its size, composition, and place in the world economy all saw significant changes (Ju and Yu, 2018). Asia has been moving towards further regional economic integration since the 1997 financial crisis, which includes the expansion of bilateral free trade agreements and even institutional collaboration with adjacent countries in the monetary system. The efficiency of economic cooperation and integration among the economies in the region has increased along with the increased economic connection between the countries of Northeast and Southeast Asia. Due to their numerous bilateral free trade agreements, ASEAN and China are significantly influencing the dynamics of East Asian regionalism as they develop (Yang and Martinez-Zarzoso, 2014).

China has been the Association of Southeast Asian Nations' (ASEAN) top trading partner for ten years since ASEAN and China formally formed their strategic alliance in 2010 to create the China-ASEAN free trade area (CAFTA), and ASEAN has been China's third-largest trading partner for eight years (Chiang, 2019). Through the CAFTA, the ten ASEAN smaller economies and China's sizable market are connected. CAFTA differs from the EU, NAFTA, and other free trade agreements (FTAs) due to its South-South nature, which includes a labor-rich region and a rapidly expanding market. The fact that members of CAFTA have engaged in East Asian advanced production networks is another unique quality. China, the hub of the network, imports intermediate commodities from around the globe as well as from its neighbors in Asia. Vietnam and the more developed ASEAN states are important participants in the network (Li et al., 2016).

With a major focus on the high- and medium-tech product divisions, China and ASEAN have grown and evolved exceptionally quickly over the years. There is a great deal of potentials for China and some ASEAN countries, such as Brunei, Laos, and Malaysia, to expand their bilateral trade (Tran et al., 2020). In addition to China-ASEAN's complementing advantages in resource cooperation, China and ASEAN also have complementarity in economic development (Yang & Martinez-Zarzoso, 2014). China ranked as the top national export market for four ASEAN members in that year (Cook, 2019).

Previous studies indicate that CAFTA is an effective tool for advancing investment, trade, and economic cooperation between the member nations. China and ASEAN members have benefited from the deal, which has increased trade, created jobs, and improved export efficiency within the region. The results of ongoing analyses of the CAFTA's impact on a range of economic metrics help scholars gain a better understanding of the dynamics of regional trade agreements and how they affect the growth and development of the Asia-Pacific economy. One important aspect of free trade agreements usually accompanies with large tariff rate reduction. Under CAFTA, 90% of products traded between China and ASEAN are subject to zero tariffs (Qu and Zhang, 2023). Also see a comparison of tariff reduction in Appendix 4 and 5. In this research, tariff rate reduction is considered as an important aspect under CAFTA to examine China-ASEAN trade flows.

1.2 Problem Statement

While China-ASEAN trade flows have witnessed unprecedented growth, several critical factors influencing these flows remain inadequately addressed. Monetary freedom, reflecting currency stability and the absence of excessive government intervention, is known to shape trade competitiveness and flow patterns. Similarly, trade liberalization facilitates market access by reducing barriers, while logistics performance and trade facilitation improve supply chain efficiency and reduce transaction costs. However, limited research has systematically analyzed the interplay of these factors in the context of China-ASEAN trade.

Moreover, the China-ASEAN Free Trade Area (CAFTA) has been hailed as a transformative agreement for regional trade. While its role in reducing tariffs and fostering trade integration is acknowledged, the specific trade creation effects of CAFTA, especially in bilateral commodity trade, remain insufficiently quantified. Addressing these gaps is essential for policymakers to formulate strategies that further enhance trade flows and economic cooperation between China and ASEAN.

This study aims to fill these gaps by investigating how monetary freedom, trade liberalization, logistics performance, trade facilitation, and CAFTA influence China-ASEAN bilateral trade flows. It seeks to provide evidence-based insights to support trade policy optimization and deepen economic integration in the region.

1.3 Research Questions

Based on the previous studies and the existed research problems above, this research tries to answer the following questions:

(1) Do monetary freedom and trade liberalization play an important role in promoting China-ASEAN bilateral commodity trade flows?

(2) Are logistics performance and trade facilitation improvement contributed to China's exports to and imports from ASEAN?

(3) Is there any trade creation effect of CAFTA on China-ASEAN trade flows, and on China's exports to and imports from ASEAN?

To address these research questions, the study sets forth the following objectives.

1.4 Research Objectives

Based on the research questions above, the main objective of this research is to analyze the impact of monetary freedom, trade freedom, logistics performance, trade facilitation, and CAFTA on China-ASEAN bilateral commodity trade flows.

Specifically, this research aims to

(1) examine the role of monetary freedom and trade freedom in promoting China-ASEAN bilateral commodity trade flows.

(2) analyze the impact of logistics performance and trade facilitation improvement on China's exports to and imports from ASEAN.

(3) quantify the trade creation effect of CAFTA China-ASEAN bilateral commodity trade flows, China's exports to ASEAN, and China's imports from ASEAN.

1.5 Significance of Study

This study offers valuable insights into the dynamics of China-ASEAN trade flows, addressing critical gaps in the literature. Its contributions are fourfold:

(1) Academic Contributions:

By examining the combined impact of monetary freedom, trade liberalization, logistics performance, and trade facilitation, this research provides a comprehensive understanding of the determinants of bilateral trade flows. It also quantifies the trade creation effects of CAFTA, offering a nuanced perspective on regional trade agreements.

(2) Policy Implications:

The findings can guide policymakers in both China and ASEAN to implement strategies that reduce trade barriers, enhance logistics infrastructure, and streamline trade facilitation measures. Insights on monetary and trade freedom can inform economic policies that foster regional integration.

(3) Practical Applications:

The study's results can assist businesses in navigating China-ASEAN trade environments by highlighting factors that influence trade dynamics. Improved logistics performance and trade facilitation measures can enhance supply chain efficiency and competitiveness.

(4) Broader Relevance:

By analyzing a South-South trade relationship, this research provides lessons for other developing countries seeking to leverage trade agreements to stimulate economic growth. The study's findings can serve as a benchmark for evaluating similar regional trade agreements globally.

1.6 Organization of the Thesis

This research mainly has five chapters. Chapter one gives an introduction about the research background, research problem statement, research questions and objectives, research significance and an overview of current China-ASEAN bilateral commodity trade flows. Chapter two illustrates the theoretical foundations related to this research and summarizes the previous empirical results related to China-ASEAN bilateral trade flows. Chapter three shows the theoretical framework, variables, methodology and estimation methods in this research. Chapter four reports the empirical results of the research models in chapter three. Chapter five will make a conclusion about the thesis with a overview of this research, a summary of empirical findings of this research, limitation of this research, and policy recommendations to improve China-ASEAN bilateral commodity trade and to strengthen the economic cooperation between China and ASEAN countries.

CHAPTER 2

LITERATURE REVIEW

2.1 Theoretical Foundations

In this section, the theoretical foundations are explained for the three objectives in this research are presented. They are the gravity model of trade, transaction cost theory, and the theory of preferential trade agreements.

2.1.1 Gravity Model of Trade

To study the bilateral trade flows among countries, one frequently used model is the gravity model of trade. The the gravity model of trade can be used to analyze the effects of trade policies quantitatively (Yotov et al., 2016). The foundation of the gravity model is Newton's Law of Universal Gravitation, which states that all particles in the universe are attracted to one another with a force that is inversely proportional to the square of the distance between their centers and proportional to the product of their masses (Rohrlich, 1989). In international trade, by applying this Law of Gravity, the gravity model of trade indicates that the international trade between countries are positively related with their sizes (gross domestic products, population) and negatively related with the distance between them(Yotov et al., 2016).

The initial usages of Newton's Law of Gravitation in economics area are purely theoretical. For example, Ravenstein (1885) applies gravity to study immigration and Tinbergen (1962) uses it to study trade flows. Isard (1954) and Anderson (1979) provide a theoretical foundation for the gravity equation of international trade.

Although this gravity equation of trade has early theoretical development and good empirical performance, the gravity model of trade just starts to have large influence in economics from late 1990s and early 2000s. Based on a Ricardian structure with intermediate goods, Eaton and Kortum (EK) (2002) extended the gravity model in the supply area. Anderson and van Wincoop (2003) emphasized the significance of the general equilibrium effects of trade costs and contributed largely to the popularity of the Armington-CES model of Anderson (1979).

There are several merits of the gravity model of trade according to Yotov et al. (2016). First, this model is very intuitive as it is based on Newton's Law of Universal Gravitation, which can predicts that two countries' trade flows are directly positively related with their sizes and inversely related with their physical distance. Second, this model is a structural model and has a solid theoretical basis, which make it suitable for counterfactual analysis to quantify the effects of trade policies. Third, this model depicts a general equilibrium environment that can accommodates numerous countries, industries, and businesses simultaneously. Fourth, the gravity model structure is very flexible and can integrate with other general equilibrium models to study the nexus with trade and other factors, such as investment, labor markets, environment and so on. Additionally, the gravity model has good predictive power for trade flows of both goods and services in different sectors, which is attractive for researchers.

The gravity model of trade is widely used to explain trade flows because of its above merits. However it is sensitive to biases resulting from omitting multilateral resistance terms (Anderson and van Wincoop, 2003), also called "remoteness" by

Head (2003) and Baier and Bergstrand (2007). The biased estimates issue due to omitting multilateral resistance terms in gravity model of trade can be addressed by integrating multilateral resistance terms or using GDP-weighted average distances (Afesorgbor, 2017). Another way to control the multilateral resistance terms is to include a proxy for"remoteness"and improve the results accuracy of the gravity model of trade (Osabuohien et al., 2019).

Some estimation techniques can also help to solve bias issue in gravity model of trade. Poisson pseudo-maximum likelihood (PPML) method can address bias in gravity models of trade caused by sample truncation and omitted variables (Prehn et al., 2016). Even with fixed effects and unobserved heterogeneity, PPML generates reliable estimates under weak distributional assumptions. In terms of bias and efficiency, PPML method performs better than other pseudo-likelihood estimators, especially when used with three-way gravity model specifications (Weidner & Zylkin, 2021). Another technique is general equilibrium estimation. In a general equilibrium framework, multilateral resistance terms or "remoteness" are calculated based on the trade cost structure across all countries. This method helps to minimize omitted variable bias and ensures consistency between trade costs and trade flows in gravity model of trade (Anderson and van Wincoop, 2003). General equilibrium models consider trade costs as variables that are influenced by observable factors such as tariffs, transportation expenses, and non-tariff barriers. By simultaneously solving the trade equilibrium for all countries, biases that may result from incorrect assumptions about trade costs can be eliminated (Caliendo and Parro, 2015).

In objective 1, this research employs the gravity model of trade to study the impact of monetary freedom and trade liberalization on China-ASEAN bilateral trade flows. To solve the bias of gravity model of trade, a proxy for "remoteness" named "trade cost index" is employed in the model.

2.1.2 Theory of Transaction Cost

The idea of transaction cost theory is firstly proposed by Ronald Coase in 1937, which aims to explain why firms exist in exchange economy (Williamson 1985; Benkler 2006). According to Coase (1937), there appears to be a cost associated with using the price mechanism, which is the primary reason why it is profitable to establish a firm. The basic idea behind Coase's theory was that market transactions involve a set of costs that can be minimized if they occur within a company (Rindfleisch, 2020). While Coase gave birth to transaction cost theory, Williamson further developed the transaction cost theory in 1970s and 1980s. Williamson (1979) emphasizes the role of opportunism and bounded rationality in economic transactions. In his book "The Economic Institutions of Capitalism", Williamson (1985) introduced key dimensions of transactions such as asset specificity, frequency, and uncertainty. He argued that transactions requiring specific assets, occurring frequently, or facing high uncertainty incur higher costs due to the potential for opportunistic behavior and the limits of human rationality.

Yochai Benkler's work in 2002 and 2006 brings transaction cost theory into the digital age (Rindfleisch, 2020). Unlike Coase and Williamson, Benkler (2006) emphasizes the critical role of technology in reducing transaction costs and enabling decentralized production. He introduces a new form of economic organization called

social production, enabled by digital tools like the Internet and personal computers. He expands the conventional understanding of economic incentives by arguing that human behavior is motivated by both monetary and non-monetary rewards, and that transactions with high levels of modularity (independent components) and granularity (small, manageable tasks) are more likely to be organized via social production (Benkler, 2017; Rindfleisch, 2020).

Numerous disciplines, including economics, public policy, international business, operations, management, and marketing, have made extensive use of transaction cost theory to analyze topics like channel relations, vertical integration, and foreign market entry. Transaction cost theory offers a useful perspective for researching the organizations that structure global interdependencies, with a special emphasis on multinational enterprises (MNEs) (Hennart, 2010; Cuypers et al., 2021). Hennart (1977) employs the transaction cost theory to explain why MNEs exist and what their activity scope is. By taking into account both market transaction costs and internal organization expenses, transaction cost theory aids in the explanation of the selection of foreign market entry strategies, such as equity joint ventures and hybrids. It also clarifies why asset specificity and information asymmetry are essential to the survival of multinational enterprises (MNEs) (Hennart, 1989). However, while analyzing governance decisions, the transaction cost theory emphasizes the necessity of taking into account both internal organization costs and market transaction costs at the same time (Hennart, 1993).

Transaction costs play a significant role in shaping the pattern of international trade. Countries with larger domestic markets tend to be net exporters of goods subject to

scale economies, as firms prefer to locate production near larger markets to minimize transaction costs (Holzhey, 2003). High transaction costs can act as barriers to trade, affecting the competitiveness of countries. Reducing these costs can enhance trade integration and economic cooperation (De, 2006). In addition to raising transportation expenses, geographic distance also impacts the likelihood of in-person interactions between buyers and sellers, resulting in additional transaction costs that may discourage trade over long distances (Håkanson and Dow, 2012).

The improvement of logistics performance and trade facilitation can largely reduce international trade costs. Thus in the second objective, this research employs theory of transaction cost to analyze the impact of logistics performance and trade facilitation on China-ASEAN bilateral trade flows.

2.1.3 Theory of Preferential Trade Agreements

The concept and theory of Preferential Trade Agreements (PTAs) were first rigorously analyzed by Jacob Viner in his seminal work, "The Customs Union Issue" (1950). He introduced the concepts of trade creation and trade diversion to analyze the economic impacts of PTAs. When a PTA results in lower-cost imports from member nations replacing more expensive domestic output, trade creation takes place, improving welfare overall. Trade diversion, on the other hand, occurs when higher-cost imports from member nations replace lower-cost imports from non-member nations, which may diminish global welfare (Viner, 1950). Later economists, such as Wonnacott and Lutz (1989), and Summers (1991) argue that PTAs bring benefits and create trade flows to member countries if these countries initially have high trade volume. The argument put forth by Wonnacott and Lutz

(1989) and Summers (1991) is not supported by Panagariya (1996) and Bhagwati and Panagariya (1999), who show that a higher initial volume of trade can result in a substantial loss for a member nation due to the redistribution of tariff revenue between member nations. Krugman (1991) and Frankel et al. (1995) imply that short distance reduces transport costs and provide benefits to natural trading countries.

The cutting-edge theory of PTAs has advanced into modeling the incentives to create PTAs due to the current interest in political economics theory and the desire to examine the reasons behind PTAs' growing popularity (Bhagwati and Panagariya, 1996). The large increasing number of PTAs over the past years have deep influence in trade flows, foreign direct investment (FDI), and economic reforms in developing countries. In order to promote more economic integration, contemporary PTAs control intellectual property rights, investment, and other behind-the-border obstacles in addition to lowering tariffs (Baccini, 2019).

Based on Frankel et al (1997) and Baier et al (2014), PTAs can be classified into non-reciprocal PTAs, reciprocal PTAs, free trade area, customs unions, common markets and economic unions. Free trade areas(FTA) can provide two-way preferences and eliminate tariffs on a substantial part of the trade, such as NAFTA, CAFTA, and so on (Limão, 2016). Political success for free trade agreements (FTAs) is more likely when partner countries have a balanced trade relationship, particularly when the deal includes greater protection (which benefits domestic exporters benefiting from high domestic pricing in the partner country). With reduced protection, import-competing industries lose domestic price protection, which can make it politically challenging to support FTAs (Grossman and Helpman, 1995).

FTAs create trade by substituting lower-cost imports from member nations for expensive domestic manufactures. This shift enhances efficiency and increases the overall volume of trade among member countries (Baier and Bergstrand, 2007; Mölders and Volz, 2011). Tariffs, quotas, and other trade restrictions between member nations are eliminated or drastically reduced by free trade agreements (FTAs). Businesses can now import and export goods and services more affordably and easily thanks to these trade cost reductions, which increases trade volumes (Cheong and Cho, 2013). Over time, the initial trade liberalization effects of FTAs can lead to dynamic gains such as economies of scale, increased productivity, and technological advancements. These dynamic effects further enhance trade flows among member countries (Breinlich, 2018).

In objective 3 of this research, the theory of Preferential Trade Agreements is employed as the theoretical foundations to examine the trade creation effects of China-ASEAN free trade area (CAFTA).

2.2 Empirical Studies

In this part, this research summarizes the previous empirical studies related to monetary freedom, trade liberalization, logistics performance, trade facilitation, trade effects of free trade agreements (FTAs) and free trade area (FTA), and China-ASEAN free trade area (CAFTA).

2.2.1 Monetary Freedom, Trade Liberalization and Trade Flows

In this section, the empirical studies about the impact of monetary freedom, and the impact of trade liberalization on trade flows are shown.

(1) Monetary freedom and trade flows

Based on the explanation of the Heritage Foundation, high monetary freedom implies low inflation rate and minimal government intervention in price controls (The Heritage Foundation, 2024). The are plenty of studies which have examined the relationship between monetary freedom and trade flows. Table 2.1 illustrates the list of studies about monetary freedom (inflation, price control, monetary policy) and trade flows.

Based on an unbalanced panel data of 33 countries in Africa, Naanwaab and Diarrassouba (2013) employ a linear regression with fixed effects to examine the effects of economic freedom on trade flows within African countries. They indicate that economic freedom, including monetary freedom, positively affects the exports and imports flows among African countries, and region trade agreements also have a positive impact on trade flows among African countries. Sonora (2014) examines how various dimensions of economic freedom, including monetary freedom, affect bilateral trade flows between the U.S. and 122 countries over a decade. Using a gravity model, the study finds that improvements in monetary freedom—characterized by stable monetary policies and reduced inflation—have a mixed impact on trade. While monetary independence boosts imports through stronger currency valuations, it can reduce exports by making goods less competitive internationally. This study emphasizes the importance of balanced monetary policies to optimize trade outcomes.

Saygılı (2020) explores how the nature of trade, particularly production fragmentation and trade intensity in intermediate inputs, influences inflation

dynamics across 31 OECD countries from 1990 to 2016. The study finds that vertical intra-industry trade in intermediate goods significantly impacts domestic inflation, whereas trade in final goods has minimal influence. Furthermore, trade openness in intermediate inputs amplifies cost-push inflation pressures through international value chains, showcasing the pivotal role of production linkages in shaping inflationary trends in open economies.

Hussain and Haque (2016) analyze the relationship between economic freedom, including monetary freedom, and economic growth using panel data for 186 countries (2013-2015) and 57 countries (2004-2014). Their findings suggest a significant positive association between economic freedom and GDP growth, particularly through trade freedom and stable fiscal policies. The study emphasizes that monetary freedom, by reducing inflation and price control distortions, enhances trade flows and fosters a business-friendly environment, thereby driving sustainable economic growth across diverse nations. Elahi et al. (2016) employs a two-step Generalized Method of Moments (GMM) estimation to analyze the effects of monetary shocks on trade balance based on data of 25 countries during 2003-2013. They find that positive monetary shocks make the trade balance worse by lowering the real exchange rate, whereas negative shocks improve the trade balance and increase competitiveness by raising the real exchange rate in developed countries. They also indicate that dynamics of trade are greatly impacted by stable monetary policy, and monetary shocks are crucial in shaping trade balances and exchange rates.

Leibovici (2019) investigates how trade openness influences monetary policy,

focusing on 26 economies over the period 1980 to 2006. The study employs a Generalized Method of Moments (GMM) estimation approach to estimate Taylor rule coefficients, which capture central banks' responses to inflation, output gaps, and other trade-related variables like real exchange rates. Findings reveal that open economies exhibit weaker responses to inflation due to heightened sensitivity to real exchange rate movements. It shows that trade openness alters inflation's impact on monetary policy design, reflecting significant trade-monetary policy interdependencies in shaping global economic outcomes. Thanh et al. (2020) explore the asymmetric effects of U.S. monetary policy on its bilateral trade deficit with China using quarterly data. Employing a Markov Switching Autoregressive Distributed Lag (ARDL) model, the research identifies two regimes for trade balance: low and high deficit states. The findings reveal that monetary policy influences trade asymmetrically, with higher U.S. money supply or lower interest rates improving the trade balance under certain conditions, while exacerbating deficits in others.

Koppány et al. (2023) examine the impact of inflation on trade through the lens of global value chains (GVCs), focusing on Hungary's inflationary exposures to global price movements. This study reveals how inflationary shocks, particularly in energy prices, are transmitted through GVCs to impact trade costs and consumer prices. It indicates Hungary's dependency on upstream suppliers for industrial and energy inputs. Yang et al. (2023) investigate the impact of monetary freedom on trade within the context of economic freedom and financial development in 72 developing countries over the period 2009–2017. Using a dynamic panel Generalized Method of Moments (GMM-IV) estimator, the study reveals that monetary freedom positively impacts financial systems and trade flows by stabilizing inflation and fostering price

control. Enhanced monetary freedom supports financial market depth and efficiency, encouraging trade openness and investment flows. Georgousis (2024) employs French customs data during 2002-2016 within the Euro area and analyzes the interaction between monetary policy and trade. Based on local projection methods, this study shows that French exporters use dynamic price discrimination, making more substantial pricing adjustments in core Euro area nations than in peripheral ones; in concentrated markets, contractionary monetary shocks increase competition, which boosts productivity among surviving firms and increases trade flow in the Euro Area.

These empirical studies indicate that monetary freedom, which includes price stability and less intervention, has a significant role in promoting trade and this relationship is found in abundant previous studies. However, impact of monetary freedom on China-ASEAN trade flows has not been explored. Thus, one sub-objective of this research tries to reveal the importance of monetary freedom on China-ASEAN bilateral trade flows.

Table 2.1 : List of Studies about Monetary Freedom and Trade

Authors	Data Time Period	Method	Results
Naanwaab and Diarrassouba (2013)	2000-2009	Linear regression with fixed effects	economic freedom positively affect the exports and imports flows among African countries
Sonora (2014)	2000-2009	Ordinary least squares estimation with gravity model of trade	improvements in monetary freedom—characterized by stable monetary policies and reduced inflation—have a mixed impact on trade.
Saygılı, H. (2020)	1990-2016	PCSE regression analysis	There is a high connection between domestic inflation and international trade outcomes.
Hussain and Haque (2016)	2004–2014	Linear regression with random and fixed effects	economic freedom, including monetary freedom, promotes economic growth through free trade.
Elahi et al. (2016)	2003-2013	Two-step Generalized Method of Moments (GMM)	Positive monetary shocks make the trade balance worse by lowering the real exchange rate, whereas negative shocks improve the trade balance and increase competitiveness by raising the real exchange rate in developed countries.
Leibovici (2019)	1980-2006	Generalized Method of Moments (GMM)	trade openness alters inflation's impact on monetary policy design, and there is a interdependency between monetary policy and trade
Thanh et al. (2020)	1993-2018	ARDL	monetary policy influences trade asymmetrically, with higher U.S. money supply or lower interest rates improving the trade balance
Koppány et al. (2023)	2018-2022 monthly data	Cost-push input-output price model	Inflationary shocks affect trade costs and consumer price through global value chain. Cost-push inflation changes trade dynamics
Yang et al. (2023)	2009–2017	Generalized Method of Moments (GMM)	monetary freedom positively impacts financial systems and trade flows by stabilizing inflation and fostering price control
Georgousis (2024)	2002-2016	Local projections estimation	In concentrated markets, contractionary monetary shocks increase competition, which boosts productivity among surviving firms and increases trade flow in the Euro Area.

(2) Trade Liberalization and Trade Flows

Abundant researches have examined the relationship between trade liberalization and trade growth. In this sub-section, the empirical studies about the impact of trade liberalization on trade growth (imports or exports growth) are demonstrated.

Using an ARDL Bounds test methodology, Hoque and Yusop (2010) investigate the effects of trade liberalization on Bangladesh's total imports. The study reveals that trade liberalization policies improve Bangladeshi import levels, increase its trade volume and economic development.

By applying the Generalized Method of Moments (GMM) for dynamic panel regression, Ju et al. (2010) finds that trade liberalization consistently promotes the imports and exports in developing countries. However they argue that the impact of trade liberalization on trade balance is complicated and varied in different countries. Hanson and Xiang (2011) employ an extended Melitz (2003) model to examine the effect of trade liberalization on trade flows, based on the exports data of U.S. to 46 countries. Their study indicates that trade barriers significantly affect U.S. trade flows, and it is important to reduce trade barriers and trade costs, so as to promote trade liberalization and to facilitate trade flows.

Nordås and Rouzet (2017) look into how trade restrictions on services can lower the potential benefits of trade liberalization in the services sector, limit cross-border services transactions, and impede trade flows. They finds that lower trade restrictions (higher trade liberalization) significantly enhance both imports and exports of services. They suggest that liberalizing regulation can bolster international service

competitiveness, such as banking, insurance, and legal services. Wish a sample of 166 countries from 1995 to 2014, Gnangnon (2017) examines the relationship between multilateral trade liberalization and domestic trade policy reforms. Based on generalized least squares (GLS), and a two-step Generalized Method of Moments (GMM) method, it is found that domestic trade liberalization is greatly aided by multilateral trade liberalization; the effect is greater in less developed nations than in developed ones.

Gnangnon (2019) employs a panel data set during 2004-2015 to examine the effect of multilateral trade liberalization on exports in 97 developing countries. The estimation results of two-step System Generalized Method of Moments (GMM) indicate that in developing nations, multilateral trade liberalization by itself has little noticeable effect on export performance or convergence to global export performance averages. However, trade liberalization greatly enhances exports when combined with increased higher aid for trade flows. Seyoum and Ramirez (2019) use a sample of 155 countries over 1995-2015 to analyzes the relationship between economic freedom and trade flows, including trade freedom and trade flows. Based on a OLS regression analysis, this study indicates that economic freedom and trade freedom significantly enhance trade flows, with FDI acting as a mediator in this relationship. Trade volumes rise as a result of increased FDI inflows to nations with more economic freedom.

Adegboye et al. (2020) explore how trade liberalization impacts trade flows and economic expansion in ECOWAS countries. Using panel data for 14 countries over the period 2000-2017, they indicate that trade liberalization, especially tariff

reductions, promote trade growth and boost economic growth in ECOWAS countries. They also suggest addressing structural deficiencies and improvement in policy alignment and infrastructure development. Flaig and Greenville (2021) examines the effects of tariff liberalization on global value chain (GVC) integration in APEC by using methods of value added decomposition and a computable general equilibrium model. They finds that trade liberalization increases APEC's GVC integration by approximately 2% and significant tariff reductions negatively impact domestic value-added exports. Based on data over 2007-2017, Purwono et al. (2022) employ generalized method of moments (GMM) and Poisson pseudo-maximum likelihood (PPML) methods to study the effects of Indonesia's free trade agreements (FTAs) with ASEAN and six other regional partners. This study points out that exports of low- and medium-tech manufactured goods increase as a result of trade liberalization FTAs, whereas high-tech and natural resource items see little change. Indonesia has comparative advantage in primary and labor intensive products, but there is increasing competition from other ASEAN partners who are challenging Indonesia's position.

Additionally, Utouh (2024) uses a time series analysis covering 1980 to 2019 to investigate how trade liberalization has affected Tanzania's export performance. It is found that trade liberalization and export success are significantly positively correlated based on ARDL and VECM estimation. Additionally, it discovers that trade liberalization and currency rates are correlated. That is, Tanzanian export growth and international export competitiveness can both be improved by effective exchange rate management. Liu et al. (2024) investigate how trade liberalization in imports impacts China's export growth patterns, based on China's trade data from

1995 to 2020. With a two-way fixed model and difference-in-differences estimation approach, they find that import liberalization enhances China's export growth by expanding the extensive margin (new products and markets) and the intensive margin (export volume of existing products), while reducing export prices and increasing quantities. This study also reveal that there is greater impact of trade liberalization on medium-high technology industries, suggesting the importance of innovation.

Numerous studies have explored the contribution of trade liberalization to trade flow growth. Trade liberalization promotes a country's trade growth and then its economic growth. The importance of trade liberalization can not be neglected when analyzing the bilateral trade flows between China and ASEAN countries. Therefore, one sub-objective of this research is to examine the impact of trade liberalization on China-ASEAN bilateral commodity trade flows.

Table 2.2 : List of Studies about Trade Liberalization and Trade

Authors	Data Time Period	Method	Results
Hoque and Yusop (2010)	1972-2005	ARDL	Trade liberalization that lowers import duties results in a big short-term increase in total imports but a negligible long-term increase in Bangladesh.
Ju et al. (2010)	1970–2004	Generalized Method of Moments (GMM)	Trade liberalization consistently promotes imports and exports, yet its impact on trade balance is complicated.
Hanson and Xiang (2011)	1995-2006	OLS regression	Bilateral trade barriers significantly affect trade flow variations; Trade liberalization promote exports of U.S.
Nordås and Rouzet (2017)	2009-2013	PPML regressions	Lower trade restrictions significantly promote imports and exports of services in OECD countries.
Gnangnon (2017)	1995-2014	generalized least squares (GLS); two-step Generalized Method of Moments (GMM)	Domestic trade liberalization is greatly aided by multilateral trade liberalization; the effect is greater in less developed nations than in developed ones.
Gnangnon (2019)	2002-2015	System GMM	Multilateral trade liberalization by itself has little noticeable effect on export performance or convergence to global export performance averages. However, trade liberalization greatly enhances exports when combined with increased higher aid for trade flows.
Seyoum and Ramirez (2019)	1995-2015	OLS regression	Economic freedom, including trade freedom significantly enhance trade flows, with FDI acting as a mediator in this relationship. Trade volumes rise as a result of increased FDI inflows to nations with more economic freedom.
Adegboye et al. (2020)	2000-2017	Pooled OLS, GLS	Trade liberalization, measured by tariff reductions—has a statistically significant impact on trade flows and economic development within ECOWAS countries
Flaig and Greenville (2021)	2014	value added decomposition and a computable general equilibrium model	Trade liberalization increases APEC's GVC integration by approximately 2% and significant tariff reductions negatively impact domestic value-added exports.
Purwono et al. (2022)	2007-2017	GMM, PPML	Exports of low- and medium-tech manufactured goods increase as a result of trade liberalization, whereas high-tech and natural resource items see little change.
Utouh (2024)	1980-2019	ARDL and VECM	trade liberalization improves the export performance of Tanzania; reduced trade barriers promote export growth in Tanzania.
Liu et al. (2024)	1995-2020	two-way fixed-effects model; difference-in-differences approach	trade liberalization in import is contributed to China's export growth pattern optimization.

2.2.2 Logistics Performance, Trade Facilitation and Trade Flows

In this section, the empirical studies about the relation between logistics performance and trade flows, and the relation between trade facilitation and trade flows are illustrated.

(1) Logistics performance and trade flows

The improvement of logistics performance can reduce trade costs and raise trade efficiency, which promotes trade growth in turn. There are abundant studies which have examined the impact of logistics performance on trade growth. Table 2.3 shows the list of studies regarding the positive connection between logistics performance and trade flows. For instance, Hoekman and Nicita (2011) employ a gravity model that incorporates World Bank-developed metrics of trade facilitation and trade restrictiveness, such as Doing Business and the Logistic Performance Index (LPI). According to their findings, trade intensity and logistical performance are significantly positively correlated. Logistics performance has a positive effects in expanding developing country trade. It indicates that trade flows would increase by about 15% if a low-income nation's LPI score were raised to the average for middle-income nations. Korinek and Sourdin (2011) examine the promoting role of high-quality logistics performance in international trade. They discover that increased bilateral merchandise trade is positively, significantly, and robustly correlated with improved trade logistics; that the impact of improved trade logistics is greater for air-transported goods than for sea-transported ones; and that middle-income countries gain more from port, and especially air-transport, infrastructure improvements than do lower-income countries.

The empirical results of Martí et al. (2014) indicate that every aspect of logistics performance is significantly and positively correlated with trade flows in developing countries and components of the logistics performance index are becoming more and more significant for nations in Eastern Europe, South America, and Africa. They suggest the improvement of shipment organizations with competitive prices. Puertas et al. (2014) investigate the relationship between export competitiveness and logistics performance within the framework of Europe.The study reveals that strong logistics performance and increased export competitiveness are positively correlated, and efficient logistics systems can help European exporters compete more successfully in global markets.

Bensassi et al. (2015) examine how trade and logistics infrastructure are related, with a particular emphasis on regional exports from Spain. Through increased trade connectivity, the study shows how investments in logistics infrastructure can boost export capacities, promote trade growth, and stimulate regional economic development. Gani (2017) investigates how logistics performance affects global trade and discovers that it has a noteworthy and favorable impact on imports and exports. He emphasizes the role of logistics efficiency, reliability, and responsiveness in promoting smooth trade transactions and supply chain coordination. By using an income-level approach and analyzing the effects of several logistics performance aspects, Çelebi (2019) investigates the function of logistics performance in fostering trade. The study finds that logistics performance positively and significantly influences trade flows, with components like infrastructure, timeliness, and quality showing the greatest impact; the impact of logistics performance is higher in exports than in imports in low-and-middle income countries.

Buvik and Takele (2019) examine the relationship between logistics performance and trade flows in African countries, by employing a gravity model with the Heckman selection approach. The results indicate that logistics performance, particularly in customs efficiency, infrastructure, and quality of logistics services, significantly impacts trade flows in African economies. It also suggests that landlocked African countries face additional challenges, with lower LPI scores correlating with diminished trade performance. Based on a sample of 39 nations globally from 2007 to 2018, Katrakylidis and Madas (2019) investigate the correlations between countries' logistics performance, international trade, and economic growth and pinpoint potential causal links among them. They conclude that the performance of logistics and global trade both act as catalysts for economic expansion; there is a long-run bidirectional causal relationship between LPI and trade.

Adelajda Zaninović et al. (2021) investigate the effects of logistics performance on international trade, comparing the European Union 15 (EU15) countries with Central and Eastern European countries (CEMS). The results reveal that logistics performance significantly boosts trade in both regions, with EU15 countries showing a stronger correlation due to advanced logistics systems. The study implies that logistics is a pivotal factor in enhancing trade competitiveness and economic development. Barakat et al. (2023) examines the influence of the logistics performance on trade in Europe, by using a panel data set of 27 European countries during 2007-2021. They find that higher logistics performance, particularly in infrastructure and international shipments, significantly enhances trade flows in EU countries. They also suggest improving logistics systems to strengthen regional trade

and economic integration and to improve European trade competitiveness.

Based on the above empirical studies regarding logistics performance and trade flows, it can be seen that high logistics performance is crucial in promoting international trade flows. Yet few research have examined its impact on China-ASEAN bilateral trade flows. Therefore, one sub-objective of this research is to study the effect of logistics performance improvement on the trade flows between China and ASEAN countries.

Table 2.3 : List of Studies about Logistics Performance and Trade

Authors	Data Time Period	Method	Results
Hoekman and Nicita (2011)	2004-2006	PPML estimator	Logistics performance has a positive effects in expanding developing country trade.
Korinek and Sourdin (2011)	2008	Poisson regression	Trade flow growth is strongly impacted by logistics performance. By lowering the cost of shipping goods, high-quality logistics services increase a nation's export competitiveness.
Martí et al. (2014)	2005-2010	Gravity model of trade; Probit regression	There is an positive and significant influence of LPI components in international trade
Puertas et al. (2014)	2005-2010	two-stage Heckman model	Improved logistics enhance export capacity
Bensassi et al. (2015)	2003-2007	Regression with random effects approach and IV method	Regional logistics and infrastructure positively impact export flows
Gani (2017)	2007-2014	OLS	There is a statistically significant positive relationship between overall logistics performance and trade flows, particularly exports.
Çelebi (2019)	2015	Negative Binomial Pseudo-Maximum Likelihood (NBPML) method,	Logistics performance positively and significantly influences trade flows, with components like infrastructure, timeliness, and quality showing the greatest impact.
Buvik and Takele's (2019)	2016	Heckman selection approach	Logistics performance, particularly in customs efficiency, infrastructure, and quality of logistics services, significantly impacts trade flows in African countries
Katrakylidis and Madas (2019)	2007–2018.	PMG model; Toda-Yamamoto Granger-causality approach	There is a long-run bidirectional causal relationship between LPI and trade.
Zaninović et al. (2021)	2010-2018	a structural gravity model with Poissonpseudo-maximum probability estimator	Bilateral trade is affected differently by variations in LPI values; logistics performance significantly boosts trade in both EU15 and CEMS countries.
Barakat et al. (2023)	2007 - 2021	fixed-effects regression	Higher logistics performance, particularly in infrastructure and international shipments, significantly enhances trade flows.

(2) Trade facilitation and trade flows

The promotion effect of trade facilitation on trade flows has been examined and verified by abundant researches. Felipe and Kumar (2012) also use a gravity model of trade to examine the function of trade facilitation in Central Asia. They indicate that effective trade facilitation is crucial for promoting regional trade cooperation in Central Asian countries. Yadav (2014) investigates the effects of trade facilitation on the trade in parts and components. The study results show that trade facilitation reforms can lower transaction costs, increase the efficiency of global value chains, and promote the movement of parts and components, and finally improve export and manufacturing competitiveness in international market.

Zaki (2015) examines how trade facilitation impacts international trade and explores the effects of trade facilitation measures on trade efficiency, market access, and trade volume. It finds that there is a positive impact of streamlined trade processes on promoting international trade. Sá Porto et al. (2015) demonstrate that trade facilitation significantly enhances trade performance and improve trade diversification by reducing transaction costs and simplifying customs processes. This study suggest that trade facilitation measures play a crucial role in improving international trade competitiveness when countries' tariff reductions have met limitations or are stable.

Sakyi and Afesorgbor (2019) select 52 African countries as a sample to examine the effects of trade facilitation based on gravity model of trade, and employ some indicators, such as time, cost, documents numbers, and others to represent trade facilitation. Their findings show that the higher trade facilitation, the better trade

performance in African countries and reductions in the real cost to export and import across borders to improve trade facilitation promote intra-trade in African countries. They also argue it is necessary to improve Africa's trade facilitation to reduce trade costs within African countries, because compared to other regions, Africa's trade facilitation is at low level. Ali and Shakoor (2020) explore the impact of trade facilitation on trade flows in Asian countries and find that tariff reduction, documentation requirements, trade costs and time, as well as ICT and infrastructure significantly increase trade flows. They indicate to improve ICT and infrastructure to reduce transaction time and cost, and to raise trade efficiency in Asian countries.

Yu and Luu (2020) examine the impact of trade facilitation on Vietnam's trade flows with a gravity model of trade. The study finds that trade facilitation improvements, especially in customs efficiency, infrastructure, and trade-related logistics, significantly boost the import and export volume of Vietnam. They point out that trade facilitation measures not only reduce transaction costs but also promote trade diversification. Based on an augmented Global Trade Analysis Project (GTAP) model, Avetisyan and Hertel (2021) analyze the effects of trade facilitation improvements on transportation mode choices and global trade flows. Their study indicates that improved logistics performance leads to increased reliance on air transportation due to reduced costs and enhanced efficiency; better logistics facilitate greater trade volumes and alter global trade patterns, favoring faster and more efficient transport modes. By using a firm-level customs dataset from 2005-2016 of Egypt, Hendy and Zaki (2021) apply Poisson-Pseudo Maximum Likelihood (PPML) estimation with a gravity model of trade to address the challenges of zero trade flows. They imply that administrative time delay is a trade cost which significantly hinders

firms' exports. This effect is more severe for smaller and medium-sized exporters. They emphasizes the importance of reducing time to improve customs processes and trade facilitation to boost exports and integrate in global value chains.

Kurul (2023) investigates the influence of trade facilitation on export diversification in developing and least developed countries (LDCs). It uses ICT infrastructure and overall infrastructure quality as the hard factors of trade facilitation, and border efficiency and business environment as the soft factors of trade facilitation.The results show that both hard factors and soft factors affect countries' export diversification; border efficiency promotes product and market diversity broadly, while ICT infrastructure is particularly significant for LDCs. The impact of trade facilitation in encouraging company participation in global value chains (GVCs) is examined by Reddy and Sasidharan (2024). Their empirical results demonstrate that while customs regulations discourage businesses from participating in GVC, loan availability and the use of digital communication promote businesses' supply chain integration. Additionally, this study reveals that different enterprises experience different effects of trade facilitation on GVC involvement. Kumari (2024) evaluates the impact of trade facilitation measures on international trade flows using a structural gravity model. The study utilizes OECD Trade Facilitation Indicators (TFIs), and finds that trade facilitation has significant positive effects on agriculture and manufacturing trade and helps to maximize global trade benefits.

The above empirical studies fully show the importance of trade facilitation in international trade flows. Yet how trade facilitation measures affect China-ASEAN bilateral trade flows have not been studied. Therefore, one sub-objective of this

research is analyze the impact of trade facilitation on the bilateral trade flows between China and ASEAN countries.

Table 2.4 : List of Studies about Trade Facilitation and Trade

Authors	Data Time Period	Method	Results
Felipe and Kumar (2012)	2005	Heckman Maximum Likelihood (ML) estimator, gravity model of trade	Trade increases because of trade facilitation improvement in Central Asian countries.
Yadav (2014)	2004-2007	the Poisson pseudo-maximum likelihood (PPML) and Heckman Selection estimation	Importers' overall trade facilitation policies have a greater impact on the promotion of parts and components than on the trade in finished goods.
Zaki (2015)	N/A	PLS with augmented gravity model	It confirms that trade facilitation significantly affects international transaction time.
Sá Porto et al. (2015)	2011-2012	Regression with random effects & fixed effects, poisson maximum likelihood (ML) estimator	Trade facilitation measures as a whole improve international trade flows for 72 countries
Sakyi and Afesorgbor (2019)	2006-2015	structural gravity model; dyadic country fixed effects;	Reductions in the real cost to export and import across borders to improve trade facilitation promote intra-trade in African countries.
Ali and Shakoor (2020)	1990-2018	Regression with random effects & fixed effects,	Improving trade facilitation can boost the amount of trade and make economies more open for higher economic growth in Asian nations.
Yu and Luu (2020)	2007-2018	GMM, gravity model of trade	Trade facilitation has a positive and significant impact on Vietnam's exports and imports.
Avetisyan and Hertel (2021)	2007-2012	GTAP analysis model	Improvement of trade facilitation, denoted by logistics performance in the poorest countries, lowers the total cost of transportation and the quantity of services needed for it, which in turn encourages trade flows.
Hendy and Zaki (2021)	2005-2016	PPML; gravity model of trade	Administrative time delay is a trade cost which significantly hinders firms' exports. This effect is more severe for smaller and medium-sized exporters.
Kurul (2023)	2007-2017	System GMM, IV-2SLS	Trade facilitation promotes countries' export diversification.
Reddy and Sasidharan (2024)	2006–2018	Probit regression with Instrumental Variables (IV) method	Customs regulations discourage businesses from participating in GVC; trade facilitation has positive, varied effects on the GVC involvement of both larger and less productive businesses.
Kumari (2024)	2012-2019	Poisson pseudo-maximum Likelihood; gravity model of trade	Improved trade facilitation performance promotes agriculture trade and manufacturing trade.

2.2.3 Trade Effects of Free Trade Agreement

In this section, the empirical studies about trade effects of free trade agreements, as well as the impact of China-ASEAN free trade area (CAFTA), will be illustrated.

There are abundant studies which attempt to study the effect of free trade agreement on bilateral or multilateral trade quantitatively. Okabe (2015) uses data from 2002 to 2012 and a gravity model of trade to examine the effect of ASEAN+1 Free Trade Agreements. Based on the Poisson Pseudo-Maximum Likelihood (PPML) method, this study indicates that the ASEAN-China Free Trade Agreement (ACFTA) and the ASEAN-Korea Free Trade Agreement (AKFTA) greatly expand trade between member nations in capital goods, consumer goods, and industrial supplies; however, due to overlapping bilateral accords, the ASEAN-Japan Free Trade Agreement (AJCEP) exhibits little trade creation. It emphasizes that in order to achieve greater trade facilitation, more recent free trade agreements (FTAs) need to include more comprehensive tariff eliminations and simplified rules of origin. Anderson and Yotov (2016) examine the effects of Free Trade Agreements (FTAs) on bilateral trade by using structural gravity models. The study reveals that FTAs significantly increase trade volumes among members, particularly in manufacturing sectors; yet FTAs also cause minor losses for non-members. It indicates that gains from FTAs are unevenly distributed, with some countries experiencing large trade benefits while some outsiders experiencing little losses.

Ebell (2016) examines the impact of trade agreements on trade flows using data from 42 nations in 2014, including OECD and BRIICS economies. The study addresses the problems of zero trade flows and heteroskedasticity by using a gravity model

estimated with Poisson Pseudo-Maximum Likelihood (PPML) approach. It is found that compared to less extensive free trade agreements (FTAs), European Economic Area (EEA) membership greatly expands bilateral trade in both commodities and services; higher trade flows are boosted by deeper economic integration agreements, especially in the services sector where regulatory harmonization and non-tariff obstacles have a higher effect than tariff reductions.Doan and Xing (2018) analyze the role of free trade agreements (FTAs) in shaping trade efficiency by using Vietnam's exports to its 28 trade partners during 1995-2013. A stochastic gravity model with maximum likelihood estimates is applied in this study. It is found that over the study period, Vietnam's trade efficiency improved dramatically, especially with ASEAN nations; its trade efficiency is positively impacted by its membership in ASEAN.

Baier et al. (2019) examine the heterogeneous effects FTAs on trade based on over 900 FTAs. The study reveals that two-thirds of the observed heterogeneity arises within FTAs, driven by factors such as geographic distance and pre-existing trade barriers. Results show that FTAs tend to yield weaker effects for trade pairs with high initial trade frictions or existing agreements. Conversely, countries with lower market power in trade negotiations gain relatively larger concessions. Grieveson et al. (2021) use a sample of six countries over 2000-2018 in the Western Balkans to examine the impact of FTAs on trade flows. Their fixed effect estimation with structural gravity modeling show that Central European Free Trade Agreement (CEFTA), significantly boostsintra-regional trade flows; regional trade liberalization through comprehensive FTAs positively influences trade integration and economic ties.

This study emphasizes the importance of addressing heterogeneity in analyzing trade effects of FTAs. French and Zylkin (2024) examine the effects of free trade agreements (FTAs) on product-level trade flows using data from 116 countries between 1991 and 2015. With PPML estimation, the study investigates the differential impacts of FTAs on products that were "least traded" prior to FTAs. They find that trade creation of FTAs occurs predominantly in "least-traded products", yet trade in more intensively traded products declines. Zhang and Li (2024) investigate the impact of FTAs on China's outbound labor services based on panel data from 164 countries during 2008-2017. With a multi-period Difference-in-Differences (DID) method, the study demonstrates that FTAs significantly enhance China's foreign labor exports, particularly to developing countries. The analysis identifies contractual engineering as a primary beneficiary of FTA-induced labor export growth. The findings imply the heterogeneity of FTA impacts across different dimensions.

China-ASEAN Free Trade Area

Some studies also have analyzed the impact of China-ASEAN Free Trade Agreement (CAFTA). For example, Zhang et al. (2018) explore the impact of CAFTA on the export performance of Chinese firms, by applying a difference-in-differences approach with data from 700 Chinese listed firms. The study shows that CAFTA significantly increases Chinese firms' export volumes to ASEAN countries; yet the trade effect of CAFTA varies across firms. Firms with stronger technological competence and richer regional export experience benefit more, while state-owned enterprises are less responsive due to structural inefficiencies and political priorities.

Jie and Zhihong (2020) investigate the trade creation effect of the China-ASEAN Free Trade Area (CAFTA) using a gravity model of trade with data from 23 countries across multiple regions, including North America, Asia, and Europe. The study finds that while CAFTA increases trade volume, the effect is not statistically significant. It suggests the need for infrastructure development, differentiated regional cooperation, transportation efficiency improvement and non-tariff barriers reduction to promote intra-regional trade in CAFTA. Darmanto et al. (2021) assess the impact of CAFTA on Indonesia's major plantation exports by applying generalized method of moments (GMM) for panel data analysis from 2007 to 2017. This study finds that CAFTA has generated trade creation for coffee, rubber, and palm oil exports. Conversely, cocoa exports exhibit a trade diversion effect because of increased competition from other ASEAN countries. It points out the necessity for Indonesia to improve infrastructure and logistics performance to increase its export competitiveness.

Whether the full establishment of CAFTA played an crucial and important role in the bilateral trade creation between China and ASEAN is a significant research issue to explore. Therefore it is significant and meaningful to examine the trade creation effect of CAFTA between China and ASEAN, and detailed analyze its effect on different main commodity categories. Moreover, to analyze the trade effects of free trade agreements and free trade areas, one commonly used model is the gravity model of trade and one suitable estimation approach is the difference-in-differences (DID) approach. Thus this research combines the gravity model of trade with DID methodology to study the trade effects of CAFTA on China-ASEAN bilateral commodity trade.

Table 2.5 : List of Studies about Trade Effects of FTA

Authors	Data Time Period	Method	Results
Okabe (2015)	2002-2012	Poisson Pseudo-Maximum Likelihood (PPML)	ASEAN-China Free Trade Agreement and ASEAN-Korea Free Trade Agreement greatly expand trade between member nations in capital goods, consumer goods, and industrial supplies; ASEAN-Japan Free Trade Agreement exhibits little trade creation.
Ebell (2016)	2004-2014	Poisson Pseudo-Maximum Likelihood (PPML) ; gravity model of trade	Compared to less extensive free trade agreements (FTAs), European Economic Area (EEA) membership greatly expands bilateral trade in both commodities and services; higher trade flows are boosted by deeper economic integration agreements,
Anderson and Yotov (2016)	1990-2002	Poisson Pseudo-Maximum Likelihood (PPML)	Greater FTA benefits are linked to more FTA partners and a greater rise in the amount of trade brought about by FTAs.
Doan and Xing (2018)	1995-2013	A stochastic gravity model with maximum likelihood estimates	Vietnam's trade efficiency improved dramatically, especially with ASEAN nations; its trade efficiency is positively impacted by its membership in ASEAN.
Baier et al. (2019)	1986-2006	Two-stage least square method, Poisson Pseudo Maximum Likelihood (PPML)	Similarly, new free trade agreements have less of an impact on pairs that already have agreements in place. The effects of FTAs are highly heterogeneous, with most variation occurring within agreements rather than across different agreements.
Zhang et al. (2018)	2008-2011	difference-in-difference analysis	The establishment of CAFTA generally stimulated Chinese firms' exports to ASEAN countries.
Jie and Zhihong (2020)	2010-2020	OLS regression with gravity model of trade	Although the effect is not significant, the achievement of CAFTA result in a rise in trade volume.
Darmanto et al. (2021)	2007-2017	Generalized Method of Moments (GMM)	The ASEAN-China Free Trade Area (ACFTA) shows trade creation for coffee, rubber, and palm oil, and trade diversion for cocoa.
Grieveson et al.(2021)	2000-2018	Fixed effect estimation with structural gravity modeling	Central European Free Trade Agreement (CEFTA),significantly boostsintra-regional trade flows; regional trade liberalization through comprehensive FTAs positively influences trade integration and economic ties.
Zhang and Li (2024)	2008-2017	multi-period difference-in-differences (DID) method and the CSDID method	The signing of Free Trade Agreements (FTAs) significantly enhances China's foreign labor export, particularly to developing countries, and this effect is more pronounced in contractual engineering industries.
French and Zylkin (2024)	1991-2015	Pooled, product-level gravity estimation; Poisson Pseudo-Maximum Likelihood (PPML)	Less-intensively traded products (LTPs) experience relatively faster rates of trade creation after liberalization.

CHAPTER 3

METHODOLOGY

In this part, this research discusses the research framework, and research methodology, research data and estimation methods. Data of this research are all secondary data. This research is a completely quantitative research. All the used data come from official databases, such as the UNTCAD database, the World Bank database, the World Heritage Fund, the CEPII database, China National Bureau of Statistics, and the the World Economic Forum.

3.1 Objective 1: Impact of Monetary Freedom, Trade Liberalization on China-ASEAN Bilateral Commodity Trade Flows

3.1.1 Theoretical Framework

One commonly used model to study the bilateral trade flows is the structural gravity model of trade. This research will employ the structural gravity model of trade to study the bilateral commodity trade flows between China and ASEAN. The structural gravity model of trade that has strong theoretical foundations is frequently used to study bilateral trade. The gravity model of trade origins from Newton's Law of Universal Gravitation. The equation of this law is defined as follows (Yotov et al., 2016):

$$F_{ij} = G \cdot \frac{M_i M_j}{D_{ij}^2} \qquad \text{Eq. (3.1.1)}$$

Here

F_{ij} gravitational force between objects i and j

G gravitational constant

M_i object i's mass

M_j object j's mass

D_{ij} distance between objects i and j

When applied in international trade area, this gravity model equation is defined as follows (Yotov et al., 2016):

$$X_{ij} = G \cdot \frac{Y_i E_j}{T_{ij}^{\theta}} \quad \text{Eq. (3.1.2)}$$

Here

X_{ij} exports from countries i and j

G inverse of world production G=1/Y

Y_i country i 's domestic production

E_j country j 's aggregate expenditure

T^{θ}_{ij} total trade costs between countries i and j

In this research, with the panel data, the structural gravity model of trade is applied to analyze the trade creation effect of CAFTA and analyze other impact factors which significantly promote the bilateral trade between China and ASEAN countries. This study makes use of Isard's (1954) gravity model of trade, which demonstrates that the GDP sizes of the two countries have a positive impact on bilateral trade flows, but their distance has a negative effect. The following is the definition of the trade gravity model's basic model:

$$TV_{ij} = A \cdot \frac{G_i G_j}{D_{ij}} \quad \text{Eq. (3.1.3)}$$

The total trade volume (TV_{ij}) between country i and country j is shown below. A is a fixed value. G_i and G_j represent the respective GDPs of countries i and j. The distance that exists between country i and country j is denoted by D_{ij}. When the

equation's natural logarithms for both sides are subtracted, it becomes:

$$ln\, TV_{ij} = \beta_0 + \beta_1 lnG_i + \beta_2 ln\, G_j + \beta_3 lnD_{ij} + e_{ij} \quad \text{Eq. (3.1.4)}$$

Based on the gravity model of trade of Isard (1954), the first objective of this research is to examine the impact of monetary freedom and trade liberalization on China-ASEAN bilateral trade flows. Figure 3.1 illustrates the influencing mechanism diagram of objective 1. The main explanatory variables in objective 1 are monetary freedom and trade liberalization.

Monetary freedom is one important aspect of economic freedom, which evaluate a country's currency stability and government intervention extent in price control. This component reflects the degree to which individuals and businesses can engage in transactions without facing significant inflation or government-imposed price distortions (The Heritage Foundation, 2024). Monetary Freedom score is calculated using weighted average inflation rate and price controls. High monetary freedom implies low inflation rate and minimal government intervention in price controls. Increased monetary freedom with reduced inflation and stable pricing, facilitates trade growth, because stable monetary policies enhance trust in a country's economic environment, making it more attractive for trade (Sonora, 2008). Higher monetary freedom can reduce exchange rate volatility, which supports stable trade relationships (Eichengreen and Taylor, 2003). Here the monetary freedom index reported by the Heritage Foundation is employed as the core explanatory variable in objective 1.

Trade liberalization is another core explanatory variable in objective 1. Trade liberalization gives nations the opportunity to focus on manufacturing goods and services where they have a comparative advantage, which can enhance overall efficiency and boost trade flows (Krueger, 1997). Trade liberalization can also attract FDI which subsequently fosters trade through multinational operations (Yanikkaya, 2003). It can broaden market access for businesses and bring more competition to firms, which in turn pushes firms to increases productivity and competitiveness in export sectors (Winters et al.,2004). Moreover, by lowering or removing tariffs, quotas, and regulatory barriers, trade liberalization reduces the cost of importing and exporting goods (Wacziarg and Welch, 2008). Reduced trade barriers also facilitate the integration of firms into global value chains, where intermediate goods and services flow seamlessly across borders, increasing overall trade volumes (Baldwin, 2012). Last but not the least, trade liberalization can lead to increased foreign-exchange reserves and motivate exports by providing equal incentives for domestic sales and exports, which enhances a country's export performance (Choksi et al., 2019).

This research also selects several control variables to ensure the reliability of the results in objective 1. Based on the gravity model of trade (Isard, 1954), it selects GDP per capita, population, and distance as control variables. Higher GDP per capita reflects greater purchasing power, enabling consumers to afford a wider variety of goods and services, including foreign products (Baier and Bergstrand, 2001; Tan and Zhou, 2015). A larger population typically leads to higher domestic demand for goods and services, including imported products (Anderson and van Wincoop, 2003). A larger population can also provide a bigger labor force to

increase production of goods and services for export (Bergstrand and Egger, 2007). The greater the distance, the higher the transportation costs between two trade countries. Trade distance is negatively correlated with trade flows (Isard, 1954; Anderson and van Wincoop, 2003).

Furthermore, this research also selects the membership of WTO as a control variable. By committing to reducing tariffs and non-tariff barriers, WTO members make it easier for countries to engage in international trade. Membership of WTO often leads to significant reductions in tariffs, subsidies, and import quotas, which reduces the costs of trading goods and services across borders and boosts trade flows (Subramanian and Wei, 2007; Van Hoa, 2010; Grant and Boys, 2012; Larch et al., 2019; Gnangnon, 2023). Finally, Anderson and van Wincoop (2003) indicate that there might be multilateral resistance terms in the traditional gravity model of trade, or "remoteness" (Head, 2003; Baier and Bergstrand, 2007). Thus there is possible estimation bias in the gravity model of trade. To solve this issue, this research selects trade costs index to represent the "remoteness" to ensure the reliability of the regression in objective 1.

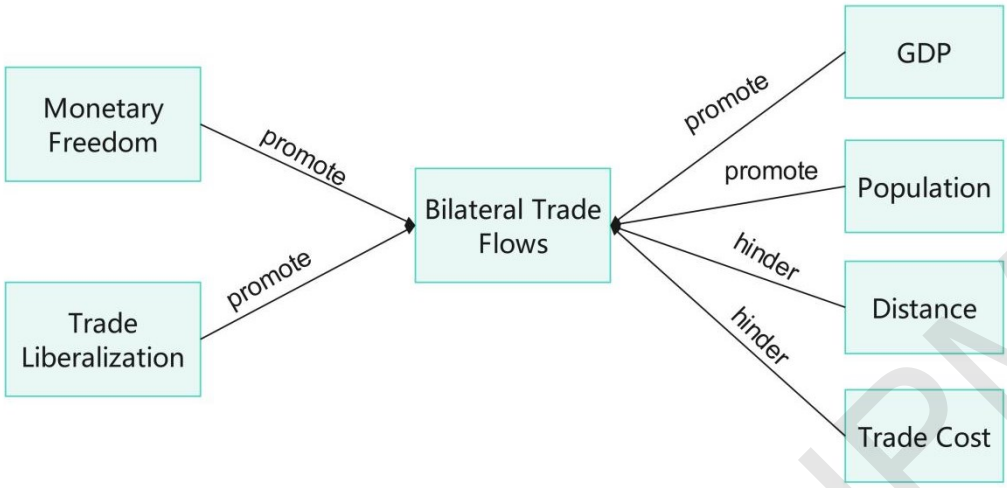

Figure 3.1 : Influencing Mechanism Diagram of Objective 1

3.1.2 Model Specification

As the objective 1 is to examine the impact of monetary freedom and trade liberalization on China-ASEAN bilateral trade flows, this research employs China-ASEAN total trade flows, China's exports to ASEAN and China's imports from ASEAN as the explained variables. The main explanatory variables monetary freedom and trade liberalization. Monetary freedom index and trade freedom index reported by the Heritage Foundation are selected to indicate monetary freedom and trade liberalization in this research. As monetary freedom index and trade freedom index are both indexes, here this research tests their impact on China-ASEAN bilateral trade flows separately. Then this research defines the model of objective 1 as follows:

Model 1.1: the impact of monetary freedom on China-ASEAN total trade value

$$\ln TV_{ijt} = \beta_0 + \beta_1 CMF_{it} + \beta_2 MF_{jt} + \beta_3 \ln CP_{it} + \beta_4 \ln TP_{jt} + \beta_5 \ln CG_{it} + \beta_6 TG_{jt} + \beta_7 DISC_{ij} + \beta_8 CONT_{ij} + \beta_9 COML_{jt} + \beta_{10} TC_{ijt} + \beta_{11} WTO_{jt} + \epsilon_{ijt} \quad \text{Eq. (3.1.5)}$$

Model 1.2: the impact of monetary freedom on China's exports to ASEAN

$$\ln EX_{ijt} = \beta_0 + \beta_1 CMF_{it} + \beta_2 MF_{jt} + \beta_3 \ln CP_{it} + \beta_4 \ln TP_{jt} + \beta_5 \ln CG_{it} +$$

$$\beta_6 TG_{jt} + \beta_7 DISC_{ij} + \beta_8 CONT_{ij} + \beta_9 COML_{jt} + \beta_{10} TC_{ijt} + \beta_{11} WTO_{jt} + \epsilon_{ijt} \quad \text{Eq. (3.1.6)}$$

Model 1.3: the impact of monetary freedom on China's imports from ASEAN

$$\ln IM_{ijt} = \beta_0 + \beta_1 CMF_{it} + \beta_2 MF_{jt} + \beta_3 \ln CP_{it} + \beta_4 \ln TP_{jt} + \beta_5 \ln CG_{it} +$$

$$\beta_6 TG_{jt} + \beta_7 DISC_{ij} + \beta_8 CONT_{ij} + \beta_9 COML_{jt} + \beta_{10} TC_{ijt} + \beta_{11} WTO_{jt} + \epsilon_{ijt} \quad \text{Eq. (3.1.7)}$$

Model 1.4: the impact of trade liberalization on China-ASEAN total trade value

$$\ln TV_{ijt} = \beta_0 + \beta_1 CTF_{it} + \beta_2 TF_{jt} + \beta_3 \ln CP_{it} + \beta_4 \ln TP_{jt} + \beta_5 \ln CG_{it} +$$

$$\beta_6 TG_{jt} + \beta_7 DISC_{ij} + \beta_8 CONT_{ij} + \beta_9 COML_{jt} + \beta_{10} TC_{ijt} + \beta_{11} WTO_{jt} + \epsilon_{ijt} \quad \text{Eq. (3.1.8)}$$

Model 1.5: the impact of trade liberalization on China's exports to ASEAN

$$\ln EX_{ijt} = \beta_0 + \beta_1 CTF_{it} + \beta_2 TF_{jt} + \beta_3 \ln CP_{it} + \beta_4 \ln TP_{jt} + \beta_5 \ln CG_{it} +$$

$$\beta_6 TG_{jt} + \beta_7 DISC_{ij} + \beta_8 CONT_{ij} + \beta_9 COML_{jt} + \beta_{10} TC_{ijt} + \beta_{11} WTO_{jt} + \epsilon_{ijt} \quad \text{Eq. (3.1.9)}$$

Model 1.6: the impact of trade liberalization on China's imports from ASEAN

$$\ln IM_{ijt} = \beta_0 + \beta_1 CTF_{it} + \beta_2 TF_{jt} + \beta_3 \ln CP_{it} + \beta_4 \ln TP_{jt} + \beta_5 \ln CG_{it} +$$

$$\beta_6 TG_{jt} + \beta_7 DISC_{ij} + \beta_8 CONT_{ij} + \beta_9 COML_{jt} + \beta_{10} TC_{ijt} + \beta_{11} WTO_{jt} + \epsilon_{ijt} \quad \text{Eq. (3.1.10)}$$

In model 1.1, the small letters i, j, and t stand for China, the nation that China trades with, and the year, respectively. The total trade value (export + import) between China and its trading partner nation (j) in year t, expressed in current US dollars, is denoted by the dependent variable TV_{ijt}. The core explanatory variable in this model is China's monetary freedom index (CMF_{it}) and its trade partner's monetary freedom index (MF_{it}). CP and TP indicates China's population and its trade partner's population, respectively. The gross domestic product (GDP) per capita of China in

year t at current US dollars, as well as that of China's trade partner j, are denoted by the independent variables CG_{it} and TG_{jt}, respectively. $DISC_{ij}$ is the physical distance between Beijing (the capital of China), and the capital of China's trading partner, j. $CONT_{ij}$ indicates whether China is contiguous or adjacent with country j, and $COML_{ij}$ refers to whether China and country j shares common language. TC_{ijt} indicates the trade costs between China and country j. WTO_{jt} indicates whether country j is a member of WTO. ε_{ijt} is the error term.

In model 1.2 and model 1.3, EX_{it} denotes China's export value to its trade partners and IM_{it} denotes China's import value from it trade partners (ASEAN countries). Other meaning of the abbreviations in the model 1.2 and model 1.3 are in line with that in model 1.1. In model 1.4, model 1.5 and model 1.5, CTF_{it} and TF_{it} indicate China's trade liberalization (trade freedom index) and its partner's trade liberalization (trade freedom index), respectively. Other meaning of the abbreviations in the model 1.4 to 1.6 are in line with that in model 1.1.

Table 3.1 also contains the variables' complete information. The World Bank provides data on GDP per capita, while UNCTAD database contains information on China's bilateral commodities trade value with ASEAN countries. The Centre d'Études Prospectives et d'Informations Internationales (CEPII) database provides information on capital distance, adjacency (contiguity), common language, and membership in the WTO. The World Heritage Fund provides the data for the trade freedom index and the monetary freedom index. The trade cost data come from ESCAP - World Bank trade cost database. According to the research model, this research expects a positive correlation between bilateral trade flow and the

following variables: GDP per capita, adjacency (contiguity), common language, WTO membership, and trade freedom, and monetary freedom index; and a negative correlation between bilateral trade flows and capital distance, and between trade flows and trade costs. In this objective, a panel data set of 8 countries (China's trade data with 8 ASEAN countries) will be used. The data of Brunei and Myanmar are excluded from the analysis due to data shortage. For the this model, it employs STATA 17.0 to conduct the data analysis. Figure 3.2 shows the methodological framework of objective 1.

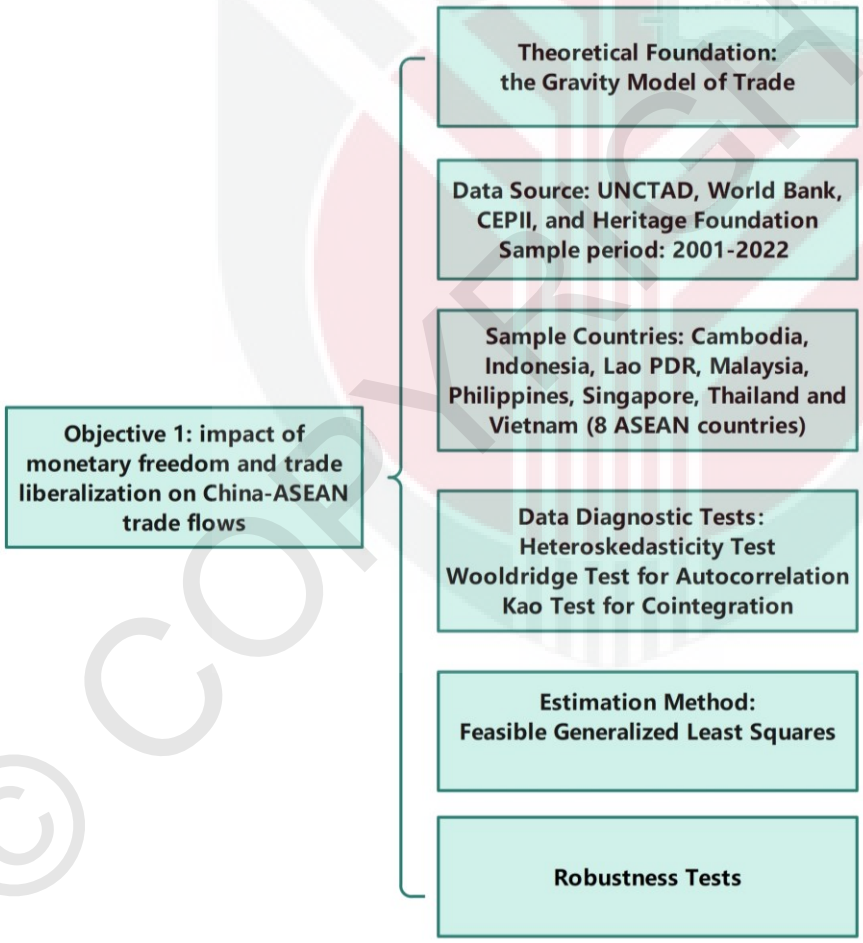

Figure 3.2 : Methodological Framework of Objective 1

Table 3.1 : Details of Variables in Objective 1

variable	specific meaning	expected sign	time span	source
dependent variable				
TV_{ijt}	Bilateral trade volume between country i China to country j		2001-2022	UNCTAD
EX_{ijt}	China's exports value to country j in year t		2001-2022	UNCTAD
IM_{ijt}	China's imports value from country j in year t		2001-2022	UNCTAD
independent variable				
CG_{it}	GDP per capita of country i China in year t	positive	2001-2022	WORLDBANK
TG_{jt}	GDP per capita of country j in year t	positive	2001-2022	WORLDBANK
CP_{it}	China's population in year t	positive	2001-2022	WORLDBANK
TP_{jt}	Country j's population in year t	positive	2001-2022	WORLDBANK
MF_{jt}	Monetary freedom index of country j in year t	positive	2001-2022	Heritage Foundation
TF_{jt}	Trade freedom index of country j in year t	positive	2001-2022	Heritage Foundation
CMF_{it}	Monetary freedom index of China	positive	2001-2022	Heritage Foundation
CTF_{it}	Trade freedom index of China	positive	2001-2022	Heritage Foundation
$DISC_{ij}$	Physical capital distance from country i China to country j	negative	2001-2022	CEPII database
$CONT_{ij}$	Whether country i China is contiguous or adjacent with country j (dummy variable), that is whether the two countries share border	positive	2001-2022	CEPII database
$COML_{ij}$	Whether country i China shares common language with country j (dummy variable)	positive	2001-2022	CEPII database
TC_{ijt}	Trade costs between China and its trade partner j	negative	2001-2022	ESCAP - World Bank trade cost database
WTO_{it}	Whether country j is a member of WTO; (dummy variable)	positive	2001-2022	CEPII database

Note: here i, j, t indicate China, China's trading partner, year t respectively.
A score of 100 is used for both the trade freedom index and the monetary freedom index.

3.2 Objective 2: Impact of Logistics Performance and Trade Facilitation on Bilateral Commodity Trade Flows

3.2.1 Theoretical Framework

Objective 2 of this research is to analyze the impact of logistics performance and trade facilitation on China-ASEAN bilateral commodity trade in the second objective. In this objective, transaction cost theory is employed to explain the influence mechanism. Transaction costs play a significant role in shaping the pattern of international trade. Countries with larger domestic markets tend to be net exporters of goods subject to scale economies, as firms prefer to locate production near larger markets to minimize transaction costs (Holzhey, 2003). High transaction costs can act as barriers to trade, affecting the competitiveness of countries. Reducing these costs can enhance trade integration and economic cooperation (De, 2006). In addition to raising transportation expenses, geographic distance also impacts the likelihood of in-person interactions between buyers and sellers, resulting in additional transaction costs that may discourage trade over long distances (Håkanson and Dow, 2012).

The improvement of logistics performance and trade facilitation can reduce transaction costs of firms, enhance trade efficiency and promote international trade flows. Figure 3.3 shows the influence mechanism in objective 2. Having a logistics system that works efficiently can boost trade and make a company more competitive in global marketplaces (Hausman et al., 2013). The importance of logistics responsiveness, efficiency, and reliability in facilitating seamless trade transactions and supply chain management (Gani, 2017). Efficient logistics practices support timely delivery, smooth cargo transportation, and trade facilitation—all of which

boost trade activity and economic expansion (Çelebi, 2019).

The Logistics Performance Index (LPI) provided by the World Bank is used to evaluate logistical performance measures, which can determine trade competitiveness, supply chain efficiency, and the overall influence on trade dynamics in international marketplaces (Martí et al., 2014). Differences in logistics performance can affect trade patterns, market access, and trade integration (Adelajda Zaninović et al., 2021). In this objective, logistics performance index (Halaszovich and Kinra, 2020; Górecka et al., 2021; Huynh and Hong, 2022; Renaldi et al., 2022) is employed as one core explanatory variable to facilitate trade flows between China and ASEAN countries.

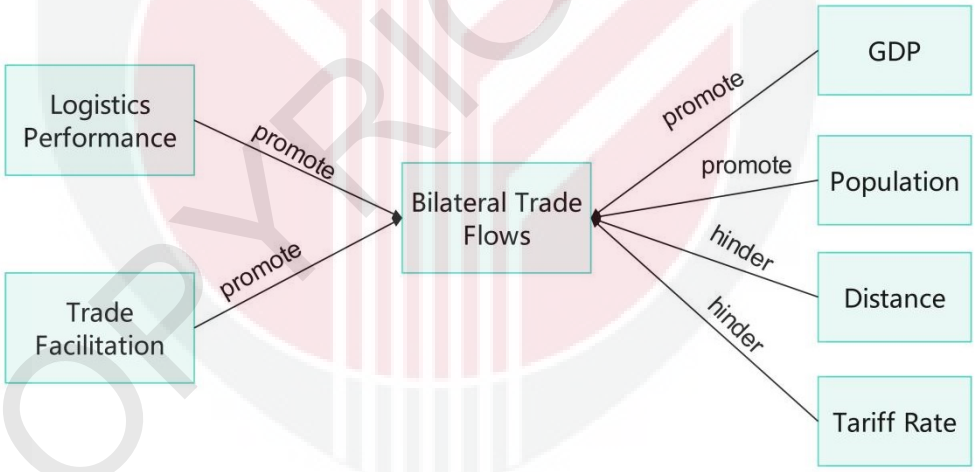

Figure 3.3 : Influencing Mechanism Diagram of Objective 2

Another main explanatory variable is trade facilitation in this research. Efficient trade facilitation measures can lead to increased trade volumes, expanded market access, and improved competitiveness for businesses. By reducing trade barriers, enhancing customs procedures, and promoting transparency in trade regulations,

trade facilitation can create a conducive environment for trade expansion and economic development (Zaki, 2015). It is necessary for policy makers to substantially improve trade facilitation to reduce trade costs, especially in developing countries. Streamlining customs processes and improving trade infrastructure, can increase trade volumes, encourage trade diversification, and improve trade performance all around (Sá Porto et al., (2015). Trade facilitation policies and reforms can raise trade competitiveness, lower trade costs, and improve trade efficiency (Sakyi and Afesorgbor, 2019). Trade facilitation policies can also affect trade flows, market access, and trade dynamics (Ali and Shakoor, 2020). Therefore, in this objective, this research select trade facilitation index (Eliason, 2015; Seck, 2016; Chakraborty and Mukherjee, 2016; Sakyi et al., 2018; Beverelli and Ticku, 2022; Hillberry and Zurita, 2022) as another core explanatory variable which impacts China-ASEAN bilateral commodity trade flows.

Wilson et al. (2005) proposed four categories to measure trade facilitation, namely, port infrastructure, customs environment, regulatory environment, e-business infrastructures. Based on the study of Zhi (2020), this research employs the trade facilitation index which has the following four main indicators: port efficiency, customs environment, institution, and e-commerce. Port efficiency mainly indicates the seaport infrastructure and airport infrastructure. Customs environment mainly indicates irregular payments, customs corruption, customs procedures simplification, and customs service quality. Institution quality refers to the regulatory transparency and stability, consistency of regulatory standards, and whether the regulations are strictly enforced. E-commerce environment indicates the country's e-commerce development degree and the extent to which e-commerce is widely used.

This research calculates the trade facilitation indexes of China and ASEAN countries, and put this new variable in the model to study the effect of the increase of trade facilitation on China and ASEAN bilateral trade. Trade facilitation index used in this research is listed in Table 3.2. The detailed indicator data come from the Global Competitiveness Report. 11 indicators for to calculate the trade facilitation index are used. The Entropy method which was provided by Jaynes (1982) is employed to standardize the data and calculate the final trade facilitation index. The data standardization processing process is as following:

$$M'_{i,j} = \frac{M_{i,j} - \min(M_{i,j})}{\max(M_{i,j}) - \min(M_{i,j})} \text{（Positive indicators）}$$

$$M'_{i,j} = \frac{\min(M_{i,j}) - M_{i,j}}{\max(M_{i,j}) - \min(M_{i,j})} \text{（Negative indicators）}$$

$$i = 1, 2 \cdots m; j = 1, 2 \cdots n$$

Eq.(3.2.1)

M'_{ij} is the results of standardization

Calculate the weight of the j index in year i：

$$P_{i,t} = M'_{i,t} / \sum_{i=1}^{x} M'_{i,t}$$

Eq.(3.2.2)

Calculate the information entropy of the j index：

$$R_j = -1 / \ln(x) \sum_{i=1}^{x} \{P_{i,j} \ln(P_{i,t})\}$$

Eq.(3.2.3)

Calculate information entropy redundancy：

$$D_j = 1 - R_j$$

Eq.(3.2.4)

Calculate the weighted indicator

$$W_i = D_j / \sum_{i=1}^{n} D_j$$

Eq.(3.2.5)

Calculation of the final index:

$$V = \sum_{j=1}^{n} W_i M'_{ij} \qquad \text{Eq.(3.2.6)}$$

Table 3.2 : Trade Facilitation Index

First-level Indicator	Second-level indicator	Value range
Institution	Government corruption index	0%-100%，0%==extremely corrupted，100%==extremely incorrupted
	Jurisdiction independence	value range 1-7， 1==extremely dependent，7==extremely independent
	Government supervision burden	value range 1-7， 1==extremely burden，7==extremely unburden
	Jurisdiction efficiency	value range 1-7， 1==extremely low，7==extremely high
Port Efficiency	Road infrastructure	value range 1-7， 1==extremely low，7==extremely high
	Railway infrastructure	value range 1-7， 1==extremely low，7==extremely high
	Seaport infrastructure	value range 1-7， 1==extremely low，7==extremely high
	Airport infrastructure	value range 1-7， 1==extremely low，7==extremely high
Customs environment	Trade barriers	value range 1-7， 1==extremely high，7==extremely low
	Customs burden	value range 1-7， 1==extremely low，7==extremely high
	Tariff	0%-100%，0%==no tariff，100%==high tariff
E-commerce	Usage of Mobile phone	%, percentage
	Broadband accession	%, percentage
	Internet penetration	%, percentage

(Source from the Global Competitiveness Report provided by the World Economic Forum; https://www.weforum.org)

3.2.2 Model Specification

As logistics performance shows one aspect of trade facilitation and there is high collinearity between logistics performance and trade facilitation, this research conducts the impact of logistics performance and the impact of trade facilitation on trade flows separately. Based on the gravity model of trade (Isard, 1954; Anderson and van Wincoop, 2003), GDP per capita, population and distance are selected as the

control variables in the model. Moreover, to solve the bias issue or "remoteness" of gravity model (Head, 2003; Baier and Bergstrand, 2007), this research adds the import tariff rate as the proxy of trade costs or "remoteness" in the model to ensure the reliability of regression results. Import tariff rate is also an important factor which affects trade flows. High import tariff rate hinders international trade flows, and low import tariff rate promotes trade flows (Caliendo and Parro, 2015; Imbruno, 2016; Orefice, 2017; Saygili et al., 2018; Cheong and Tang, 2018). To analyze the impact of logistics performance and trade facilitation on China-ASEAN bilateral commodity trade flows, the models in objective 2 are set as following.

Model 2.1: impact of logistics performance on China-ASEAN total trade value

$$TV_{ijt} = \beta_0 + \beta_1 LPIP_{jt} + \beta_2 CP_{it} + \beta_3 TP_{jt} + \beta_4 CG_{it} + \beta_5 TG_{jt} + \beta_6 DISC_{ijt} + \beta_7 TFRC_{it} + \beta_8 TFRP_{jt} + \epsilon_{ijt} \quad \text{Eq.(3.2.7)}$$

Model 2.2: impact of logistics performance on China's export value to ASEAN

$$EX_{ijt} = \beta_0 + \beta_1 LPIP_{jt} + \beta_2 CP_{it} + \beta_3 TP_{jt} + \beta_4 CG_{it} + \beta_5 TG_{jt} + \beta_6 DISC_{ijt} + \beta_7 TFRP_{it} + \epsilon_{ijt} \quad \text{Eq.(3.2.8)}$$

Model 2.3: impact of logistics performance on China's import value from ASEAN

$$IM_{ijt} = \beta_0 + \beta_1 LPIP_{jt} + \beta_2 CP_{it} + \beta_3 TP_{jt} + \beta_4 CG_{it} + \beta_5 TG_{jt} + \beta_6 DISC_{ijt} + \beta_7 TFRC_{it} + \epsilon_{ijt} \quad \text{Eq.(3.2.9)}$$

Model 2.4: impact of trade facilitation on China-ASEAN total trade value

$$TV_{ijt} = \beta_0 + \beta_1 TFS_{jt} + \beta_2 CP_{it} + \beta_3 TP_{jt} + \beta_4 CG_{it} + \beta_5 TG_{jt} + \beta_6 DISC_{ijt} + \beta_7 TFRC_{it} + \beta_8 TFRP_{jt} + \epsilon_{ijt} \quad \text{Eq.(3.2.10)}$$

Model 2.5: impact of trade facilitation on China's export value to ASEAN

$$EX_{ijt} = \beta_0 + \beta_1 TFS_{jt} + \beta_2 CP_{it} + \beta_3 TP_{jt} + \beta_4 CG_{it} + \beta_5 TG_{jt} + \beta_6 DISC_{ijt} + \beta_7 TFRP_{it} + \epsilon_{ijt} \quad \text{Eq.(3.2.11)}$$

Model 2.6: impact of trade facilitation on China's import value from ASEAN

$$IM_{ijt} = \beta_0 + \beta_1 TFS_{jt} + \beta_2 CP_{it} + \beta_3 TP_{jt} + \beta_4 CG_{it} + \beta_5 TG_{jt} + \beta_6 DISC_{ijt} + \beta_7 TFRC_{it} + \epsilon_{ijt} \quad \text{Eq.(3.2.12)}$$

In model 2.1, i, j and t refer to China, China's trade partner in ASEAN countries, and year respectively. TV indicates the total bilateral trade value between China and China's trade partner - ASEAN. LPIP is the core explanatory variable in the model and it denotes the logistics performance index of trade partner j. CP and TP stand for China's population and trade partner's population. CG and TG refer to China's GDP per capita and trade partner's GDP per capita. DISC represents the capital distance between China and its trade partner. TFRC is China's import tariff rate on its trade partner's products, and TFRP is trade partner's import tariff rate on China's products.

In model 2.2 and model 2.3, EX and IM refer to China's exports from its trade partner and China's imports from its trade partner - ASEAN. The meaning of other abbreviations in model 2.2 and model 2.3 are in line with that in model 2.1. In model 2.4, model 2.5 and model 2.6, the abbreviation TFS indicates trade partner's trade facilitation index. The meaning of other abbreviations in these models are the same with that above.

For the above models, this research employs data of each variable from 2009 to 2019 because the data for trade facilitation are only reported for 2009-2019 by the World

Economic Forum. The trade panel data between China and ASEAN countries will be used. However, due to data shortage of some countries, here this research only use the trade panel data between China and six ASEAN countries. That is Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. Other four ASEAN countries, namely, Brunei Darussalam, Cambodia, Lao PDR, Myanmar are excluded from the panel data set due to some data shortage.

The positive effects of logistics performance, trade facilitation, population, GDP per capita on China's total trade flows with ASEAN, and on China's exports to and imports from ASEAN are expected. The import tariff rate and distance are expected to have a negative relation with China's trade flows with ASEAN countries. The data of total trade value, export value, import value are from the UNCTAD database. The data of logistics performance come from the World Bank database. The data of trade facilitation are from the Global Competitiveness Report provided by the World Economic Forum. The data of population and GDP per capita are from the World Bank. The average tariff rate is from the World Bank. The data of distance come from the CEPII database. Software STATA 17.0 is used to conduct the research data analysis. The details of each variable are listed in Table 3.3. The methodological framework of objective 2 is shown in Figure 3.4.

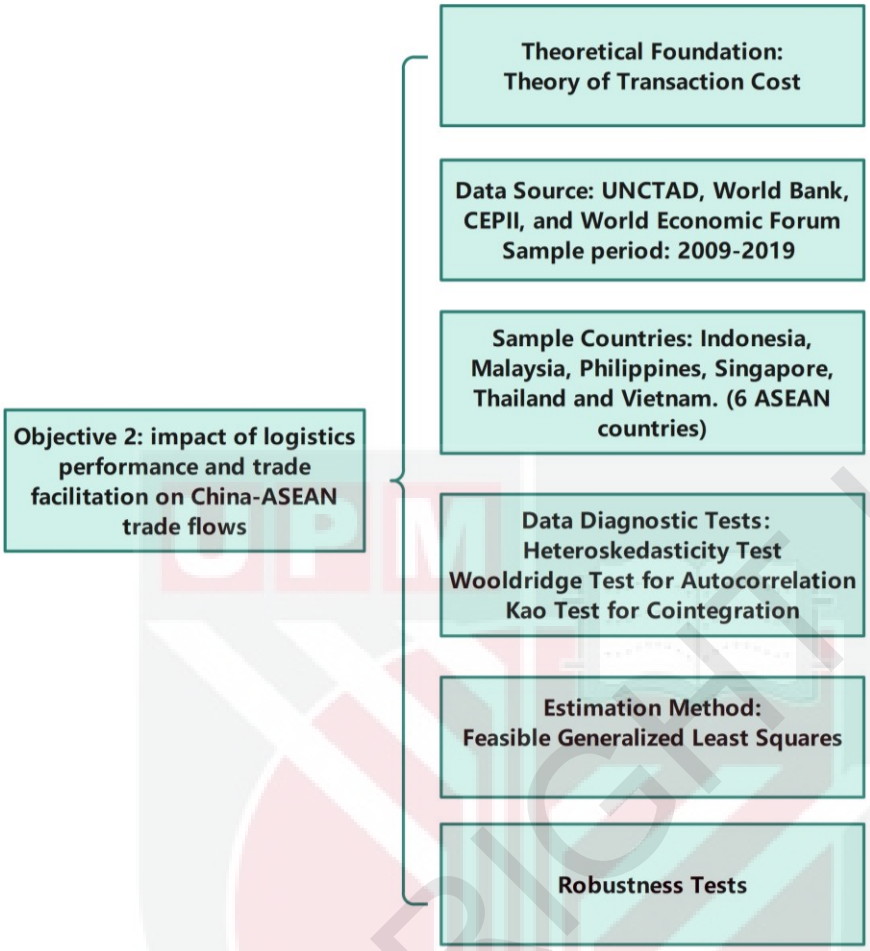

Figure 3.4 : Methodological Framework of Objective 2

Table 3.3 : Details of Variables in Objective 2

variable	specific meaning	expected sign	time span	source
dependent variable				
TV	Total trade value between China and its partner - ASEAN		2009-2019	UNCTAD
EX	China's total export value to its trade partner - ASEAN		2009-2019	UNCTAD
IM	China's total import value from its trade partner - ASEAN		2009-2019	UNCTAD
independent variable				
LPIP	Logistics performance of China's trade partner	positive	2009-2019	World Bank
TFS	Trade facilitation index of China's trade partner	positive	2009-2019	World Economic Forum
CP	China's population	positive	2009-2019	World Bank
TP	Trade partner's population	positive	2009-2019	World Bank
CG	China's GDP per capita	positive	2009-2019	World Bank
TG	Trade partner's GDP per capita	positive	2009-2019	World Bank
DISC	Capital distance between China and its partner	negative	2009-2019	The CEPII database
TFRC	China's import tariff rate on its trade partner	negative	2009-2019	World Bank
TFRP	Trade partner's import tariff rate on China's products	negative	2009-2019	World Bank

Only six ASEAN countries are included in the panel date set, namely, Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam. The data of Brunei, Laos, Myanmar and Cambodia are excluded in this objective due to data shortage of some variables.
The time period in this objective is from 2009-2019.

3.3 Objective 3: The Trade Creation Effect of CAFTA on China-ASEAN Bilateral Commodity Trade Flows

3.3.1 Theoretical Framework

The third objective of this research is to quantify the trade creation effects of China-ASEAN free trade area (CAFTA) on China-ASEAN bilateral commodity trade flows. In this objective, the theory of Preferential Trade Agreements is employed as the theoretical foundations to examine the trade creation effects of China-ASEAN free trade area (CAFTA). The concept and theory of Preferential Trade Agreements (PTAs) were first rigorously analyzed by Jacob Viner in his seminal work, "The Customs Union Issue" (1950). He introduced the concepts of trade creation and trade diversion to analyze the economic impacts of PTAs.Trade creation happens when a PTA encourages lower-cost imports from member nations to replace more expensive domestic output, improving welfare overall. On the other hand, trade diversion occurs when member countries' higher-cost imports replace lower-cost imports from non-member nations, which may diminish global welfare (Viner, 1950).

Based on Frankel et al (1997) and Baier et al (2014), PTAs can be classified into non-reciprocal PTAs, reciprocal PTAs, free trade area, customs unions, common markets and economic unions. Free trade areas(FTA) can provide two-way preferences and eliminate tariffs on a substantial part of the trade, such as NAFTA, CAFTA, and so on (Limão, 2016). FTAs create trade by substituting lower-cost imports from member nations for expensive domestic manufactures. This shift enhances efficiency and increases the overall volume of trade among member countries (Baier and Bergstrand, 2007; Mölders and Volz, 2011). Tariffs, quotas, and

other trade restrictions between member nations are eliminated or drastically reduced by free trade agreements (FTAs). Businesses may now import and export goods and services more affordably and easily because to the decrease in trade expenses, which boosts trade volumes (Cheong and Cho, 2013). Over time, the initial trade liberalization effects of FTAs can lead to dynamic gains such as economies of scale, increased productivity, and technological advancements. These dynamic effects further enhance trade flows among member countries (Breinlich, 2018).

In this objective, CAFTA is selected as the main explanatory variable to in the model to examine the trade creation effect of CAFTA. Figure 3.5 shows the influence mechanism diagram for objective 3. The establishment of CAFTA can reduce tariff trade barriers and non-tariff trade barriers between China and ASEAN countries to promote their bilateral trade flows. The increase of bilateral investment under CAFTA also boost trade flows among member countries. One commonly used estimation approach to quantify the trade creation effect of free trade area is difference-in-differences (DID) method, such as Alvarez and López (2008), Dava (2012), Hayakawa (2015), Ahmed et al. (2021), Rong and Yingli (2022), Chi et al. (2022). Therefore, the DID estimation method will be applied to analyze the trade creation effect of CAFTA.

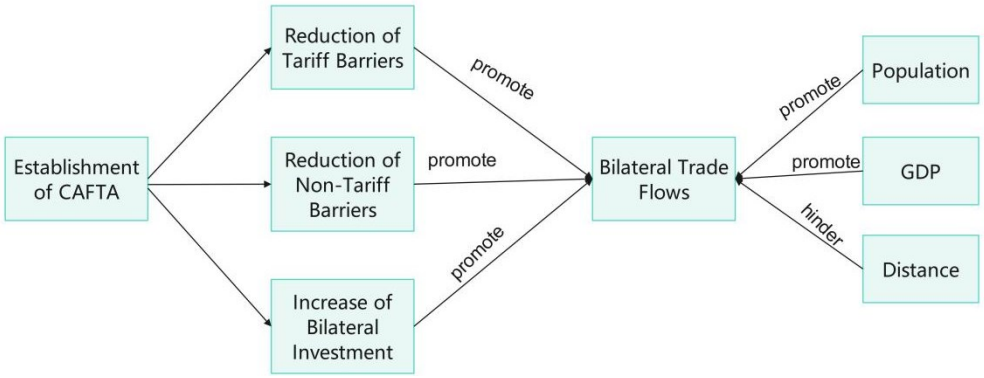

Figure 3.5 : Influencing Mechanism Diagram of Objective 3

3.3.2 Model Specification

Based on objective 3 and the model set of DID in this research, here the models for objective 3 are set as following:

Model: 3.1: impact of CAFTA on China-ASEAN total trade value

$$TV_{ijt} = \beta_0 + \beta_1 DID + \beta_2 treat_{jt} + \beta_3 post_{jt} + \beta X_{jt} + \gamma_t + \nu_j + \varepsilon_{jt} \quad \text{Eq. (3.3.1)}$$

Model: 3.2: impact of CAFTA on China's exports to ASEAN

$$EX_{ijt} = \beta_0 + \beta_1 DID + \beta_2 treat_{jt} + \beta_3 post_{jt} + \beta X_{jt} + \gamma_t + \nu_j + \varepsilon_{jt} \quad \text{Eq. (3.3.2)}$$

Model: 3.2: impact of CAFTA on China's imports from ASEAN

$$IM_{ijt} = \beta_0 + \beta_1 DID + \beta_2 treat_{jt} + \beta_3 post_{jt} + \beta X_{jt} + \gamma_t + \nu_j + \varepsilon_{jt} \quad \text{Eq. (3.3.3)}$$

Here *TV* represents the total merchandise trade value between China and its trade partner. *EX* indicates China's total merchandise export value to its trade partner and *IM* stands for China's total merchandise import value from its partner. *i* stands for China, *j* stands for trade partner and *t* is the year. *treat* is used to judge whether the sample country is a member of CAFTA. *post* indicates whether the year is at or after the establishment of CAFTA (2010). ε_{jt} represents the random disturbance term

involved in the model. X_{jt} is the control variable determined in the model. ν_j and γ_t represents the individual effect and time effect involved in model, respectively.

As objective 3 is to examine the trade effects of CAFTA on China-ASEAN bilateral commodity trade, the explained variables in objective 3 are China-ASEAN total commodity trade flows (TV), China's total commodity exports to ASEAN (EX) an China's total commodity imports from ASEAN (IM). The main explanatory variables here are *DID*, *treat*, and *post*. *DID* is the interaction of *treat* and *post,* that is *treat*×*post*. It is used here to measure the impact of CAFTA on China-ASEAN commodity trade flow changes. By comparing the differences before and after the establishment of the CAFTA with the control group, it is possible to find out the effect of the CAFTA on the bilateral trade. *treat* is a policy dummy variable with a value of 1 or 0. It indicates whether the country is a member of the CAFTA. *post* is the time dummy variable with a value of 1 or 0. It indicates whether the time is at and after the policy change (the establishment of the CAFTA).

Besides the main explanatory variables, this research also selects several control variables in the model to ensure the reliability of the empirical results. As the signing of free trade agreements often involves substantial tariff reductions, the tariff rate is added as an important control variable in this model. Moreover, the population which represents a country's market size and the gross regional product (GDP) per capita (Jayachandran and Seilan, 2010; Alvarez, 2013; Akadiri et al., 2020), which can imply a country's income level and consumption capability, are selected as the control variables in this analysis. Moreover, the population which can indicate a country market size is also selected a control variable. Based on the gravity model of

trade, the bilateral trade flow of countries is negatively related to their distance. The further the distance, the higher the delivery cost and trade cost (Yotov, 2016). Therefore, this research also select the physical distance as a control variable in the model.

Together with the main explanatory variables and control variables, here the specific models are set as following:

Model 3.1: impact of CAFTA on China-ASEAN total trade value

$$TV_{ijt} = \beta_0 + \beta_1 DID + \beta_2\, treat_{it} + \beta_3\, post_{it} + \beta_4\, CP_{it} + \beta_5\, CG_{it} + \beta_6\, TP_{jt} + \beta_7 TG_{jt} + \beta_8 TFRC_{it} + \beta_9 TFRP_{jt} + \beta_{10} DISC_{ijt} + \gamma_{it} + v_{it} + \varepsilon_{it}$$

Eq.(3.3.4)

Model 3.2: impact of CAFTA on China's exports to ASEAN

$$EX_{ijt} = \beta_0 + \beta_1 DID + \beta_2\, treat_{it} + \beta_3\, post_{it} + \beta_4\, CP_{it} + \beta_5\, CG_{it} + \beta_6\, TP_{jt} + \beta_7 TG_{jt} + \beta_8 TFRP_{jt} + \beta_9 DISC_{ijt} + \gamma_{it} + v_{it} + \varepsilon_{it}$$

Eq.(3.3.5)

Model 3.3: impact of CAFTA on China's imports from ASEAN

$$IM_{ijt} = \beta_0 + \beta_1 DID + \beta_2\, treat_{it} + \beta_3\, post_{it} + \beta_4\, CP_{it} + \beta_5\, CG_{it} + \beta_6\, TP_{jt} + \beta_7 TG_{jt} + \beta_8 TFRC_{it} + \beta_9 DISC_{ijt} + \gamma_{it} + v_{it} + \varepsilon_{it}$$

Eq.(3.3.6)

In model 3.1, i, j, t indicate China, China's trade partner and year, respectively. *TV* is the total trade value between China and its trade partner. *DID* is the interaction of *treat* and *post*, that is *treat*×*post*. *treat* is used to judge whether the sample country is a member of CAFTA. *post* indicates whether the year is at or after the establishment of CAFTA (2010). *DID* indicates the trade creation effect of CAFTA on

China-ASEAN trade flows. CP and CG indicate China's population and GDP per capita. TP and TG stands for the trade partner's population and GDP per capita. TFRC represents China's average import tariff rate towards its trade partner's products. TFRP is the trade partner's average import tariff rate towards China's products. DISC indicates the physical distance between China and its trade partners.

In model 3.2 and model 3.3, *EX* indicates China's exports value from its trade partners and *IM* refers to China's imports value from its trade partners. The meaning of other abbreviations in model 3.2 and model 3.3 are in line with model 3.1.

The source of the total commodity trade value between China and its partner (TV), China's export value to its partner (EX), and China's import value from its partner (IM) is the UNCTAD database. The data of China's population (CP), China's GDP per capita (CG), trade partner's population (TP), trade partner's GDP per capita (TG), are distance (DISC) are from the CEPII database. The average import tariff rate data come from the World Bank database. Here, a panel data set of 2000-2021 is employed to conduct the DID estimation analysis. Table 3.4 shows details of variables in Objective 3. The interpolation method is used for the missing data and software STATA 17.0 is employed to conduct the analysis. In the data analysis, the logarithm is taken for the variables except tariff rate, distance and other dummy variables.

In this objective, China's trade data with 162 countries are used. Since this research employs differences-in-differences (DID) estimation method to conduct the analysis to study the trade effect of CAFTA, it needs to set the control group and treatment

group in the data set. Six ASEAN countries are in treated group and the rest countries are in the control group. Propensity Score Matching (PSM) will be used to select the final control group countries in the final data analysis in empirical results. Here ASEAN six countries are Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. Other four ASEAN countries (Brunei, Cambodia, Laos and Myanmar) are excluded in this data set due to data shortage. Figure 3.6 shows the methodological framework of objective 3.

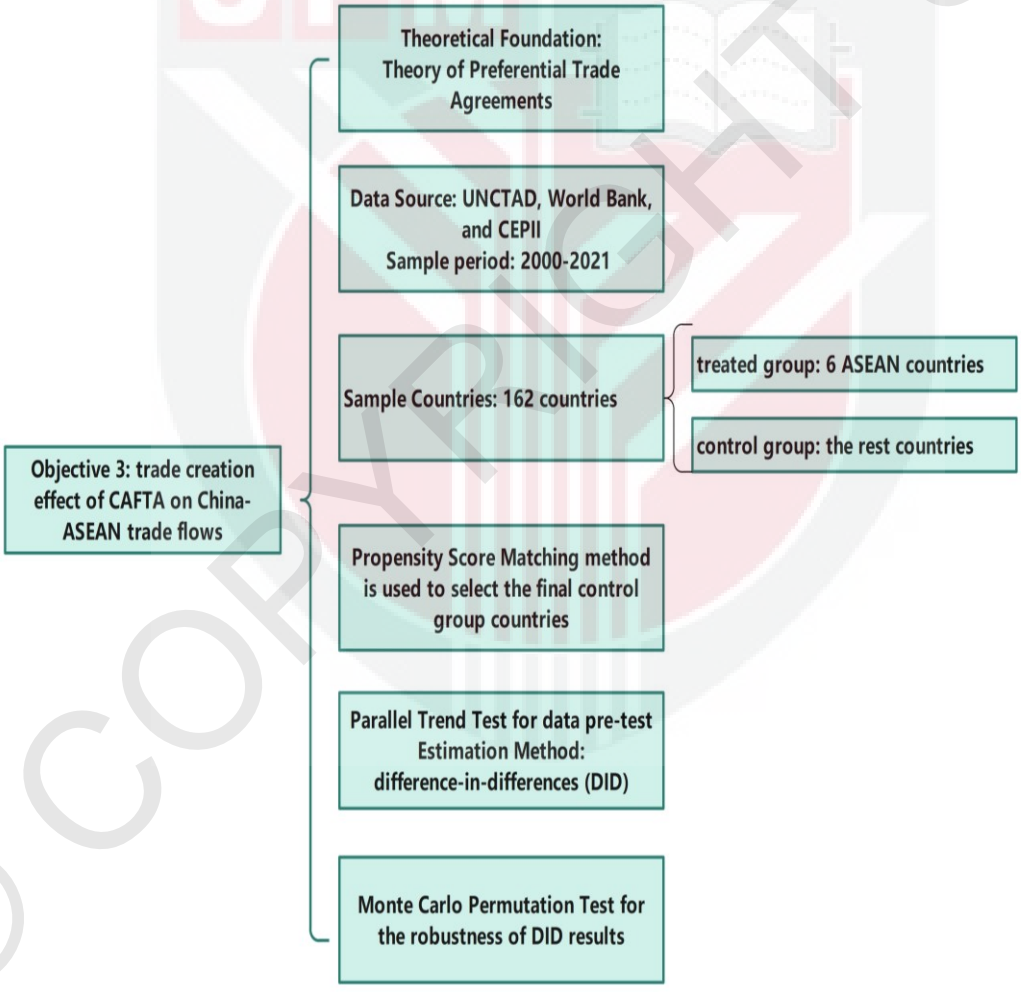

Figure 3.6 : Methodological Framework of Objective 3

Table 3.4 : Details of Variables in Objective 3

Variable	specific meaning	expected sign	time span	source
Dependent variable				
TV	Bilateral trade volume between country China and China's trade partner		2000-2021	UNCTAD
EX	China's total export value to China's trade partner		2000-2021	UNCTAD
IM	China's total import value from China's trade partner		2000-2021	UNCTAD
Core explanatory variable				
DID	Interaction term of policy (treat) and time (post)	positive	2000-2021	
treat	Dummy variable of CAFTA (1 for CAFTA member, 0 otherwise)	positive	2000-2021	
post	Dummy variable of year 2010 (1 for 2010 and after, 0 otherwise)	positive	2000-2021	
Control variable				
CP	Population of country China in year	positive	2000-2021	CEPII
CG	GDP per capita of country China in year	positive	2000-2021	CEPII
TP	Population of China's trade partner	positive	2000-2021	CEPII
TG	GDP per capita of China's trade partner	positive	2000-2021	CEPII
DISC	Physical capital distance between China and its trade partner	positive	2000-2021	CEPII
TFRC	China's average import tariff rate towards its trade partner's products	negative	2000-2021	World Bank
TFRP	Trade partner's average import tariff rate towards China's products	negative	2000-2021	World Bank

In this objective, China's trade data with 162 countries are used. Six ASEAN countries are in treated group and the rest countries are in the control group. Propensity Score Matching (PSM) will be used to select the final control group countries in the final data analysis in empirical results.

3.4 Estimation Methods

In this section, the related estimation methods panel data regression are introduced, including Generalized Least Squares regression, and Propensity Score Matching with Difference-in-Differences.

3.4.1 Feasible Generalized Least Squares

Ordinary least squares (OLS) method assumes constant variance (homoskedasticity) and independent errors in the model. However, sometimes this assumption is violated in panel data set. In this case, OLS becomes inefficient, meaning that while OLS estimators remain unbiased, their variance is no longer minimal. Generalized Least Squares (GLS) is an extension of the ordinary least squares (OLS) method. It aims to account for the structure of heteroskedasticity or autocorrelation by incorporating the variance-covariance matrix of the errors. By transforming the data using the inverse of this matrix, GLS provides efficient and unbiased estimates of model coefficients (Stedinger and Tasker, 1985).

GLS requires prior knowledge of the variance-covariance matrix of the error terms. It assumes that this matrix is known or can be directly specified. Feasible Generalized Least Squares (FGLS), on the other hand, is far more practical for use in empirical studies, as it allows the researcher to estimate the unknown error structure. It is widely used in panel data and time-series cross-sectional analyses, where errors often exhibit heteroskedasticity or serial correlation. (Umoru and Osemwegie, 2016). Unlike the ordinary least squares (OLS) method, which assumes homoscedasticity and no autocorrelation, FGLS adjusts for these issues, providing more efficient and reliable estimates under certain conditions. The application of FGLS spans various

fields, including econometrics, finance, and machine learning, underpinning its significance in empirical research. The adaptation of FGLS in dynamic factor models underscores its efficiency, especially when dealing with heteroscedastic and serially correlated errors (Wooldridge, 2020).

FGLS can significantly improve estimation efficiency over principal components in small samples. It can handle complex data structures that are common in macroeconomic and financial time series analysis. Moreover, advancements in computational methods and machine learning have also broadened the applicability of FGLS (Breitung and Tenhofen, 2011). Miller and Startz (2018) demonstrate the promise of incorporating machine learning techniques into FGLS to address heteroscedasticity, where their Monte Carlo simulations reveal considerable improvements in precision and nominal coverage rates compared to traditional OLS with heteroscedasticity-consistent standard errors. In panel data contexts, where both cross-sectional and serial correlations present challenges, FGLS methodologies have been adapted to account for such complexities. FGLS methodologies show more robust estimation results (Bai et al., 2021).

3.4.2 Propensity Score Matching with Difference-in-Differences

The number of published literature which employs difference-in-differences (DID) treatment effects for non-experimental evaluation has been increasing significantly in academic area. Difference-in-Differences (DID) estimation method is a reliable method and widely used to assess the intervention impact with the availability of panel data or repeated cross-sections data (Villa, 2016). DID estimation can help to analyze the causal effect of an intervention if there exists time-invariant unobserved

heterogeneity and may cause the confusion of cause-effect analysis (Abadie 2005; Angrist and Pischke 2009). Although there are other estimation methods which can be used for non-experimental causal inference, DID estimation can provide unbiased results if there is time-invariant unobserved heterogeneity (Villa, 2016). DID estimation approach entails keeping an eye on a subset of units both before and after they get treatment. These units are referred to as the "treated group" when taken as a whole. It is a particularly effective method for understanding causal effects by observing some units during times both before and after they get treatment (Callaway, 2023). As an important tool in policy effect evaluation, difference-in-differences (DID) estimation method is favored by more and more researchers in economic area.

According to Villa (2016), when using DID estimation, there are four elements important to be set: (1) a treated group and a control group; (2) the existence of parallel paths in the pre-treatment trends; (3) clear time cutoff of the treatment start; (4) the assumption-the treated group would have a similar trend with observed control group if there is not treatment. The difference-in-differences (DID) setting is shown in Figure 3.7.

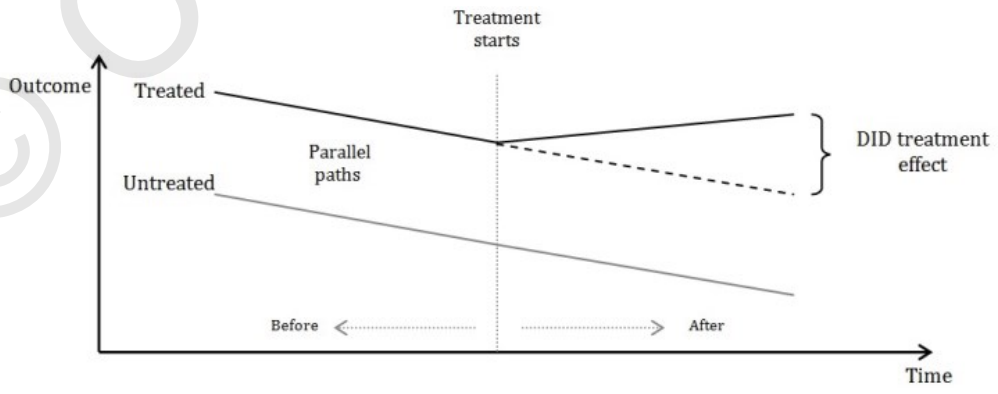

Figure 3.7 : DID Setting

Based on Villa (2016) difference-in-differences (DID) estimation approach, this research can make a clear and quantitative comparison about the trade creation effect of CAFTA on the bilateral commodity trade between China and ASEAN countries. The differences-in-differences model is set as following:

$$Y_{it} = \beta_0 + \beta_1 treat \cdot post + \beta_2 treat_{it} + \beta_3 post_{it} + \beta X_{it} \quad \text{(eq 3.4.1)}$$

Use *DID* to replace *treat·post*, it becomes:

$$Y_{it} = \beta_0 + \beta_1 DID + \beta_2 treat_{it} + \beta_3 post_{it} + \beta X_{it} \quad \text{(eq 3.4.2)}$$

Here Y_{it} represents the explained variable (trade volume), $treat_{it}$ represents the grouping dummy variable, which is assigned 1 to treatment group, and 0 to control group. $post_{it}$ is the dummy variable of intervention time, and its value is 1 at the intervention time and after it, and 0 before the intervention time. *DID* is the core explanatory variable (*treat·post*), and its coefficient value represents the treatment effect of the intervention on the explained variable.

When a predictor variable correlates with the error term, this is known as endogeneity. Apart from the unequal distribution between the control and treated groups, endogeneity is another serious mistake that hinders researchers from determining objective causal effects. According to Antonakis et al. (2010), it hinders researchers from making accurate deductions. Management researchers have employed a variety of methods that econometricians have offered to address endogeneity, such as instrumental variables, fixed effects models, and selection models. Li (2013) introduces the propensity score method (PSM) as another technique to calculate causal effects of treatment.

Propensity Score Matching (PSM) is a statistical technique introduced by Rosenbaum and Rubin (1983) to estimate causal effects in observational studies, particularly when randomized controlled trials are not feasible. PSM enables researchers to use observational data to recreate counterfactuals. It accomplishes this by minimizing bias resulting from two sources in the observational data: bias resulting from disparate density weighting and bias resulting from a lack of distribution overlap (Heckman et al., 1998). The likelihood that research participants would receive treatment based on observable features is known as a propensity score. The PSM is a unique process that determines the causal effect using matching algorithms and propensity scores (Li, 2013). PSM attempts to balance the distribution of covariates between the two groups by matching treated and control units with comparable propensity scores. This lessens the influence of confounding variables and yields more accurate estimates of treatment effects (Stuart, 2010).

Leuven et al. (2018) provides a method to calculate the propensity score and select the matching observations for analysis. First, the treatment groups and control groups need to be defined in the data. Second, a logistic regression model is applied to estimate the propensity score. The balance between the treatment and control groups will be displayed by the propensity scores. Third, depending on their propensity ratings, members of the treatment group are paired with members of the control group using standard matching techniques. After matching, it is necessary to examine whether the bias has been reduced. After reduced the bias in the observations, the final regression results of the treatment effect can be reliable (Kurz et al., 2024).

CHAPTER 4

RESULTS AND DISCUSSION

In this chapter, the empirical results of the models for the three objectives are reported and discussed. The regression results about the impact of monetary freedom and trade liberalization on China-ASEAN total bilateral trade flows are presented in the first part. In the second part, the regression results about the impact of logistics performance and trade facilitation on China-ASEAN total trade flows, and on China's export to and import from ASEAN are shown. In the third part, the trade creation effect of China-ASEAN free trade area (CAFTA) on China-ASEAN bilateral trade flows is demonstrated by applying Propensity Score Matching with Difference-in-Differences (PSM-DID).

4.1 Objective 1

As the objective in this section is to study the impact of monetary freedom and trade liberalization on China-ASEAN bilateral trade flows, the dependent variable is total trade flows and the core explanatory variables here are monetary freedom index and trade freedom index. Other explanatory variables are GDP per capita, population, capital, distance, contiguity, common language, WTO membership and trade cost index. Due to the data shortage of Brunei and Myanmar, this research only employs the panel data of eight ASEAN countries (namely, Indonesia, Malaysia, Philippine, Thailand, Singapore, Cambodia, Laos, and Vietnam) to conduct the data analysis. The time period used for the data set is from 2001-2022. The software used in this section is Stata 17.0.

4.1.1 Descriptive Statistics

The descriptive statistics of all variables used in objective 1 is reported in Table 4.1. All variables have 176 observations. The mean trade value (TV) between China and ASEAN countries in the sample data is $46.467 billion, with a standard deviation of $47.837 billion. It implies trade between China and the ASEAN countries has large differences. China's exports value (EX) to ASEAN has a mean of $24.834 billion, a standard deviation of $26.921 billion, a maximum value of $146.96 billion, and a minimum value of $0.054 billion. China's imports (IM) value from ASEAN shows a mean of $21.633 billion, a significant standard deviation of $22.641 billion, a maximum value of $109.897 billion, and a minimum value of $0.007 billion. These numbers indicate that China-ASEAN trade has large fluctuation over time and large difference within ASEAN countries as well.

The main explanatory variables in this objective are monetary freedom and trade liberalization. Here monetary freedom index and trade freedom index are used to indicate them respectively. The average monetary freedom index (MF) of ASEAN countries in the sample data is 76.419, with a standard deviation of 8.025, a maximum value of 92.9 and a minimum value of 38.1. This implies during the past two decades, the monetary freedom of ASEAN countries has been increased, and there is also large difference of monetary freedom in ASEAN countries. Singapore has the highest monetary freedom index (over 90), other undeveloped ASEAN countries have lower monetary freedom, such as Laos. The mean value of trade freedom index (TF) of ASEAN countries is 74.059, with a standard deviation of 10.333 and a range from 50.2 to 95. ASEAN's trade freedom has improved a lot during the past decades, yet there is still significant difference among ASEAN

countries. China's monetary freedom has a mean of 75.854, a standard deviation of 5.853, a range from 69.8 to 87.6. China's trade freedom has an average value of 66.773, a standard deviation of 9.217, a minimum value of 46 and a maximum value of 73.6. This implies that China's trade liberalization has a large improvement over the past decades.

Table 4.1 : Descriptive Statistics of Objective 1

Variable		Obs	Mean	Std. Dev.	Min	Max
TV	trade value in billion $	176	46.467	47.837	0.062	234.921
EX	China's export value in billion $	176	24.834	26.921	0.054	146.96
IM	China's import value in billion $	176	21.633	22.641	0.007	109.879
CP	China's population in million	176	1350.332	45.979	1271.85	1412.36
TP	Trade partner's population in million	176	69.760	76.258	4.115	275.501
CG	China's GDP per capita $	176	6527.762	2915.944	2359.572	11560.242
TG	Trade partner's GDP per capita $	176	9395.019	16169.869	518.384	67359.79
DISC	Physical distance between capital	176	3584.417	936.417	2330.799	5220.879
MF	Monetary freedom index	176	76.419	8.025	38.1	92.9
TF	Trade freedom index	176	74.059	10.333	50.2	95
CMF	China's monetary freedom index	176	75.854	5.853	69.8	87.6
CTF	China's trade freedom index	176	66.773	9.217	46	73.6
TC	Trade cost index between two countries	176	102.147	35.714	38.4	215.274

Data used in this objective contains China's trade with ASEAN 8 countries, namely, Cambodia, Indonesia, Malaysia, Laos, Philippines, Singapore, Thailand, and Vietnam. Brunei and Myanmar are excluded due to some data shortage.
Time period: 2001-2022

4.1.2 Correlation Matrix

The correlations matrices for monetary freedom and trade flows, trade freedom and trade flows are provided in Tables 4.2 and 4.3. The correlation between lnTV (trade value) and MF (monetary freedom) is moderately positive with a coefficient of 0.265, which implies that greater monetary freedom is associated with higher trade flows between China and ASEAN countries. However, the correlation between lnTV and CMF (China's monetary freedom) is negative at -0.493. This implies that China's monetary freedom does not show a positive correlation with China-ASEAN trade flows. Both lnCG (China's GDP per capita) and lnTG (trade partners' GDP per capita) show a high correlation with lnTV(trade values) with a coefficient of 0.534 and 0.621 respectively, which indicates economic development level of China and ASEAN countries are highly associated with China-ASEAN trade flows.

Moreover, it shows that both lnCP (China's population) and lnTP (trade partner's population) are positively connected with lnTV (trade value) with a coefficient value of 0.525 and 0.442 respectively. This implies that large consumption market denoted by large population is positively associated with China-ASEAN bilateral trade flows. Here lnDISC (physical distance) is found to have a positive relation with lnTV(trade flows). The reason might be that all ASEAN countries are close to China so the physical distance here does not play an important role. However it is found that TC (trade cost) is highly negatively correlated with lnTV (trade value), which indicates that trade cost hinder bilateral trade flows between China and ASEAN countries.

In addition, the trade liberalization is found high correlated with trade value. TF(trade freedom of ASEAN countries) shows a high coefficient with lnTV(trade

value) with a coefficient of 0.732, indicating that ASEAN's trade freedom is highly associated with China-ASEAN bilateral trade flows. CTF (China's trade freedom) has a moderate coefficient (0.481) with lnTV (trade value), which implies that trade freedom of China also has a positive connection with China-ASEAN bilateral trade flows.

Table 4.2 : Correlation Matrix in Objective 1 (Impact of Monetary Freedom)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) lnTV	1.000								
(2) MF	0.265	1.000							
(3) CMF	-0.493	0.054	1.000						
(4) lnCG	0.534	0.014	-0.913	1.000					
(5) lnTG	0.621	0.490	-0.188	0.212	1.000				
(6) lnCP	0.525	0.024	-0.875	0.994	0.212	1.000			
(7) lnTP	0.442	-0.261	-0.060	0.067	-0.298	0.067	1.000		
(8) lnDISC	0.313	0.386	-0.000	-0.000	0.511	-0.000	0.022	1.000	
(9) TC	-0.844	-0.149	0.293	-0.343	-0.337	-0.348	-0.523	-0.056	1.000

Table 4.3 : Correlation Matrix in Objective 1 (Impact of Trade Liberalization)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) lnTV	1.000								
(2) CTF	0.481	1.000							
(3) TF	0.732	0.364	1.000						
(4) lnCG	0.534	0.867	0.419	1.000					
(5) lnTG	0.621	0.178	0.770	0.212	1.000				
(6) lnCP	0.525	0.821	0.420	0.994	0.212	1.000			
(7) lnTP	0.442	0.057	0.014	0.067	-0.298	0.067	1.000		
(8) lnDISC	0.313	-0.000	0.463	-0.000	0.511	-0.000	0.022	1.000	
(9) TC	-0.844	-0.264	-0.457	-0.343	-0.337	-0.348	-0.523	-0.056	1.000

4.1.3 Heteroskedasticity Test Results

When the variability of the errors or residuals in a regression model is not consistent across all levels of the independent variables, this is known statistically as heteroskedasticity. To put it another way, heteroskedasticity happens when the residuals' spread or dispersion varies depending on the independent variables' values. Heteroskedasticity can result in inaccurate and ineffective estimations of the correlations between variables when panel data analysis is used. The assumption that the errors are homoscedastic (constant variance) across all data is one of the fundamental tenets of traditional linear regression that has been violated by this. Detecting and addressing heteroskedasticity is important in panel data analysis to ensure the reliability and robustness of the results (Baltagi and Baltagi, 2021). There are several ways to test heteroskedasticity, such as Breusch-Pagan Test (Breusch and Pagan, 1979; Halunga et al., 2017), White Test (White, 1980), and Wooldridge Test (Wooldridge, 1991).

Table 4.4 summarizes the results of the Heteroskedasticity test results for the models in Objective 1. In model 1.1, the heteroskedasticity test results show that Chi-squared statistic is 196.00, and the corresponding p-value is 0.0000, indicating that the model exhibits significant heteroskedasticity. In model 1.2, the heteroskedasticity test results show that Chi-squared statistic is 185.36, also with a p-value of 0.0000. This result confirms the presence of heteroskedasticity. In model 1.3, the heteroskedasticity test results show that Chi-squared statistic is 194.97, with a p-value of 0.0000, suggesting that the relationship between import values (lnIM) and monetary freedom is also impacted by heteroskedasticity. In model 1.4, the heteroskedasticity test results show that Chi-squared statistic for the model

analyzing the impact of trade liberalization on trade value (lnTV) is 176.34, with a p-value of 0.0000. This significant result shows that heteroskedasticity is present, meaning that the error terms' variance is not constant. In model 1.5, the heteroskedasticity test results show Chi-squared statistic is 149.44, with a p-value of 0.0000, confirming the presence of heteroskedasticity. In model 1.6, the heteroskedasticity test results show that Chi-squared statistic is exceptionally high at 1020.26, with a p-value of 0.0000. This large value highlights the pronounced presence of heteroskedasticity when analyzing the impact of trade liberalization on import values (lnIM). The high variance in the error terms suggests that the model's assumptions of homoskedasticity are strongly violated, indicating the need for corrective measures such as robust estimators.

In summary, the heteroskedasticity test results in Table 4.4 demonstrate that all the six models in Objective 1 maintain constant error variance across observations, signifying the presence of heteroskedasticity models. To address this issue and ensure the reliability of the regression results, adjustments such as the use of robust standard errors or generalized least squares (GLS) should be considered. This research employs feasible generalized least squares (FGLS) to solve the heteroskedasticity issues in the regression models. This will mitigate the effects of heteroskedasticity and improve the efficiency and accuracy of the model estimators in evaluating the impact of monetary freedom and trade liberalization on China-ASEAN bilateral trade flows.

Table 4.4 : Heteroskedasticity Test Result

	The impact of Monetary Freedom			The impact of Trade Liberalization		
	Model 1.1	Model 1.2	Model 1.3	Model 1.4	Model 1.5	Model 1.6
	lnTV	lnEX	lnIM	lnTV	lnEX	lnIM
Chi2	196.00	185.36	194.97	176.34	149.44	1020.26
Prob>Chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

4.1.4 Wooldridge Test Results of Autocorrelation

Autocorrelation in panel data refers to the correlation between error terms across different time periods for the same cross-sectional unit. Specifically, in a panel data context, serial correlation (or autocorrelation) occurs when the disturbances (errors) in the regression model are not independent over time, implying that an error in one period is correlated with an error in another period for a given entity. The error components must be independent and have the same distribution according to the traditional requirements of Ordinary Least Squares (OLS) regression (Miron, 1984). This premise of independence is broken by autocorrelation. OLS estimators are still objective but ineffective if autocorrelation is present and ignored. This results in inaccurate confidence intervals and possibly biased hypothesis testing since the standard errors are no longer accurately estimated. The reliability of t-tests and F-tests can be impacted by underestimating or overestimating standard errors caused by ignoring serial correlation. Inaccurate conclusions on the importance of explanatory factors may result from this (Griffith, 2000).

Several tests are proposed to detect autocorrelation in panel data models. For example, Durbin-Watson test for autocorrelation (Bhargava et al., 1982), LM test for autocorrelation (Baltagi and Li, 1991), and Wooldridge test for autocorrelation (Wooldridge, 2010) are commonly used to detect serial correlation in residuals.

These tests help determine whether there is significant evidence of autocorrelation that needs to be addressed. One way to deal with autocorrelation is by using Feasible Generalized Least Squares (FGLS) or Panel-Corrected Standard Errors (PCSE), which can accommodate the serial correlation and heteroskedasticity (Menke, 2015).

Table 4.5 presents the results of the Wooldridge test for autocorrelation in each model under objective 1. Autocorrelation in panel data models can be identified through the Wooldridge test. One of the fundamental principles of the traditional linear regression model is violated when the residuals (error terms) in a regression model exhibit cross-observation or cross-time correlations with one another. This phenomenon is known as autocorrelation. If autocorrelation is present, it can lead to inefficient estimates and biased standard errors, which may distort hypothesis testing and inference. The Wooldridge test evaluates the null hypothesis of no autocorrelation in the panel data.

The Wooldridge test results for all six models in objective 1 suggest that there is a significant autocorrelation issue in all the model (all p value <0.01). Without correcting this issue in models, the estimates may have inefficient and biased standard errors. To address this issue of autocorrelation in this panel data set in objective 1, this research applies Feasible Generalized Least Squares (FGLS) estimation method. By addressing autocorrelation, the models will yield more reliable estimates and provide a clearer understanding of the impact of monetary freedom and trade liberalization on China-ASEAN trade flows.

Table 4.5 : Wooldridge Test Result of Autocorrelation

	Model 1.1	Model 1.2	Model 1.3	Model 1.4	Model 1.5	Model 1.6
F	35.62***	53.52***	109.39***	38.94***	62.69***	111.82 ***
Prob>F	0.0006	0.0002	0.0000	0.0004	0.0001	0.0000

4.1.5 Kao Test Results for Cointegration

In panel data set, cointegration analysis can investigate the long-term relationship between variables. Sometimes, some individual variables may have trends or are non-stationary over time, but these variables are cointegrated which implies these variables have a long-term relationship, and their relationship is stable. By identifying cointegration relationships, researchers can uncover the underlying economic or statistical relationships that drive the behavior of the variables in the panel dataset (Baltagi, 2008). Cointegration analysis in panel data typically involves estimating panel cointegration models, testing for cointegration using appropriate statistical tests such as the panel unit root test, and interpreting the results to understand the long-term relationships between variables. This analysis is commonly used in econometrics, finance, and other fields where researchers are interested in studying the long-term relationships between variables in panel datasets (Wooldridge, 2010).

Given the complexity and the unique characteristics of panel data, specifically in economic studies where time and individual-specific effects are significant, Kao (1999) proposes residual-based cointegration tests in panel data. Kao (1999) effectively addresses the challenges posed by panel data sets that exhibit cross-sectional and time-series dimensions in a balanced manner. His research shows the shortcomings of conventional cointegration tests used in time-series

analysis when directly applied to panel data without adjustments for cross-section dependencies and heterogeneity across units. Kao test has flexibility and vitality in diverse economic research, and it provides robust cointegration test results (Alam et al., 2021). Kao's test is based on residuals from a pooled regression, making it relatively straightforward and computationally less intensive. It uses a null hypothesis that assumes no cointegration against the alternative of cointegration. This approach is particularly suitable when working with smaller panel datasets or when a simpler model is desired for a general test of cointegration (McCoskey and Kao, 1998).

Table 4.6 presents the results of the Kao Test for Cointegration for each model in Objective 1. The Kao test is used to determine if variables in panel data have a long-term equilibrium connection, or cointegration. Cointegration indicates that the variables in the study move together throughout time, sustaining a stable relationship despite short-term volatility. The idea that there is no cointegration between the independent and dependent variables is tested using the Kao test. The rejection of the null hypothesis suggests cointegration, which denotes a shared long-term relationship between the variables. The table presents two test statistics: the Unadjusted Modified Dickey-Fuller t and the Unadjusted Dickey-Fuller t. All the Kao test results in models of objective 1 provide evidence of cointegration, with the significance indicated by the associated p-values < 0.01. The consistently significant test statistics reject the null hypothesis of no cointegration, confirming that the variables in the models of objective 1 have a long-term equilibrium relationship.

Table 4.6 : Kao Test Results for Cointegration

	Model 1.1	Model 1.2	Model 1.3	Model 1.4	Model 1.5	Model 1.6
Unadjusted Modified Dickey–Fuller t	-4.7162***	-3.0878***	-5.1559***	-4.6766***	-3.2490***	-3.6989***
Unadjusted Dickey–Fuller t	-3.9636***	-2.4684***	-3.6337***	-3.9342***	-2.6287***	-2.6481***

*** p<0.01, ** p<0.05, * p<0.1

4.1.6 Regression Results of Objective 1

Table 4.7 and Table 4.8 present the regression results of models in objective 1. Model 1.1 evaluates the effect of monetary freedom on the overall trade value (lnTV) between China and ASEAN countries. The regression results indicate that China's Monetary Freedom (CMF) has a positive and significant impact (0.0212, $p < 0.05$) on total China - ASEAN trade value (lnTV). This implies that increases in China's monetary freedom are associated with higher trade flows between China and ASEAN. The positive relationship indicates that when China's monetary policies allows price stability and reduced inflation, it fosters an environment conducive to increased bilateral trade. Monetary Freedom (MF) of the ASEAN countries also has a strong positive effect on trade flows (lnTV) (0.0099, $p < 0.01$). The positive coefficient implies that greater monetary freedom in ASEAN countries also boosts trade between China and ASEAN.

Moreover, China's GDP per capita (lnCG) has a highly significant and positive impact (4.2798, $p < 0.01$) on China-ASEAN total trade flows. As China's per capita income increases, so does China's trade value with ASEAN countries. The large coefficient suggests that China's economic growth has a substantial positive effect on its trade flows with ASEAN countries. ASEAN's GDP per capita (lnTG) also

show a positive and significant effect (0.851, $p < 0.01$) on China-ASEAN total trade flows. This indicates that wealthier ASEAN countries engage in more trade with China. Economic development level of ASEAN countries plays an important role in driving bilateral trade flows between China and ASEAN.

The results show that China's population (lnCP) is negatively correlated with its total trade flows with ASEAN countries (lnTV) (-44.72, $p < 0.01$). ASEAN's Population (lnTP) has a positive and significant impact (0.685, $p < 0.01$) on China-ASEAN bilateral total trade flows. This implies larger ASEAN countries tend to engage more in trade with China. In addition, physical distance (lnDISC) between capitals has a negative and significant effect (-0.771, $p < 0.01$) on China-ASEAN total trade flows (lnTV), confirming that geographical distance poses a barrier to trade. Greater distance increases transport costs and logistics challenges, which reduces the trade volume between China and ASEAN. Trade Costs (TC) also show a negative and significant correlation (-0.0132, $p < 0.01$) with China-ASEAN bilateral trade flows (lnTV). This is because higher trade costs, including tariffs and non-tariff barriers, reduce bilateral trade volumes.

In China-ASEAN bilateral trade lows, common language (COML) is an important and significant factor (0.4008, $p < 0.01$). Sharing a common language, or having linguistic similarities, facilitates trade by reducing communication barriers between China and ASEAN countries. Lastly, ASEAN countries' WTO membership (WTO) is also an important factor (0.4533, $p < 0.01$) which affects China-ASEAN total trade flows. Being a member of the World Trade Organization promotes trade by reducing trade barriers and providing a stable regulatory framework for trade

negotiations.

Model 1.2 evaluates the impact of monetary freedom on China's exports value to ASEAN countries (lnEX). The regression results of model 1.2 indicate that China's Monetary Freedom (CMF) has a positive but not statistically significant coefficient (0.0202) on China's exports to ASEAN countries (lnEX). While there is a positive relationship, it is not robust enough to make strong conclusions about the effect of China's monetary freedom on export flows specifically. Monetary Freedom (MF) of ASEAN countries has a positive and significant effect (0.0101, $p < 0.05$) on China's exports to ASEAN countries (lnEX). This implies that more stable monetary environments in ASEAN countries encourage China's exports to ASEAN countries, because greater stability lowers the risks and uncertainties associated with exporting.

Model 1.3 focuses on the impact of monetary freedom on China's imports from ASEAN. The regression results of model 1.3 show that China's Monetary Freedom (CMF) has a positive but statistically insignificant coefficient (0.0141), which implies that China's monetary policy environment has a limited direct impact on China's import flows from ASEAN. Monetary Freedom (MF) of ASEAN countries is positive but not statistically significant (0.00681), implying that while more stable monetary environments may encourage China's imports from ASEAN, the effect is not strong enough to be statistically meaningful. Both regression results of model 1.2 and 1.3 indicate that GDP per capita and and population are significantly correlated with China's bilateral commodity trade flows with ASEAN countries. Additionally, it is found that trade cost is negatively correlated with China's exports to and imports from ASEAN countries.

Table 4.7 : Regression Results (Impact of Monetary Freedom)

VARIABLES	Mode1 1.1 lnTV	Model 1.2 lnEX	Model 1.3 lnIM
CMF	0.0212**	0.0202	0.0141
	(2.133)	(1.191)	(0.800)
MF	0.00997***	0.0101**	0.00681
	(3.598)	(2.134)	(1.384)
lnCG	4.279***	4.167***	3.897***
	(8.613)	(4.922)	(4.423)
lnTG	0.851***	0.783***	1.229***
	(30.63)	(16.53)	(24.93)
lnCP	-44.72***	-39.00***	-45.79***
	(-7.309)	(-3.740)	(-4.219)
lnTP	0.685***	0.745***	0.631***
	(22.52)	(14.36)	(11.71)
lnDISC	-0.771***	-1.094***	0.143
	(-6.267)	(-5.222)	(0.656)
TC	-0.0132***	-0.00662***	-0.0270***
	(-12.33)	(-3.630)	(-14.22)
COML	0.400***	0.683***	-0.471**
	(3.802)	(3.814)	(-2.527)
CONT	-0.158**	-0.172	0.181
	(-2.487)	(-1.593)	(1.606)
WTO	0.453***	0.405***	0.152
	(5.873)	(3.085)	(1.114)
Constant	912.5***	794.1***	930.2***
	(7.365)	(3.761)	(4.233)
Observations	176	176	176
Number of ID	8	8	8

z-statistics in parentheses; N=8, Time=22 (2001-2022); estimation method: FGLS
*** p<0.01, ** p<0.05, * p<0.1

Model 1.4 investigates how trade liberalization influences the overall trade value (lnTV) between China and ASEAN countries. The regression results of model 1.4 show that China's trade freedom (CTF) has a positive coefficient (0.00490) but is not statistically significant, implying that changes in China's trade policy liberalization do not significantly affect the overall bilateral trade flows with ASEAN countries. This could suggest that other factors may play a more substantial role in determining trade flows. Trade freedom (TF), which reflects the trade liberalization or trade openness of ASEAN countries, has a positive and marginally significant coefficient (0.00619, $p < 0.1$). This suggests that more liberal trade

policies in ASEAN countries, characterized by fewer tariff and non-tariff barriers, can enhance trade flows with China. This supports the argument that trade liberalization within ASEAN contributes to greater integration with China

Model 1.5 focuses on how trade liberalization affects China's exports to ASEAN countries. The regression results of model 1.5 show that China's Trade Freedom (CTF) has a small positive coefficient (0.00306) with China's exports to ASEAN, but it is not statistically significant. Trade Freedom (TF) of ASEAN countries is positive but not statistically significant (0.00157) correlated with China's exports to ASEAN countries. While more liberalized trade regimes in ASEAN countries might support China's exports to ASEAN, the effect is not strong enough to be statistically meaningful in this model.

Model 1.6 examines how trade liberalization affects China's imports from ASEAN. It is found that China's Trade Freedom (CTF) has a positive coefficient (0.00632) with China's imports from ASEAN (lnIM), but is not statistically significant. Trade Freedom (TF) of ASEAN countries, however, has a positive and highly significant impact on China's imports from ASEAN (0.0176, $p < 0.01$). This indicates that more open trade policies in ASEAN countries lead to higher export volumes to China. Greater trade freedom lowers tariffs and non-tariff barriers, making it easier and cheaper for ASEAN countries to export goods to China. In addition, in model 1.4 to 1.6, this research finds that China's bilateral trade flows with ASEAN countries are significantly influenced by both economies' GDP size and population. This show the similar results with model 1.1-1.3. Lastly, it is found that in bilateral trade flows, trade cost is an important and significant factor which is negatively correlated with

trade flows. It confirms that higher costs associated with trade reduce bilateral trade flows, and reducing trade costs would lead to increased trade flows between China and ASEAN countries.

Table 4.8 : Regression Results (Impact of Trade Liberalization)

VARIABLES	Model 1.4 lnTV	Model 1.5 lnEX	Model 1.6 lnIM
CTF	0.00490	0.00306	0.00632
	(0.869)	(0.326)	(0.674)
TF	0.00619*	0.00157	0.0176***
	(1.856)	(0.283)	(3.187)
lnCG	2.949***	3.014***	2.782***
	(5.597)	(3.440)	(3.179)
lnTG	0.815***	0.777***	1.116***
	(22.41)	(12.85)	(18.48)
lnCP	-30.24***	-26.22**	-34.40***
	(-4.501)	(-2.347)	(-3.083)
lnTP	0.652***	0.717***	0.594***
	(20.80)	(13.75)	(11.41)
lnDISC	-0.751***	-1.082***	0.174
	(-5.835)	(-5.055)	(0.815)
TC	-0.0139***	-0.00733***	-0.0275***
	(-12.52)	(-3.964)	(-14.87)
COML	0.423***	0.700***	-0.431**
	(3.848)	(3.830)	(-2.362)
CONT	-0.209***	-0.243**	0.202*
	(-3.244)	(-2.270)	(1.885)
WTO	0.422***	0.388***	0.0971
	(5.204)	(2.878)	(0.720)
Constant	622.0***	537.9**	701.8***
	(4.541)	(2.361)	(3.084)
Observations	176	176	176
Number of ID	8	8	8

z-statistics in parentheses; N=8, Time=22 (2001-2022); estimation method: FGLS
*** p<0.01, ** p<0.05, * p<0.1

Based on regression results in this section, this research finds that both China and ASEAN's GDP per capita promotes the trade flow growth between China and ASEAN countries. The growth of GDP per capita indicates the growth of a country's economic growth. With economic growth, people in the country can have higher income, and more consumption capability, which facilitates the trade growth among countries (Greaney and Kiyota, 2020). Higher economic development, enables

nations to take use of their comparative advantages, produce goods and services more effectively, and improve their competitiveness in global trade (Feenstra and Taylor, 2016).

Moreover, this research finds that China and ASEAN countries' monetary freedom positively impact the trade flows between China and ASEAN, which indicate that improvement of monetary freedom significantly reduces one important aspect of trade barriers and promotes trade flows in turn. A country with high monetary freedom usually has a stable and transparent monetary policy framework, sound financial institutions, and minimal government intervention in the financial sector. Monetary freedom can facilitate the stability of exchange rate, and then reduce currency risks and transaction costs, which in turn promotes trade flows (Rose and Engel, 2000). A country with monetary freedom emphasizes price stability and inflation control, thus helps maintain a stable macroeconomic environment, which is conducive to trade growth (Clark and MacDonald, 1999).

The large improvement of ASEAN countries' trade freedom also stimulates ASEAN's trade flows with China. The improvement of trade freedom indicates that the trade barriers of ASEAN countries have been reducing in all aspects. The reduction of trade barriers decreases the trade costs between China and ASEAN, which promotes the bilateral trade flows in turn. This research finds that China's trade freedom from 2000 to 2021 has largely improved, which also significantly reduces China's trade barriers, such as high reduction of tariff trade barriers and non-tariff trade barriers. The large reduction of China's trade barriers significantly contributes to China's large flows between China and ASEAN countries. The

positive impact of trade freedom (trade liberalization) on trade growth found in this research is also consistent with the study results of Santos-Paulino (2002), Pacheco-López (2004), Santos-Paulino (2006), Hoque and Yusop (2010), and Nordås and Rouzet (2017). Trade freedom, also known as trade liberalization, characterized by the reduction of trade barriers and the promotion of free trade, has been a focal point of economic policies for many countries aiming to enhance international trade flows and economic growth. As Bahmani-Oskooee and Hegerty (2009) mentioned, the role of trade liberalization policies can shape bilateral trade patterns and stimulate commodity trade flows. In this research, it is also found that WTO membership promotes China-ASEAN bilateral trade flows. This is confirmed with previous studies Chang and Lee (2011) and Esteve-Pérez et al. (2020) that the membership of WTO plays a significant role in facilitating bilateral trade flows between the two member countries.

4.1.7 Robustness Test Results

The results presented in Table 4.9 show the robustness tests for Models 1.1 to 1.6, where an additional control variable, China's Exchange Rate (CEXR), has been introduced to assess the consistency of the regression findings in section 4.1.6. The robustness test is essential to determine whether the inclusion of the exchange rate variable significantly alters the relationship between monetary freedom, trade liberalization, and China-ASEAN trade flows.

In Model 1.1 (lnTV), which examines the effect of monetary freedom on China-ASEAN total trade flows, the introduction of the exchange rate variable (CEXR) has a negative coefficient (-0.0407), but it is statistically insignificant. The

core variables, China's Monetary Freedom (CMF) and Monetary Freedom in ASEAN (MF), remain positively significant, with coefficients of 0.0211 ($p < 0.05$) and 0.0100 ($p < 0.01$), respectively. These results suggest that the inclusion of China's exchange rate does not alter the relationship between monetary freedom and bilateral trade flows, confirming the robustness of the original findings in section 4.1.6.

In Model 1.2 (lnEX), which focuses on China's exports to ASEAN, CEXR remains statistically insignificant (-0.0774), and the core variables like Monetary Freedom in ASEAN (MF) maintain their positive and significant impact on exports (0.0102, $p < 0.05$). This shows that monetary freedom continues to be a key determinant of China's exports, and the exchange rate does not significantly change this relationship. In Model 1.3 (lnIM), which examines China's imports from ASEAN, CEXR is also insignificant (-0.111), suggesting that China's exchange rate does not play a significant role in altering the determinants of imports from ASEAN countries. The primary variables, such as Trade Partner's GDP per capita (lnTG), remain positive and significant (1.230, $p < 0.01$), further confirming the robustness of the results in section 4.1.6.

For the models 1.4-1.6 that examine the impact of trade liberalization on China-ASEAN total trade, China's exports to and imports from ASEAN countries, the inclusion of CEXR similarly does not significantly affect the results. In Model 1.4 (lnTV), CEXR is negative (-0.0299) but statistically insignificant, while key variables like Trade Freedom (TF) remain positive and marginally significant (0.00611, $p < 0.1$). This indicates that trade liberalization continues to be an

important factor for China-ASEAN trade flows, irrespective of changes in the exchange rate. In Model 1.5 (lnEX), CEXR is again insignificant (-0.0720), and the core determinants of exports, such as Trade Partner's GDP per capita (lnTG), retain their significance (0.778, $p < 0.01$). This shows that the robustness of the export determinants is maintained, even when considering exchange rate fluctuations. In Model 1.6 (lnIM), which focuses on China's imports from ASEAN, CEXR has no statistically significant effect, and key variables like Trade Freedom (TF) (0.0172, $p < 0.01$) remain significant. This further strengthens the conclusion that trade liberalization and economic factors in ASEAN are more influential than exchange rate changes in determining China's import patterns.

In conclusion, the robustness tests show that the core findings regarding the impact of monetary freedom and trade liberalization on China-ASEAN total trade flows, China's exports to and imports from ASEAN countries are largely unaffected by the inclusion of China's exchange rate as a control variable. The insignificance of CEXR across models suggests that while the exchange rate may have some influence in other contexts, it does not substantially alter the key relationships in these models. Thus, the regression results of objective 1 remain robust in section 4.1.6.

Table 4.9 : Robustness Test Results of Models in Objective 1

	The impact of monetary freedom			The impact of trade liberalization		
	Model 1.1	Model 1.2	Model 1.3	Model 1.4	Model 1.5	Model 1.6
VARIABLES	lnTV	lnEX	lnIM	lnTV	lnEX	lnIM
CMF	0.0211**	0.0199	0.0134	--------	--------	--------
	(2.118)	(1.174)	(0.765)	--------	--------	--------
MF	0.0100***	0.0102**	0.00708	--------	--------	--------
	(3.623)	(2.161)	(1.452)	--------	--------	--------
CTF	--------	--------	--------	0.00489	0.00302	0.00623
	--------	--------	--------	(0.866)	(0.322)	(0.669)
TF	--------	--------	--------	0.00611*	0.00137	0.0172***
	--------	--------	--------	(1.831)	(0.248)	(3.125)
lnCG	4.005***	3.647***	2.683**	2.753***	2.549**	1.739
	(6.219)	(3.324)	(2.365)	(4.097)	(2.282)	(1.567)
lnTG	0.851***	0.783***	1.230***	0.815***	0.778***	1.119***
	(30.67)	(16.56)	(25.14)	(22.43)	(12.88)	(18.64)
lnCP	-41.50***	-32.88**	-31.51**	-27.93***	-20.71	-22.08
	(-5.329)	(-2.478)	(-2.297)	(-3.352)	(-1.496)	(-1.604)
lnTP	0.684***	0.742***	0.625***	0.651***	0.714***	0.588***
	(22.45)	(14.29)	(11.65)	(20.73)	(13.68)	(11.34)
lnDISC	-0.766***	-1.086***	0.163	-0.747***	-1.074***	0.191
	(-6.230)	(-5.182)	(0.751)	(-5.806)	(-5.020)	(0.897)
ITC	-0.0133***	-0.00676***	-0.0273***	-0.0140***	-0.00747***	-0.0278***
	(-12.35)	(-3.693)	(-14.43)	(-12.50)	(-4.018)	(-15.04)
COML	0.394***	0.673***	-0.494***	0.419***	0.691***	-0.452**
	(3.746)	(3.754)	(-2.666)	(3.805)	(3.774)	(-2.484)
CONT	-0.159**	-0.174	0.176	-0.211***	-0.247**	0.195*
	(-2.505)	(-1.613)	(1.579)	(-3.264)	(-2.301)	(1.826)
WTO	0.448***	0.396***	0.130	0.419***	0.380***	0.0788
	(5.788)	(3.003)	(0.954)	(5.144)	(2.809)	(0.586)
CEXR	-0.0407	-0.0774	-0.181*	-0.0299	-0.0712	-0.160
	(-0.667)	(-0.744)	(-1.679)	(-0.468)	(-0.671)	(-1.513)
Constant	847.4***	670.5**	641.9**	575.4***	426.8	452.9
	(5.380)	(2.499)	(2.313)	(3.398)	(1.516)	(1.620)
Observations	176	176	176	176	176	176
Number of ID	8	8	8	8	8	8

z-statistics in parentheses; N=8, Time=22 (2001-2022); estimation method: FGLS
*** p<0.01, ** p<0.05, * p<0.1

4.2 Objective 2

The Objective 2 in this research is to study the impact of logistics performance and trade facilitation on China's total commodity trade with ASEAN, China's export to and import from ASEAN countries. Here in this section, the explained variables are China's total trade flows with ASEAN, China's total exports to ASEAN, and China's total imports from ASEAN. The core explanatory variables are logistics performance

index and trade facilitation index. Due to some data shortage of Brunei, Laos, Myanmar, and Cambodia, this research only employs the panel data of six ASEAN countries (namely, Indonesia, Malaysia, Philippine, Thailand, Singapore, and Vietnam) to conduct the data analysis. The time period used for the data set is from 2009-2019. The software used in this section is STATA 17.0. The interpolation method is applied for missing data.

4.2.1 Descriptive Statistics

The descriptive statistics of variables in objective 2 is provided in Table 4.10. The average total trade value (TV) between China and six ASEAN countries amounts to $70.346 billion, with a relatively high standard deviation of $28.108 billion, a maximum value of $161.986 billion and a minimum value of $20.531 billion. It indicates large variability in trade volumes among different observations. China's export value (EX) to the six ASEAN countries averages $37.572 billion, with a standard deviation of $16.368 billion, a maximum value of $97.869 billion and a minimum value of $ 8.585 billion. China's import value from the six ASEAN countries (IM) averages $32.774 billion with a standard deviation of $15.668 billion, a maximum value of $71.91 billion and a minimum value of $4.747 billion.

The core analysis of objective 2 is the impact of logistics performance and trade facilitation on China-ASEAN bilateral trade flows. The Logistics Performance Index (LPIP) ranges between 0-5, which captures the overall efficiency and quality of logistics services. It has an average value of 3.314 with a standard deviation of 0.396. a minimum value of 2.668 and a maximum value of 4.144. Similarly, the Trade Facilitation Index (TFS) ranges between 0-1.0, which measures the effectiveness of

customs and other border procedures. It has an average value of 0.447, with a standard deviation of 0.251, a minimum value of 0.144 and a maximum value of 0.936. This implies that there are notable differences in ASEAN countries' trade facilitation status.

Table 4.10 : Descriptive Statistics of Objective 2

Variable		Obs	Mean	Std. Dev.	Min	Max
TV	Trade value in billion US$	66	70.346	28.108	20.531	161.986
EX	Export value in billion US$	66	37.572	16.368	8.585	97.869
IM	Import value in billion US$	66	32.774	15.668	4.747	71.91
LPIP	Logistics performance index	66	3.314	0.396	2.668	4.144
TFS	Trade facilitation index	66	0.447	0.251	0.114	0.936
CP	China's population in million	66	1367.459	25.362	1331.26	1407.745
TP	Trade partner's population in million	66	91.438	80.656	4.988	270.626
CG	China's GDP per capita in US$	66	7206.455	2025.795	3749	10144
TG	Trade partner's GDP per capita in US$	66	13197	19259.132	1232	66859
DISC	Physical distance between capital in KM	66	3741.5	1010.014	2322	5200
TFRC	China's tariff rate towards trade partner	66	1.004	.804	0.031	3.324
TFRP	Trade partner's tariff rate towards China	66	2.112	2.598	0	11.888

Only six ASEAN countries are included in the panel date set, namely, Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam. The data of Brunei, Laos, Myanmar and Cambodia are excluded in this objective due to data shortage of some variables.
The time period in this objective is from 2009-2019.

4.2.2 Correlation Matrix

The correlation matrices of variables in objective 2 are presented in Tables 4.11 and Table 4.12. In Table 4.11, it can be seen that the correlation between trade value (lnTV) and the logistics performance index (LPIP) is positive with a coefficient of 0.350. It indicates that higher logistics performance is associated with increased trade flows between China and ASEAN countries. In Table 4.12, the correlation between trade value (lnTV) and the trade facilitation index (TFS) is 0.429, showing

a moderate to high correlation between trade value and trade facilitation. This indicates that improved trade facilitation—such as streamlined customs procedures and more efficient border management—has a meaningful impact on trade volumes between China and ASEAN countries.

In this panel data set, China's GDP per capita (lnCG) exhibits a high positive correlation (0.682) with it total trade value with ASEAN countries (lnTV). ASEAN countries' GDP per capita (lnTG) also shows a positive correlation (0.400) with China-ASEAN trade flows, which further confirms the idea that wealthier ASEAN countries engage in more trade flows with China. China's population (lnCP) also shows a positive correlation (0.627) with China's total trade value with ASEAN counties, which suggests that as China's population grows, China-ASEAN trade flow also increases. On the other hand, ASEAN countries' population (lnTP) exhibits a weaker positive correlation (0.252) with China-ASEAN trade value, which may reflect the diversity within ASEAN populations.

Furthermore, physical distance (lnDISC) is negatively correlated with trade value (-0.185) in the correlation matrix. Greater distance between capitals increases transportation costs and logistical challenges, leading to lower trade volumes. The correlations between China's tariff rate towards ASEAN (TFRC) and trade value (lnTV) (0.188) and between the trade partner's tariff rate towards China (TFRP) and trade value (lnTV) (0.039) are in weak positive effects. This suggests that tariffs do not have a very strong influence on trade volumes in this data set, that is because the time periods used in this data set is around 10 years, which does not show large variation within years and countries.

Table 4.11 : Correlation Matrix in Objective 2 (Impact of Logistics Performance)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) lnTV	1.000								
(2) LPIP	0.350	1.000							
(3) lnCP	0.627	0.043	1.000						
(4) lnCG	0.682	0.053	0.946	1.000					
(5) lnTP	-0.252	-0.935	0.032	0.032	1.000				
(6) lnTG	0.400	0.940	0.149	0.155	-0.900	1.000			
(7)lnDISC	0.165	0.355	-0.000	-0.000	-0.211	0.546	1.000		
(8) TFRC	-0.188	-0.306	-0.354	-0.399	0.343	-0.335	-0.022	1.000	
(9) TFRP	0.039	-0.133	-0.109	-0.161	0.042	-0.090	0.047	0.187	1.000

Table 4.12 : Correlation Matrix in Objective 2 (Impact of Trade Facilitation)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) lnTV	1.000								
(2) TFS	0.429	1.000							
(3) lnCP	0.627	0.111	1.000						
(4) lnCG	0.682	0.111	0.946	1.000					
(5) lnTP	-0.252	-0.909	0.032	0.032	1.000				
(6) lnTG	0.400	0.977	0.149	0.155	-0.900	1.000			
(7) lnDISC	0.165	0.530	-0.000	-0.000	-0.211	0.546	1.000		
(8) TFRC	-0.188	-0.279	-0.354	-0.399	0.343	-0.335	-0.022	1.000	
(9) TFRP	0.039	-0.067	-0.109	-0.161	0.042	-0.090	0.047	0.187	1.000

4.2.3 Heteroskedasticity Test Results

The heteroskedasticity test results presented in Table 4.13 are essential for assessing the reliability of the regression models used in evaluating the impact of logistics performance and trade facilitation on China-ASEAN trade flows. Specifically, this table shows the results of heteroskedasticity tests results of model 2.1 to 2.6 in objective 2. When the variance of the error terms in a regression model is not constant over all observations, it is referred to as heteroskedasticity. If this condition is ignored, it may result in ineffective estimates and erroneous hypothesis testing. The table reports the Chi-squared (Chi2) test statistics and the corresponding p-values (Prob > Chi2) for each model. The null hypothesis in these tests assumes

that the model does not suffer from heteroskedasticity, i.e., the error terms have constant variance. A low p-value (typically below 0.05) indicates the rejection of the null hypothesis, suggesting the presence of heteroskedasticity.

All the heteroskedasticity test results shown in Table 4.13 for model 2.1- 2.6 in Objective 2 indicate that the null hypothesis of no heteroskedasticity in all the six models is rejected (all p-value is 0.0000, <0.05). This suggests that there is heteroskedasticity issue in all the six models, and it is necessary to solve this heteroskedasticity issue when conducting regressions. To address this issue, heteroskedasticity-robust standard errors or other corrective measures, such as weighted least squares (WLS) or generalized least squares (GLS), should be applied. In this research, generalized least squares (GLS) estimation method is applied to improve the efficiency and validity of the estimates, ensuring that the results more accurately reflect the relationships between logistics performance, trade facilitation, and China-ASEAN trade flows.

Table 4.13 : Heteroskedasticity Test Results

	The Impact of Logistics Performance			The Impact of Trade Facilitation		
	Model 2.1	Model 2.2	Model 2.3	Model 2.4	Model 2.5	Model 2.6
Chi2	45.77	77.91	369.77	22.66	23.98	240.98
Prob>Chi2	0.0000	0.0000	0.0000	0.0009	0.0005	0.0000

4.2.4 Wooldridge Test Results for Autocorrelation

The Wooldridge test results for autocorrelation in Table 4.14 provide key insights into the presence of autocorrelation in the models of Objective 2 to examine the impact of logistics performance and trade facilitation on China-ASEAN bilateral trade flows. The Wooldridge test for autocorrelation is used to detect whether the

residuals (error terms) of the regression models are serially correlated. Autocorrelation in panel data leads to inefficient estimates and inaccurate standard errors, distorting hypothesis testing and resulting in unreliable conclusions if left uncorrected. The table presents the F-statistics and corresponding p-values (Prob > F) for each model. A significant p-value (typically less than 0.05) indicates the rejection of the null hypothesis of no autocorrelation, confirming the presence of autocorrelation in the model.

All the Wooldridge test results for autocorrelation shown in Table 4.14 for model 2.1- 2.6 in Objective 2 indicate that the null hypothesis of no autocorrelation in all the six models is rejected (all p-value is <0.05). The presence of autocorrelation implies that the error terms are correlated across time or cross-sectional units, which can affect the efficiency and accuracy of the regression estimates. To address this issue, the models should be adjusted using corrective techniques, such as applying robust standard errors, generalized least squares (GLS), or heteroskedasticity- and autocorrelation-consistent (HAC) estimators, to ensure that the regression results are reliable and valid. In this research, feasible generalized least squares (FGLS) estimation method is applied to address the issue of heteroskedasticity and autocorrelation to improve the efficiency and validity of the estimation results.

Table 4.14 : Wooldridge Test Results for Autocorrelation

	Logistics Performance			Trade Facilitation		
	Model 2.1 lnTV	Model 2.2 lnEX	Model 2.3 lnIM	Model 2.4 lnTV	Model 2.5 lnEX	Model 2.6 lnIM
F	20.657	57.469	21.390	16.086	57.351	20.831
Prob>F	0.0061	0.0006	0.0057	0.0102	0.0006	0.0060

4.2.5 Kao Test Results for Cointegration

The Kao test results for cointegration of model 2.1-2.6 under Objective 6 are presented in Table 4.15. It can provide valuable insights into whether there is a long-term equilibrium relationship (cointegration) between the variables in the models assessing the impact of logistics performance and trade facilitation on China-ASEAN trade flows. The Kao test is used to determine whether variables in a panel data set are cointegrated, which would suggest that despite short-term fluctuations, the variables move together in the long run. In this table, the unadjusted Modified Dickey–Fuller t-statistic and the Dickey–Fuller t-statistic are used to test for the presence of cointegration, with significance indicated by the p-values.

The results of the Kao test for cointegration for all six models indicate the presence of cointegration between the key variables, as evidenced by the significant Modified Dickey–Fuller and Dickey–Fuller t-statistics (all p value is <0.05). This implies that logistics performance and trade facilitation have long-term equilibrium relationships with China-ASEAN total bilateral trade flows, China's exports to and imports from ASEAN countries. In other words, improvements in logistics and trade facilitation are associated with sustained increases in trade volumes over time, despite any short-term fluctuations. These findings underscore the importance of continued investments in logistics infrastructure and the implementation of efficient trade facilitation measures to support long-term trade growth between China and ASEAN countries.

Table 4.15 : Kao Test Results for Cointegration

	Logistics Performance			Trade Facilitation		
	Model 2.1 lnTV	Model 2.2 lnEX	Model 2.3 lnIM	Model 2.4 lnTV	Model 2.5 lnEX	Model 2.6 lnIM
Unadjusted Modified Dickey–Fuller t	-2.9686***	-2.2105**	-2.1185**	-2.8609***	-1.8828**	-2.1252**
Unadjusted Dickey–Fuller t	-3.6770***	-2.7402***	-2.6504***	-3.5495***	-2.5011***	-2.6443***

4.2.6 Regressions Results of Objective 2

Table 4.16 reports the regression results of model 2.1-2.6 in Objective 2. Feasible generalized least squares (FGLS) estimation method is applied in this section to address the issue of heteroskedasticity and autocorrelation and to improve the efficiency and validity of the estimation results. Model 2.1-2.3 examine the impact of logistics performance on China's total trade value with ASEAN countries, China's exports to ASEAN countries and China's imports from ASEAN countries. Model 2.4-2.6 analyze the impact of trade facilitation on China's total trade value with ASEAN countries, China's exports to ASEAN countries and China's imports from ASEAN countries.

The regression results in model 2.1 show that ASEAN's logistics performance coefficient is positive and statistically significant at the 10% level (0.590, $p < 0.1$), indicating that improvements in logistics infrastructure and services are associated with higher trade flows between China and ASEAN. Better logistics performance reduces transportation costs, improves reliability, and enhances trade efficiency, leading to increased trade volumes. The regression results in model 2.2 indicate that ASEAN's logistics performance has a positive (0.469) yet not statistically

significant effect on China's exports to ASEAN countries. Furthermore, the regression results in model 2.3 suggest that ASEAN's logistics performance is positive but not statistically significant correlated with China's imports from ASEAN countries (0.341), suggesting that improvements in logistics performance do not have a strong impact on China's import volumes from ASEAN countries in this model.

In addition, it is found in model 2.4 that that the trade facilitation index (TFS) is highly positive and significant (3.534, $p < 0.01$), showing that improvements in customs procedures, regulatory frameworks, and border controls lead to increased trade flows. This highlights the critical role that efficient trade facilitation plays a crucial role in reducing trade barriers and promoting smoother cross-border exchanges. The regression results of model 2.5 show that trade facilitation has a positive and significant effect on China's exports to ASEAN countries (4.239, $p < 0.01$). It indicates that the improvement of ASEAN countries' trade facilitation helps reduce delays and costs, making Chinese goods more competitive in ASEAN markets. Lastly, in model 2.6, it is found that ASEAN countries' trade facilitation also has a positive and significant impact on China's imports from ASEAN countries (0.595, $p < 0.1$). It implies that improvements in trade facilitation of ASEAN countries, such as more streamlined customs procedures and reduced border delays, are associated with higher import volumes from ASEAN countries. This highlights the importance of trade facilitation in encouraging imports from ASEAN into China.

To sum up, based on the data set in objective 2 , the regression results indicate that efficient logistics operations can impact international trade by reducing

transportation costs, improving delivery times, and increasing supply chain reliability. Logistics performance, encompassing factors such as infrastructure quality, customs efficiency, and logistics services, plays a crucial role in facilitating trade flows and enhancing trade competitiveness (Hausman et al., 2013; Shikur 2022). The positive impact of logistics performance on trade flows in this research is also consist with the study results of Martí et al (2014), Gani (2017), Çelebi (2019), Bugarčić et al. (2020), Adelajda Zaninović et al. (2021), and Song and Lee (2022).

This positive contribution of trade facilitation to trade flows growth is also found in the regression results of objective 2. As pointed out by Zaki (2015), efficient trade facilitation measures can lead to increased trade volumes, expanded market access, and improved competitiveness for businesses. By reducing trade barriers, enhancing customs procedures, and promoting transparency in trade regulations, trade facilitation can create a conducive environment for trade expansion and economic development. The study result in objective 2 about the impact of trade facilitation on trade flow growth is also consistent with the previous research of Zaki (2015), Sá Porto et al. (2015), Sakyi and Afesorgbor (2019), Ali and Shakoor (2020), Yu and Luu (2020), and Avetisyan and Hertel (2021).

Table 4.16 : Regression Results of Objective 2

VARIABLES	Model 2.1 lnTV	Model 2.2 lnEX	Model 2.3 lnIM	Model 2.4 lnTV	Model 2.5 lnEX	Model 2.6 lnIM
LPIP	0.599*	0.469	0.341	--------	--------	--------
	(1.896)	(1.427)	(0.682)	--------	--------	--------
TFS	--------	--------	--------	3.534***	4.239***	0.595*
	--------	--------	--------	(5.219)	(7.919)	(1.814)
lnCP	-5.975	-4.536	-1.945	-9.483**	-8.875**	-3.456*
	(-1.110)	(-0.808)	(-0.227)	(-2.036)	(-2.167)	(-1.783)
lnCG	1.438***	1.431***	0.994*	1.161***	1.338***	0.669***
	(4.192)	(4.146)	(1.801)	(3.862)	(5.334)	(4.742)
lnTP	0.00232	-0.0803	0.0515	0.515***	0.421***	0.351***
	(0.0150)	(-0.527)	(0.219)	(3.057)	(3.282)	(4.317)
lnTG	-0.0718	-0.164	0.0751	-0.000796	-0.287*	0.436***
	(-0.326)	(-0.724)	(0.216)	(-0.00468)	(-1.953)	(3.588)
lnDISC	0.103	0.0867	0.326	-0.960***	-0.954***	-0.131
	(0.323)	(0.265)	(0.656)	(-3.002)	(-3.717)	(-0.854)
TFRC	0.109**	--------	0.120	0.0101	--------	0.0403*
	(2.221)	--------	(1.555)	(0.215)	--------	(1.699)
TFRP	0.0318**	-0.0179	--------	0.0381***	-0.0147	--------
	(2.358)	(-1.294)	--------	(3.268)	(-1.478)	--------
Constant	135.5	107.6	50.73	211.1**	200.1**	81.57**
	(1.226)	(0.933)	(0.288)	(2.208)	(2.381)	(2.050)
Observations	66	66	66	66	66	66
Number of ID	6	6	6	6	6	6

z-statistics in parentheses; N=6, T=11 (2009-2019);estimation method: FGLS.
*** p<0.01, ** p<0.05, * p<0.1

4.2.7 Robustness Test Results of Objective 2

The robustness test results in Table 4.17 examine the stability and reliability of the regression results of model 2.1 to 2.6 in section 4.2.6 by introducing an additional control variable: China's exchange rate (CEXR). By including CEXR, the goal is to determine whether exchange rate fluctuations significantly influence China-ASEAN trade flows, exports, and imports, and whether the inclusion of this variable alters the relationships between logistics performance, trade facilitation, and trade outcomes. A key aspect of a robustness test is ensuring that the core results remain consistent, even when additional control variables are added to the models.

In Model 2.1, the inclusion of China's exchange rate does not significantly alter the relationship between Logistics Performance Index (LPIP) and total trade value (lnTV). The coefficient for LPIP remains positive and statistically significant at the 10% level (0.606, $p < 0.1$), indicating that improvements in logistics performance continue to be associated with higher trade flows between China and ASEAN. The exchange rate (CEXR) itself is positive but not statistically significant, suggesting that fluctuations in China's exchange rate do not have a major impact on total trade value in this model. Model 2.2 (lnEX) and Model 2.3 (lnIM) assess the impact of logistics performance on China's exports to and imports from ASEAN countries respectively. The inclusion of CEXR similarly does not produce any significant changes in the core results. The coefficient for LPIP remains positive in both models but is not statistically significant, showing similar results in section 4.2.6. The exchange rate (CEXR) is also not significant in either model, indicating that exchange rate fluctuations have a limited direct effect on China's export and import volumes with ASEAN.

Model 2.4 examines the impact of trade facilitation on total trade value between China and ASEAN countries. The coefficient for the trade facilitation index (TFS) remains positive and highly significant (3.536, $p < 0.01$), even with the inclusion of the exchange rate variable. This suggests that improvements in customs procedures, regulatory environments, and border controls continue to have a strong positive impact on total trade flows between China and ASEAN, regardless of exchange rate fluctuations. The exchange rate (CEXR) itself is not statistically significant, suggesting that it does not play a major role in influencing total trade flows in this panel data set.

In Model 2.5 (lnEX), the impact of trade facilitation on China's exports to ASEAN remains highly significant (4.243, $p < 0.01$) after accounting for the exchange rate. This indicates that more efficient trade facilitation measures in ASEAN countries are consistently associated with higher export volumes from China. As in the other models, the exchange rate variable (CEXR) is not statistically significant, suggesting that fluctuations in China's exchange rate have minimal direct impact on exports in this model. In Model 2.6 (lnIM), the coefficient for TFS remains positive, although it is not statistically significant (0.538). The inclusion of CEXR does not alter the main conclusions regarding trade facilitation's influence on imports, and the exchange rate itself remains insignificant. This indicates that, while trade facilitation is important for imports, exchange rate fluctuations do not play a substantial role in affecting China's import volumes from ASEAN countries.

Overall, the robustness test results confirm that the core relationships between logistics performance, trade facilitation, and China-ASEAN bilateral trade flows (total trade, exports, and imports) remain largely unaffected by the inclusion of China's exchange rate (CEXR) as a control variable. The coefficients for logistics performance and trade facilitation continue to show positive and significant effects on trade flows, indicating that these factors are crucial for promoting trade between China and ASEAN, independent of exchange rate movements. The robustness test results here show that the regression results and findings in section 4.2.6 are reliable.

Table 4.17 : Robustness Test Results of Models in Objective 2

VARIABLES	Model 2.1 lnTV	Model 2.2 lnEX	Model 2.3 lnIM	Model 2.4 lnTV	Model 2.5 lnEX	Model 2.6 lnIM
LPIP	0.606*	0.476	0.353	--------	--------	--------
	(1.912)	(1.444)	(0.703)	--------	--------	--------
TFS	--------	--------	--------	3.536***	4.243***	0.538
	--------	--------	--------	(5.218)	(7.918)	(1.626)
lnCP	-10.29	-9.070	-8.721	-8.335	-7.113	-9.148
	(-0.601)	(-0.507)	(-0.317)	(-0.564)	(-0.548)	(-1.480)
lnCG	1.691*	1.697	1.390	1.094	1.235	0.994***
	(1.671)	(1.610)	(0.854)	(1.249)	(1.614)	(2.786)
lnTP	0.00157	-0.0814	0.0509	0.516***	0.422***	0.353***
	(0.0102)	(-0.535)	(0.217)	(3.058)	(3.286)	(4.324)
lnTG	-0.0755	-0.168	0.0699	-0.000482	-0.287*	0.451***
	(-0.342)	(-0.741)	(0.201)	(-0.00283)	(-1.949)	(3.647)
lnDISC	0.107	0.0913	0.331	-0.961***	-0.956***	-0.126
	(0.336)	(0.279)	(0.666)	(-3.003)	(-3.720)	(-0.826)
TFRC	0.109**	--------	0.120	0.0101	--------	0.0384
	(2.215)	--------	(1.547)	(0.215)	--------	(1.602)
TFRP	0.0317**	-0.0180	--------	0.0382***	-0.0146	--------
	(2.351)	(-1.303)	--------	(3.268)	(-1.469)	--------
CEXR	0.103	0.108	0.162	-0.0274	-0.0421	0.136
	(0.265)	(0.267)	(0.259)	(-0.0819)	(-0.143)	(0.971)
Constant	223.2	200.0	188.7	187.7	164.2	197.4
	(0.640)	(0.549)	(0.336)	(0.623)	(0.620)	(1.568)
Observations	66	66	66	66	66	66
Number of ID	6	6	6	6	6	6

z-statistics in parentheses;N=6, T=11 (2009-2019); estimation method: FGLS
*** p<0.01, ** p<0.05, * p<0.1

4.3 Objective 3

The objective 3 in this research is to investigate the trade effects of China-ASEAN free trade area (CAFTA) on China's bilateral trade flows with ASEAN countries. The explained variables in this section are China's bilateral trade flows with ASEAN countries and the rest of the world countries as the control group. Propensity score matching method is used to select the final control group countries in the panel data set. The main explanatory variables here are *DID* (interaction variable of policy and time, namely effect of CAFTA), treat (dummy variable of CAFTA) and post (dummy variable of time). As the signing of free trade agreements mainly involves tariff reductions among FTA members, this objective mainly focuses on the core

variables: *DID* (effect of CAFTA) and tariff rates. The panel data set used in this section is from 2001-2021. Software used to conduct the data analysis in this part is STATA 17.0 and the interpolation method is applied for missing data.

4.3.1 Descriptive Statistics

As objective 3 is to examine the trade creation effect of CAFTA, this research employs China's bilateral trade flows with all 162 countries in this panel data set. It sets ASEAN countries as the treated group and the rest countries in the world as control group. The sample data used in this section contains 3564 observations and the time period is from 2000 to 2021. The descriptive statistics presented in Table 4.18.

In the sample data set, China's average trade value (TV) with its partner is $14.695 billion, with a large standard deviation of $48.14 billion. The minimum trade value is near $1 million and the maximum value is $758.097 billion. China's export value (EX) to its trade partners averages $8.099 billion, with a standard deviation of $29.853 billion, a minimum value of $0.0001 billion, and a maximum value of $577.126 billion. China's import value (IM) from its trade partners has a mean value of $6.5968 billion, a standard deviation of $21.4 billion, a minimum value of close to zero and a maximum value of $213.445 billion.

In the sample data set, China's trade partner has an average population of 32.896 million, with a large standard deviation of 106.339 million. The maximum population is 1407.564 million and the minimum is 0.018 million. China's population in the sample has a mean value of 1343.535 million, a standard deviation

of 47.246, a minimum value of 1262.645 million, and a maximum value of 1412.36 million. The GDP per capita of China's trade partners has an average value of $13907.9, a standard deviation of $19554.9, a minimum value of $255.1, and a maximum value of $128757.88. This implies that there is a large economic development level difference among China's trade partners. Moreover, China's GDP per capita shows a mean value of $6102.019 and a standard deviation of $2824.53. China's economic development has improved significantly from $2193.897 in 2000 to $11223.255 in 2021.

Trade tariff can have a deep influence on China's bilateral trade flows. China's import tariff towards its trade partner averages 5.929%, and a standard deviation of 7.66%. It ranges from 0% to 93.748%, showing that the tariff rate of China on its partners vary largely across countries and years. The trade partner's import tariff towards China has an average value of 9.006%, and a standard deviation of 6.065%, a minimum value of 0% and a maximum value of 79.193%. The average distance between China and its trade partners (DISC) is 9,293.66 kilometers, with a large standard deviation of 3,768.423 kilometers. The minimum distance is 955 kilometers, and the maximum distance is 19, 264 kilometers.

Table 4.18 : Descriptive Statistics of Objective 3

Variable	Meaning	Obs	Mean	Std. Dev.	Min	Max
TV	China's trade value with partners in billion $	3564	14.6953	48.1396	0.000103	758.0974
EX	China's export value with partners in billion $	3564	8.0985	29.8529	0.000103	577.1255
IM	China's import value with partners in billion $	3564	6.5968	21.4004	1.00e-09	213.4451
TP	Trade partner's population in million	3564	32.896	106.339	0.018	1407.564
CP	China's population in million	3564	1343.535	47.246	1262.645	1412.36
TG	Trade partner's GDP per capita $	3564	13907.921	19554.931	255.1	128757.88
CG	China's GDP per capita $	3564	6102.019	2824.53	2193.897	11223.255
TFRC	China's import tariff towards trade partner	3564	5.929	7.66	0	93.748
TFRP	Trade partner's tariff towards China	3564	9.006	6.065	0	79.193
DISC	Physical distance between capital	3564	9293.66	3768.423	955	19264

N=162 countries, time period:2000-2021

4.3.2 Correlation Matrix

Table 4.19 reports the correlation matrix of variables in objective 3. *DID* (the effect of CAFTA) shows a moderate positive correlation with trade value (TV) at 0.202. This suggests that members of China-ASEAN free trade area have higher trade flows with China, because within a free trade area, reduced tariff barriers and other trade costs facilitate trade flows between member countries. The economic development level, denoted by GDP per capita, represents a country's consumption capability. Here both China's GDP per capita (CG) and its partner's GDP per capita (TP) show a positive connection with China's trade flows with its partners, with a coefficient of 0.164 and 0.261 respectively. This indicates that China tends to trade more with wealthier countries, because countries with higher per capita income are likely to have greater demand for imports.

Trade partner's population (TP) has a stronger positive correlation with trade value (TV) with a coefficient of 0.303. This implies that China tends to engage in higher levels of trade with more populous nations, as larger populations usually means larger consumer markets and greater potential for both imports and exports. China's population (CP) also shows a positive correlation with its bilateral trade value (TV) with a coefficient of 0.164. This suggests that China's large and growing population supports its capacity for both exporting goods and importing goods.

Distance between capitals (DISC) has a negative correlation with trade value (TV) at -0.175. This confirms the expectation that greater geographic distance is associated with lower trade value because of higher transportation costs, and longer shipping times. Trade partner's tariff rate towards China (TFRP) is found negatively correlated with trade value with a coefficient of -0.230, indicating that higher tariffs imposed by China's trading partners are associated with lower trade flows with China. China's tariff rate on imports (TFRC) also shows a weaker negative correlation with trade value (TV) at -0.055. This is because higher tariffs increase trade costs and reduce the flow of goods between China and its trade partners.

Table 4.19 : Correlation Matrix of Objective 3

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) TV	1.000								
(2)DID	0.202	1.000							
(3) TG	0.261	-0.003	1.000						
(4) CG	0.164	0.113	0.046	1.000					
(5) TP	0.303	0.082	-0.051	0.026	1.000				
(5) CP	0.164	0.113	0.047	0.991	0.026	1.000			
(7) DISC	-0.175	-0.212	-0.117	-0.000	-0.167	-0.000	1.000		
(8) TFRP	-0.230	-0.164	-0.317	-0.169	-0.011	-0.180	0.307	1.000	
(9) TFRC	-0.055	-0.095	-0.008	-0.276	-0.041	-0.301	0.030	0.091	1.000

4.3.3 Propensity Score Matching

The results in Table 4.20 and Table 4.21 provide a detailed analysis of the Propensity Score Matching (PSM) results in this research. PSM is employed to reduce selection bias in estimating the impact of CAFTA on bilateral trade flows between China and ASEAN countries. It selects *DID* (treat effect of CAFTA) and three key covariates (partner's population, partner's GDP per capita and trade distance) to calculate the propensity score.

Table 4.20 shows the mean values and percentage bias of key covariates before and after matching (unmatched (U) and matched (M)) for the treated and control groups. In the unmatched (U) sample, the mean population in the treated group is 88.437 million, compared to only 30.76 million in the control group, leading to a substantial bias of 61.8%. This large difference in means suggests that the treated and control groups were initially not comparable in terms of trade partner population, which could influence the estimation of treatment effects.

After matching, the mean population for the treated group is 88.507 million, and for the control group, it is 97.037 million. The percentage bias is reduced to -9.2%, representing a bias reduction of 85.1%. The t-test results show that the difference between the means of the treated and control groups is no longer statistically significant ($t = -0.33$, $p > 0.1$), indicating that matching successfully balanced the population variable between the groups.

Before matching, the mean GDP per capita for the treated group is 11,711 USD, while it is 13,992 USD for the control group, resulting in a bias of -12.3%. Although

this bias is smaller than that observed for population, it still suggests some imbalance between the groups. After matching, the bias increases slightly to -12.3%, and the t-test shows that the difference in GDP per capita remains insignificant ($t = -1.32$, $p > 0.1$). The bias reduction for this variable is 18.8%, indicating that while matching reduced bias to some extent, there is still some imbalance in terms of economic wealth between the treated and control groups.

Distance plays a crucial role in international trade. Before matching, there is a substantial difference in the mean distances between the treated group (3,741.5 km) and the control group (950.7 km), leading to an exceptionally high bias of -214.2%. After matching, the bias is reduced to 10.7%, with a bias reduction of 95.0%. The t-test indicates that the distance difference is statistically significant after matching ($t = 3.05$, $p < 0.01$), suggesting that matching greatly reduced bias.

Table 4.21 provides a summary of the overall matching process, including the pseudo-R-squared (Ps R2), likelihood ratio chi-square (LR chi2), mean and median bias, and two additional balance indicators (B and R). The pseudo-R-squared drops from 0.374 in the unmatched sample to 0.175 after matching, suggesting that the propensity score model successfully reduces the variability in the covariates. The mean bias decreases significantly from 96.1% in the unmatched sample to 26.6% in the matched sample, demonstrating a substantial reduction in bias across the covariates. Similarly, the median bias decreases from 61.8% to 10.7%, confirming that the matching process effectively minimizes the imbalances between the treated groups and control groups.

Figure 4.1 presents a visual comparison of the standardized percentage bias for three key covariates—Trade Partner's Population (TP), Trade Partner's GDP per Capita (TG), and Physical Distance (DISC)—before and after matching using Propensity Score Matching (PSM). The graph shows the magnitude of bias in the unmatched (black dots) and matched (black crosses) samples, providing an immediate indication of how effective the matching procedure was in reducing bias for each covariate.

To sum up, the results from the PSM analysis demonstrate that the matching process is largely successful in reducing selection bias. After matching, there are only 15 countries in the sample. They are six ASEAN countries (treated group) (Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam) and nine control group countries (Afghanistan, Bangladesh, Bhutan, Kazakhstan, India, Kyrgyz Republic, Pakistan, Nepal, Tajikistan).

Table 4.20 : Bias Reduction and t-Test Results of Propensity Score Matching

Variable	Unmatched /Matched	Mean Treated	Mean Control	% Bias	% Reduced |Bias|	t-test t	t-test p>|t|	V(T) /V(C)
TP	U	88.437	30.76	61.8		6.15	0.000	0.53*
	M	88.507	97.037	-9.2	85.1	-0.33	0.742	0.11*
TG	U	11711	13992	-12.3		-1.32	0.188	0.78
	M	13617	2498.9	60.0	-387.3	6.16	0.000	20.07*
DISC	U	3741.5	9507.2	-214.2		-18.02	0.000	0.08*
	M	4025.4	3737.5	10.7	95.0	3.05	0.003	2.90*

*if variance ratio outside [0.71; 1.41] for U and [0.69; 1.46] form M

Table 4.21 : Summary of Propensity Score Matching Results

Sample	Ps R2	LR chi2	p>chi2	Mean Bias	Med Bias	B	R	% Var
Unmatched	0.374	421.98	0.000	96.1	61.8	214.3*	0.07*	67
Matched	0.175	53.49	0.000	26.6	10.7	84.8*	19.05*	100

* if B>25%, R outside [0.5; 2]

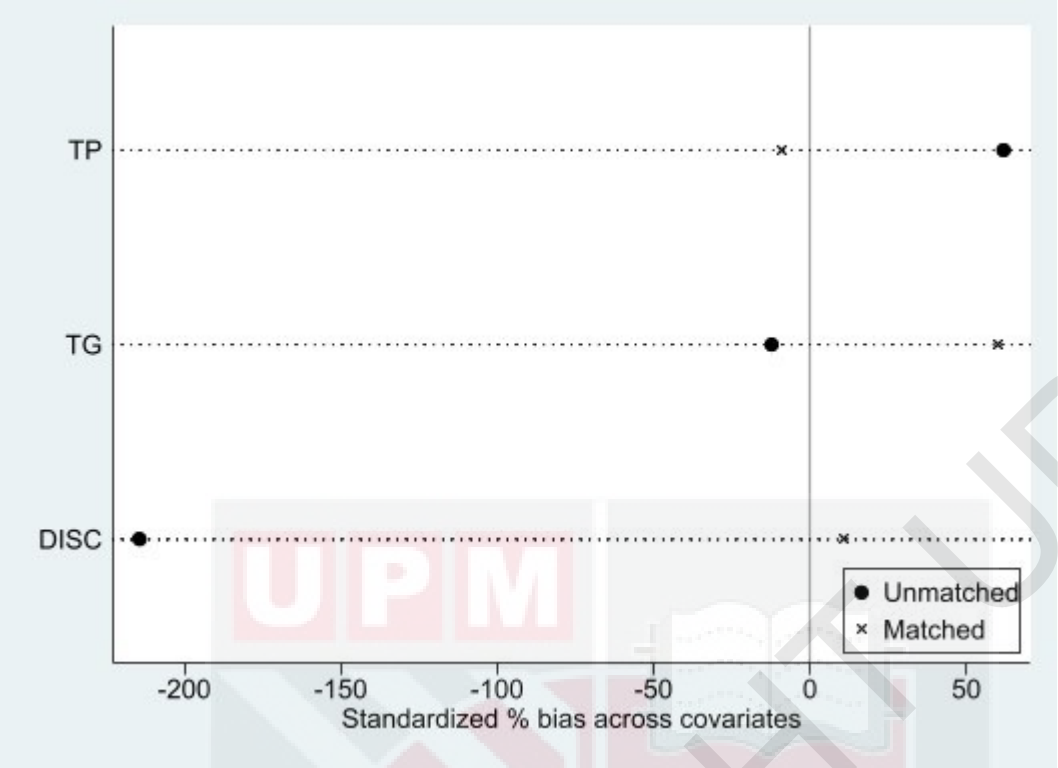

Figure 4.1 : Standardized Bias Plot of Propensity Score Matching

4.3.4 Parallel Trend Test

The Parallel Trend Test is a crucial assumption in difference-in-differences (DID) analysis, which is used to estimate causal effects of interventions or treatments. This test checks whether the treatment and control groups have similar trends in the outcome variable before the intervention. If the trends are parallel, it suggests that any post-intervention differences can be attributed to the treatment rather than other factors (Rambachan and Roth, 2023). Pre-treatment differences in trends test is required to conduct when using difference-in-differences method (Roth, 2022). It examines whether the pre-treatment group and the control group have a common trend before the policy interference (Callaway, 2023).

If the parallel trends assumption does not hold in a difference-in-differences (DID) framework, the causal interpretation of the treatment effect may be invalid, as this assumption is foundational to DID. However, there are other ways if the parallel trends assumption is violated. Augmented DID or the synthetic control method (SCM), can relax the parallel trends assumption by constructing a counterfactual more accurately (Abadie, 2021). Matching treated and control units based on pre-treatment characteristics and trends can ensure that control units provide a better comparison for the treated units. Methods like propensity score matching (PSM) can improve the comparability of groups(Stuart, 2010). The parallel trend test in this research is conducted based on the sample selected by PSM method to match the treated groups and control groups to ensure the comparability.

Figure 4.2, Figure 4.3 and Figure 4.4 present a visual representation of the changes of China's trade value (TV), exports (EX), and imports (IM) with ASEAN countries (treatment group) compared to other countries (control group) over the period from 2000 to 2021. These graphs illustrate the trade growth trends before and after the establishment of the China-ASEAN Free Trade Area (CAFTA) in 2010 (indicated by the vertical dashed line), which represents the intervention event.

Figure 4.2 shows that before 2010, China's total trade value with ASEAN countries shows a steady increase, but after the implementation of CAFTA in 2010, China's total trade value with ASEAN shows a significant upward growth. This sharp increase reflects the positive impact of trade liberalization measures under CAFTA, which facilitate greater trade flows between China and ASEAN. In comparison, China's total trade value with the control group remains relatively flat over the

period, which further emphasizes the trade effect of CAFTA on China-ASEAN trade bilateral trade flows.

Figure 4.3 indicates that before the CAFTA agreement, China's export to ASEAN countries exhibits a steady increase. However, after the establishment of CAFTA in 2010, China's export value to ASEAN countries rises sharply. The strong upward trend in exports suggests that CAFTA has a pronounced effect on facilitating Chinese exports to ASEAN countries. Meanwhile, China's exports value to control group remains relatively constant with only slight increases, which again implies that CAFTA significantly enhances China's export activities to ASEAN countries.

Figure 4.4 shows that prior to the establishment of CAFTA, China's imports from ASEAN gradually increases from a very low base in the early 2000s. After 2010, there is a clear acceleration in China's import value from ASEAN countries. This trend continues to rise sharply through the 2010s and into the early 2020s, indicating that CAFTA has a significant positive impact on China's imports from ASEAN. However, China's imports from the control group remains relatively stable with modest growth. This contrast also highlights the effectiveness of CAFTA in boosting China's imports from ASEAN countries.

In summary, these three figures of parallel trend test provide strong evidence that the establishment of CAFTA in 2010 significantly contributes to the growth of China-ASEAN trade, particularly in the areas of imports. This implies the importance of CAFTA in fostering economic cooperation and boosting bilateral trade flows between China and ASEAN countries.

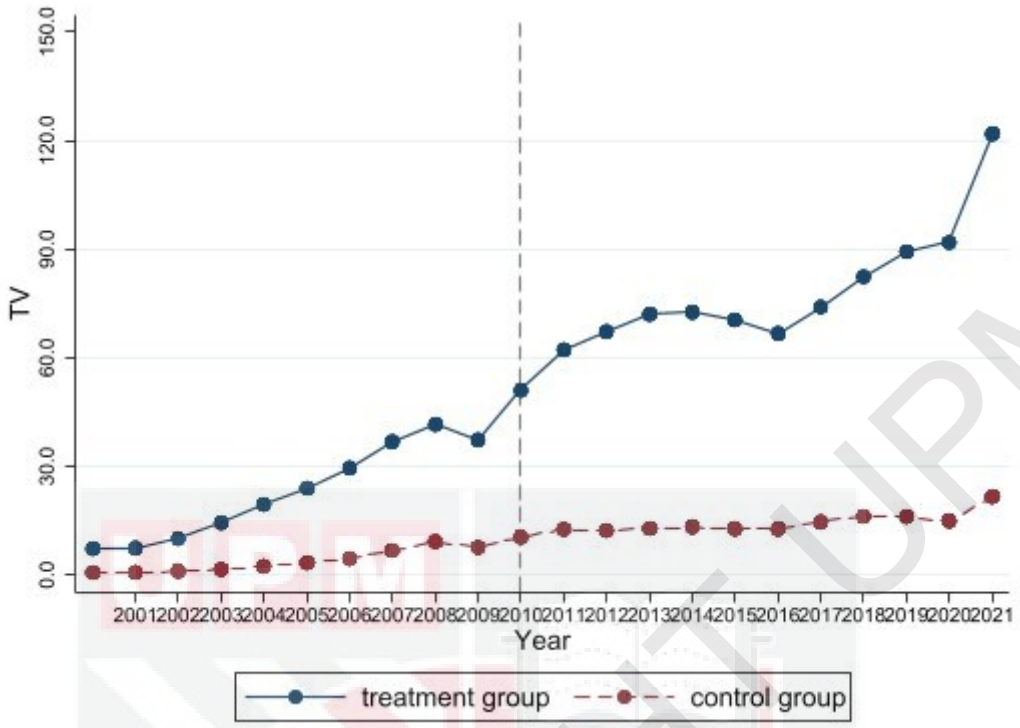

Figure 4.2 : Parallel Trend Test (China's Trade Value with ASEAN)

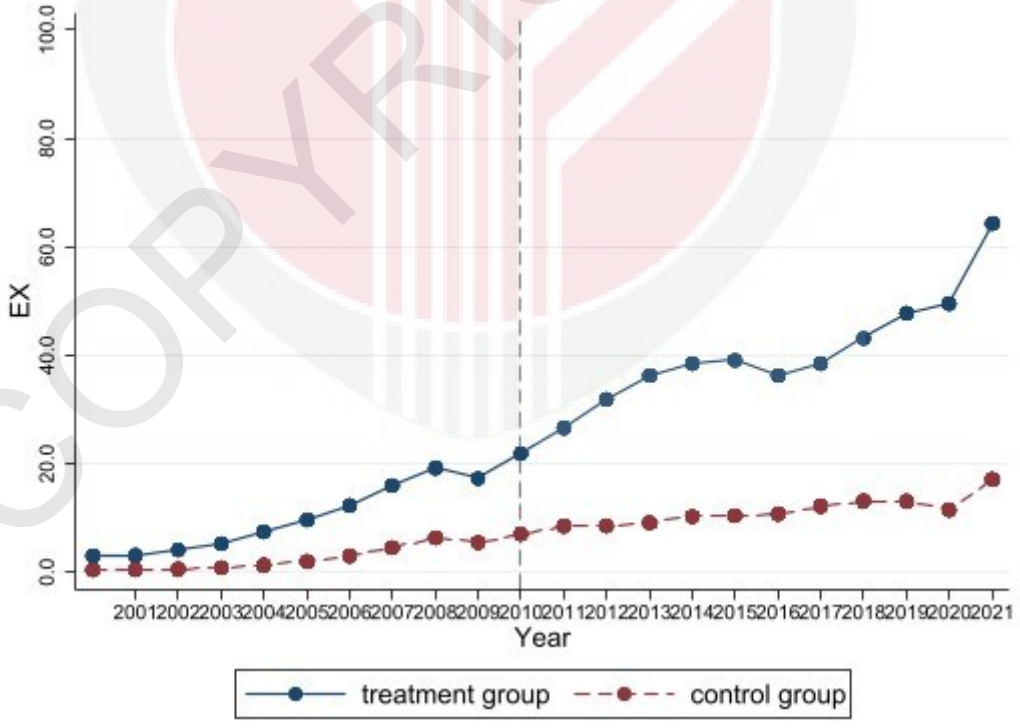

Figure 4.3 : Parallel Trend Test (China's Exports to ASEAN)

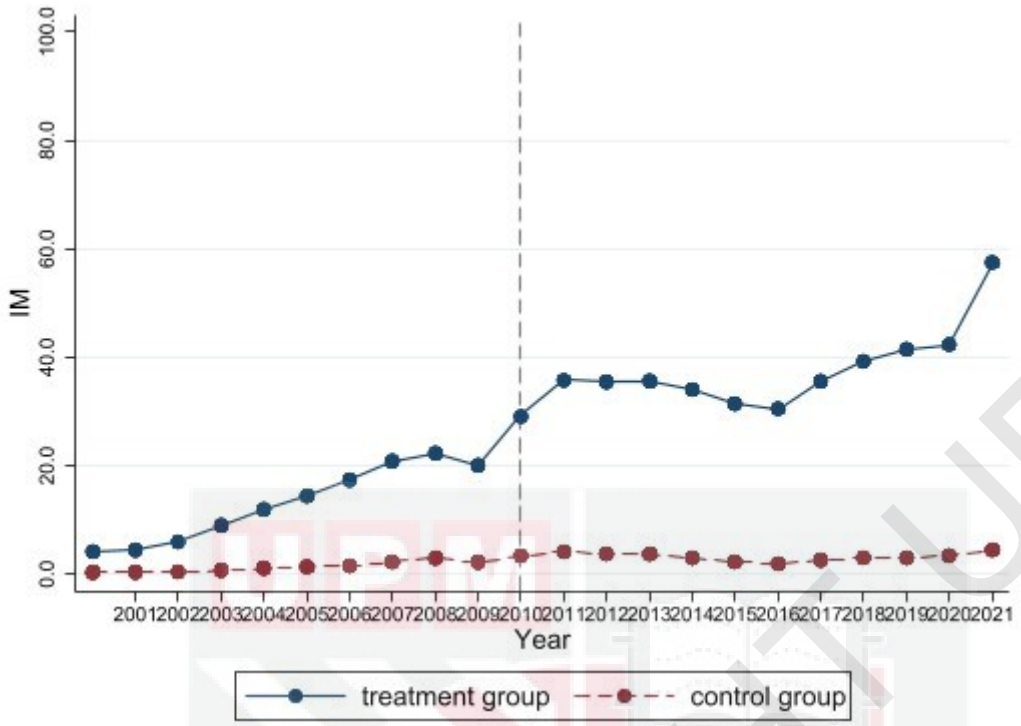

Figure 4.4 : Parallel Trend Test (China's Imports from ASEAN)

4.3.5 PSM-DID Regression Results

Table 4.22 the propensity score matching difference-in-differences (PSM-DID) regression results of Model 3.1, which investigates the impact of CAFTA on China's total trade value (TV) with ASEAN countries. It reports the regression results of three estimation methods: random effects, fixed effects, FGLS (feasible generalized least squares), to ensure robustness of the results.

The coefficient of *DID* measures the trade effect of CAFTA. All the regression results of random effect, fixed effect and FGSL estimation method show that the CAFTA has a significant and positive impact on China's total trade value with ASEAN countries. The total trade value increases by approximately 41 to 44 billion US dollar on average. The consistent significance across all models suggests the

robustness of the CAFTA effect in boosting trade flows between China and ASEAN countries. The variable *treat* measures the pre-CAFTA difference in China's trade value with ASEAN (treatment group) and with other countries (control group). The positive and significant coefficients indicate that ASEAN countries also have higher trade flows with China before CAFTA, suggesting that these countries have better trade relationships with China before the full establishment of the free trade area. The variable *post* measures the overall effect of the post-2010 period. It shows a negative and significant effect, which suggests that control group countries have a decline in trade flows with China after 2010, likely due to trade diversion.

The regression results also show that trade partner's population and GDP per capita have significant and positive effect on bilateral trade flows. This is because larger populations likely represent bigger markets with higher demand for Chinese goods. Wealthier trade partners, which has higher purchasing power, tend to trade more with China. This research does not find China's population has a significant positive impact on China's trade value with its partners, yet it finds that China's economic growth (GDP per capita) has significantly contributed to China's trade growth with it trade partners. This reflects China's growing economic power and capacity to engage in international trade.

Moreover, the regression results show that both China's tariff rate (TFRC) and trade partner's tariff rate (TFRP) have a significantly negative impact on China's trade value with its trade partners (TV). This implies that the reduction of tariff rate under CAFTA has significantly promoted the bilateral trade flows between China and ASEAN countries.

Table 4.22 : PSM-DID Regression Results of Model 3.1

VARIABLES	Random effect TV	Fixed effect TV	FGLS TV
DID	41.33***	43.79***	42.31***
	(15.58)	(17.57)	(12.97)
treat	16.39**	----	16.14***
	(2.119)	----	(6.123)
post	-10.82***	-11.43***	-10.93***
	(-4.279)	(-5.003)	(-3.368)
TP	0.0766***	0.263***	0.0413***
	(7.519)	(11.37)	(15.87)
TG	0.000547***	0.000793***	0.000266***
	(2.606)	(3.170)	(3.659)
CP	-0.172	-0.206**	-0.137
	(-1.597)	(-2.122)	(-1.025)
CG	0.00652***	0.00612***	0.00620***
	(3.754)	(3.910)	(2.842)
DISC	-0.00375	----	0.000214
	(-0.676)	----	(0.158)
TFRC	-0.0840	-0.201*	-0.120
	(-0.646)	(-1.695)	(-0.811)
TFRP	-0.759***	-0.277*	-0.500***
	(-5.208)	(-1.904)	(-3.412)
Constant	213.4	222.2*	159.4
	(1.564)	(1.832)	(0.951)
Observations	330	330	330
R-squared	----	0.801	----
Number of ID	15	15	15
F	----	154.4	----

z-statistics in parentheses; N=15, T=22 (2001-2021)
*** p<0.01, ** p<0.05, * p<0.1

Table 4.23 reports the PSM-DID regression results of Model 3.2, which investigates the impact of CAFTA on China's exports value to ASEAN countries. The regression results of three estimation methods are shown: random effects, fixed effects, FGLS (feasible generalized least squares), to ensure robustness of the results. The *DID* coefficient measures the trade creation effect of CAFTA on China's exports to ASEAN countries.

All the regression results of random effects, fixed effects, FGLS estimation show the coefficient of *DID* is positive and statistically significant at 1% significance level. It indicates that the establishment of CAFTA has a significant positive impact on

China's exports to ASEAN countries. This consistent positive effect across all models implies the success of CAFTA in boosting China's export performance in the ASEAN region.

The variable *treat* captures the pre-CAFTA difference in China's export performance to ASEAN (treatment group) and to other countries (control group). The treat coefficient is positive but not statistically significant, suggesting that although China's exports to ASEAN is slightly higher before CAFTA, the difference was not substantial. The variable *post* reflects the effect of the post-2010 period on countries outside the treatment group. It is negative and significant, indicating that China's export value to control group countries declines after 2010, possibly due to a trade diversion effect. Possibly, China redirects export activities toward ASEAN countries after the implementation of CAFTA.

The coefficient of TP (trade partners' population) in all three estimation results is positive and significant, indicating that China's exports increase with the population size of its trade partners. Larger populations represent larger markets with greater demand for imported goods. TG (Trade Partner's GDP per Capita) also shows a positive and significant coefficient in all three estimation results, suggesting that wealthier trade partners import more from China, possibly due to higher purchasing power. However, it does not find positive effect of China's population (CP) on China's trade flows with its partners. CG (China's GDP per Capita) has a positive and significant coefficient on China's exports value to its trade partners in all three estimation results, suggesting that as China becomes wealthier, its export capacity also increases. This also reflects the importance of economic development in

promoting export growth.

Moreover, this research finds that trade partner's import tariff on China's goods (TFRP) is negatively and significantly correlated with China's exports to its partners (EX). This indicates that the reduction of ASEAN's import tariff on Chinese goods under CAFTA has largely increased China's exports to ASEAN countries. On the contrary, the high tariff of control group countries on Chinese goods has restricted China's exports value to the control group countries, such as India.

Table 4.23 : PSM-DID Regression Results of Model 3.2

Variables	Random effect EX	Fixed effect EX	FGLS EX
DID	19.28***	21.58***	19.89***
	(12.08)	(17.25)	(11.36)
treat	4.475	----	4.869***
	(1.336)	----	(3.486)
post	-5.782***	-6.305***	-5.824***
	(-3.745)	(-5.499)	(-3.345)
TP	0.0485***	0.228***	0.0325***
	(10.80)	(19.71)	(23.45)
TG	0.000421***	0.000679***	0.000283***
	(3.990)	(5.413)	(7.291)
CP	-0.141**	-0.137***	-0.111*
	(-2.376)	(-3.104)	(-1.664)
CG	0.00485***	0.00393***	0.00449***
	(4.930)	(5.387)	(4.059)
DISC	-0.00323	----	-0.00120*
	(-1.367)	----	(-1.652)
TFRP	-0.636***	-0.175**	-0.445***
	(-7.307)	(-2.397)	(-5.657)
Constant	178.8**	137.2**	134.3
	(2.394)	(2.501)	(1.617)
Observations	330	330	330
R-squared	----	0.865	----
Number of ID	15	15	15
F	----	282.4	----

z-statistics in parentheses;N=15, T=22 (2001-2021)
*** p<0.01, ** p<0.05, * p<0.1

Table 4.24 reports the PSM-DID regression results of Model 3.3, which investigates the impact of CAFTA on China's imports value from ASEAN countries. It reports the regression results of three estimation methods: random effects, fixed effects, FGLS (feasible generalized least squares), to ensure robustness of the results.

The results of the three estimation methods all show a positive and significant coefficient of *DID* (trade effects of CAFTA) on China's imports from ASEAN countries (at 1% significance level). This indicates that the implementation of CAFTA has a strong and positive impact on China's imports from ASEAN countries. It increases China's imports from ASEAN countries by approximately 22 to 23 billion USD. The consistency and significance of the *DID* coefficient across the three methods underscore the robustness of the trade effect of CAFTA on trade flows between China and ASEAN.

The variable *treat* measures the difference between China's imports from ASEAN countries (treatment group) and from other countries (control group) before the CAFTA agreement. In both the random effects and FGLS regression results, the coefficients are positive and significant. This indicates that before CAFTA, ASEAN countries already has better trade relations with China. The variable *post* reflects the effect of the post-2010 period on the control group. Its coefficient is negative and statistically significant in both regression results, which suggests that after the implementation of CAFTA, China's imports value from control group countries declines, likely because China shifts its import focus toward ASEAN countries.

The coefficient of TP (trade partner's population) is positive and statistically significant in all three estimation results. It shows that trade partner's population is positively associated with China's higher imports, because larger population typically supports more goods for export. This research finds that the coefficient of TG (trade partner's GDP per capita) is positive but not consistently significant, suggesting that economic wealth of trade partners does not play a strong role in determining China's import levels.

This research also finds that the coefficient of CG (China's GDP per Capita) is positive and significant in all three estimation results. As China's economy grows, its imports also increase. This also reflects the rising demand for goods from ASEAN as China's economy develops. Moreover, it is found that China's import tariff rate on its trade partners (TFRC) is negatively connected with its imports from its trade partners (IM). Under CAFTA, the China's tariff rate towards ASEAN countries is close to 0, which largely promotes China's imports from ASEAN countries, and reduces China's imports from other neighbour countries at the same time.

Table 4.24 : PSM-DID Regression Results of Model 3.3

Variables	Random effect IM	Fixed effect IM	FGLS IM
DID	22.40***	22.55***	22.51***
	(15.69)	(15.38)	(11.79)
treat	11.87***	----	11.54***
	(2.644)	----	(7.769)
post	-5.061***	-5.134***	-5.091***
	(-3.701)	(-3.756)	(-2.677)
TP	0.0154***	0.0407***	0.00867***
	(2.655)	(3.235)	(5.701)
TG	3.94e-05	9.10e-05	-1.57e-05
	(0.337)	(0.610)	(-0.369)
CP	-0.0181	-0.0325	-0.0195
	(-0.317)	(-0.567)	(-0.250)
CG	0.00154*	0.00163*	0.00160
	(1.668)	(1.770)	(1.262)
DISC	0.000908	----	0.00155**
	(0.280)	----	(2.027)
TFRC	-0.105	-0.126*	-0.119
	(-1.502)	(-1.775)	(-1.366)
Constant	14.67	37.01	15.26
	(0.203)	(0.519)	(0.157)
Observations	330	330	330
R-squared	----	0.636	----
Number of ID	15	15	15
F	----	76.75	----

z-statistics in parentheses; N=15, T=22 (2001-2021)
*** p<0.01, ** p<0.05, * p<0.1

In summary, based on the results of PSM-DID estimation method, this research finds that the establishment of China-ASEAN free trade area (CAFTA) has significantly promoted the trade flows between China and ASEAN countries. The total trade value increases by approximately 41 to 44 billion US dollar on average. The trade creation effect of CAFTA in China's imports from ASEAN is slightly larger than that in China's exports from ASEAN. The trade creation effects of FTA found in this research is also consistent with previous studies, such as Baier and Bergstrand (2007), Baier and Bergstrand (2009), Sun and Reed (2010), Begović (2011), Islam et al. (2014), Hndi et al. (2016), Yang and Martinez-Zarzoso (2014). Free trade agreements serve as mechanisms to reduce trade barriers, promote economic integration, and facilitate cross-border trade. By eliminating tariffs, quotas, and other

restrictions, free trade agreements aim to create a more open and competitive trading environment, allowing for increased market access and trade efficiency (Rodrik, 2018; Baier et al., 2019).

The results also show that the reduction of tariff barriers is directly contributed to trade flows growth between China and ASEAN countries. As tariff reductions can stimulate trade growth by increasing import-export activities, encouraging market penetration, and promoting trade expansion (Khan and Khederlarian, 2021). In the studies of Disdier et al. (2015), Hayakawa and Kimura (2016), they also find that the tariff reduction significantly promotes trade flow growth.

4.3.6 Monte Carlo Permutation Results

To test the robustness of the PSM-DID regression results in objective 3, Monte Carlo permutation test, also called simulation test, is applied. Monte Carlo simulation, which is a kind of simulation that uses statistical analysis and repeated random sampling to calculate the results, is closely related to random experiments, which are experiments for which the precise outcome is unknown beforehand. Monte Carlo simulation can be thought of as a systematic approach to so-called what-if analysis (Harrison, 2010). Monte Carlo simulations are employed in economics to represent intricate systems and assess the effectiveness of various economic models in uncertain environments. Through stochastic sampling methods, economists can create simulations of diverse economic scenarios by randomly varying inputs and examining their impacts on outcomes (Brandimarte, 2014). This approach is especially valuable for studying equilibrium properties in macroeconomic models, where the relationships between variables often lack

explicit analytical solutions (Earl and Deem, 2008; Whiteside, 2008).

Monte Carlo simulations enable researchers to evaluate the performance of DID estimators under different assumptions regarding data features, such as sample size, error distribution, and treatment effects. These simulations are instrumental in identifying potential biases, inefficiencies, or problems with standard errors in the estimators (Bertrand et al., 2004). By highlighting the degree of bias in standard errors across various assumptions, Monte Carlo methods assist researchers in selecting suitable correction techniques (Manfè and Nunziata, 2023; Ciaccio, 2024).

Table 4.25 reports the Monte Carlo Permutation Results for model 3.1 and Figure 4.5 illustrates the density plot of the permutation distribution for model 3.1. The permutation variable used here is *DID* (trade effect of CAFTA). Number of observations here is 330, and number of permutations is 500.

The observed test statistic (beta) is 43.79, representing the estimated treatment effect of CAFTA on total trade value (TV) from the original DID regression. This high value confirms the large impact of CAFTA on China-ASEAN trade flows. The standard error of the observed beta is 2.49, indicating that the estimation is precise, with low variability. In the Monte Carlo simulation, 500 permutations are conducted to evaluate the null hypothesis that the observed effect is due to random chance. Across all tests (lower, upper, and two-sided), the p-value is 1.000, meaning that none of the permutations produced a higher test statistic than the observed value. This strong result supports the conclusion that the treatment effect of CAFTA in section 4.3.5 for model 3.1 is statistically significant and not a product of random

variation. In Figure 4.5, the density distribution clusters around smaller values (close to 0), which suggests that the random permutations mostly resulted in small or negligible effects. The observed estimator value (43.79) lies far to the right of the bulk of the distribution, confirming that the actual treatment effect is much larger than what could be expected under random chance.

Table 4.25 : Monte Carlo Permutation Results of Model 3.1

T	T(obs)	Test	c	n	p	SE(p)	[95%	CI(p)]
beta	43.79097	lower	500	500	1.0000	0.0000	0.9926	1.0000
		upper	0	500	0.0000	0.0000	0.0000	0.0074
		two-sided	-	-	0.0000	0.0000	-	-
se	2.492859	lower	500	500	1.0000	0.0000	0.9926	1.0000
		upper	0	500	0.0000	0.0000	0.0000	0.0074
		two-sided	-	-	0.0000	0.0000	-	-
df	307	lower	500	500	1.0000	0.0000	0.9926	1.0000
		upper	500	500	1.0000	0.0000	0.9926	1.0000
		two-sided	-	-	1.0000	0.0000	-	-

Permutation variable: *DID*; Number of observation:330; Number of permutations: 500

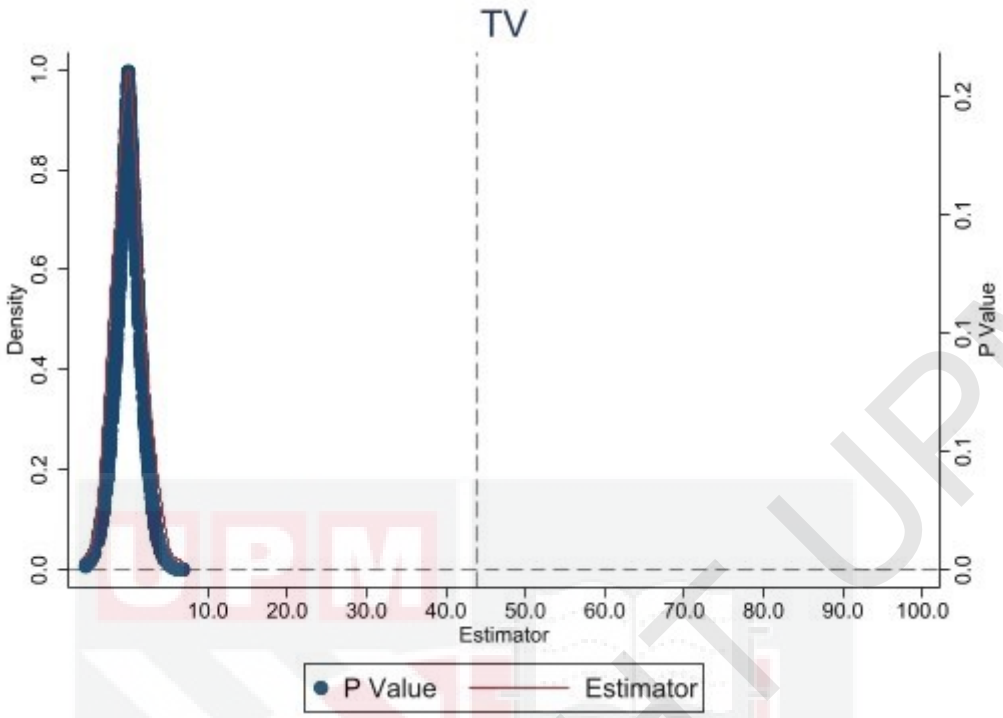

Figure 4.5 : Density Plot of the Permutation Distribution (Model 3.1)

Table 4.26 reports the Monte Carlo Permutation Results for model 3.2 and Figure 4.6 illustrates the density plot of the permutation distribution for model 3.2. The permutation variable used here is *DID* (effect of CAFTA). Number of observation here is 330, and Number of permutations is 500. The observed beta (treatment effect of CAFTA) is 21.58, indicating that CAFTA increases China's exports to ASEAN countries by approximately 21.58 billion USD. This result reflects a strong positive impact of CAFTA on exports, consistent with the earlier DID regression results for model 3.2 in section 4.3.5. The standard error is 1.25, indicating a relatively low level of uncertainty around the estimated effect, suggesting the results are precise. Across all tests (lower, upper, and two-sided), the p-value is 1.000, indicating that none of the randomly generated permutations produces a treatment effect larger than the observed value. This provides strong evidence that the observed effect in model 3.2 in section 4.3.2 is statistically significant and not due to random variation.

In Figure 4.6, the density plot visualizes the distribution of the permutation-based treatment effect estimates. The density distribution clusters around smaller beta values close to zero, suggesting that the majority of random permutations resulted in negligible or small effects. The observed estimator value (21.58) lies far to the right of the bulk of the distribution, indicating that the observed effect is much larger than what would be expected by random. This reinforces the validity of the DID results for model 3.2 in section 4.3.2.

Table 4.26 : Monte Carlo Permutation Results of Model 3.2

T	T(obs)	Test	c	n	p	SE(p)	[95%	CI(p)]	
beta	21.5817	lower	500	500	1.0000	0.0000	0.9926	1.0000	
		upper	0	500	0.0000	0.0000	0.0000	0.0074	
		two-sided	-	-	0.0000	0.0000	-		-
se	1.251289	lower	500	500	1.0000	0.0000	0.9926	1.0000	
		upper	0	500	0.0000	0.0000	0.0000	0.0074	
		two-sided	-	-	0.0000	0.0000	-		-
df	308	lower	500	500	1.0000	0.0000	0.9926	1.0000	
		upper	500	500	1.0000	0.0000	0.9926	1.0000	
		two-sided	-	-	1.0000	0.0000	-		-

Permutation variable: *DID;* Number of observation: 330; Number of permutations: 500

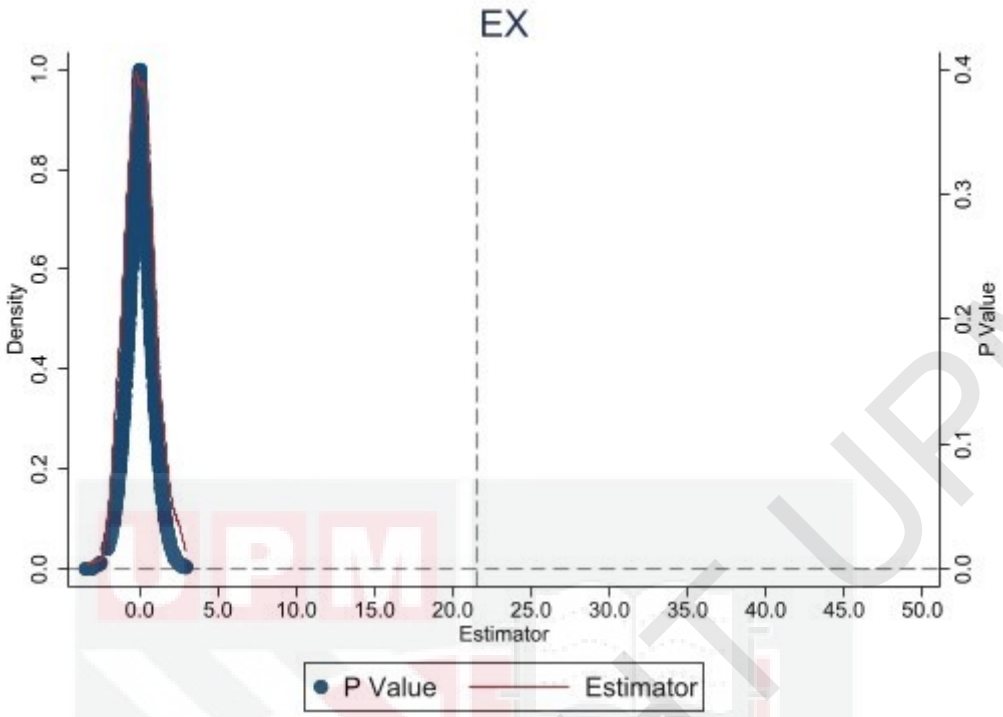

Figure 4.6 : Density Plot of the Permutation Distribution (Model 3.2)

Table 4.27 reports the Monte Carlo permutation results for model 3.3. The observed coefficient (beta) is 22.55, indicating that CAFTA has a positive and significant impact on China's imports from ASEAN countries, increasing by approximately 22.55 billion USD. The standard error for the observed estimate is 1.47, suggesting that the treatment effect is estimated with high precision, with low variability. Across all tests (lower, upper, and two-sided), the p-value is 1.000, indicating that none of the 500 randomly generated permutations results in a treatment effect as large as the observed effect. This provides strong statistical evidence that the observed effect is not due to random variation.

In Figure 4.7, the density plot visually presents the distribution of the permutation-based treatment effect estimates. The majority of the permutation-based estimates cluster around 0. This suggests that most randomly generated permutations

result in small or negligible effects. The observed treatment effect lies far to the right of the bulk of the distribution, indicating that the actual impact of CAFTA is substantially larger than what would be expected by random.

Table 4.27 : Monte Carlo Permutation Results of Model 3.3

T	T(obs)	Test	c	n	p	SE(p)	[95%	CI(p)]
beta	22.55321	lower	500	500	1.0000	0.0000	0.9926	1.0000
		upper	0	500	0.0000	0.0000	0.0000	0.0074
		two-sided	-	-	0.0000	0.0000	-	-
se	1.46604	lower	500	500	1.0000	0.0000	0.9926	1.0000
		upper	0	500	0.0000	0.0000	0.0000	0.0074
		two-sided	-	-	0.0000	0.0000	-	-
df	308	lower	500	500	1.0000	0.0000	0.9926	1.0000
		upper	500	500	1.0000	0.0000	0.9926	1.0000
		two-sided	-	-	1.0000	0.0000	-	-

Permutation variable: *DID;* Number of observation:330; Number of permutations: 500

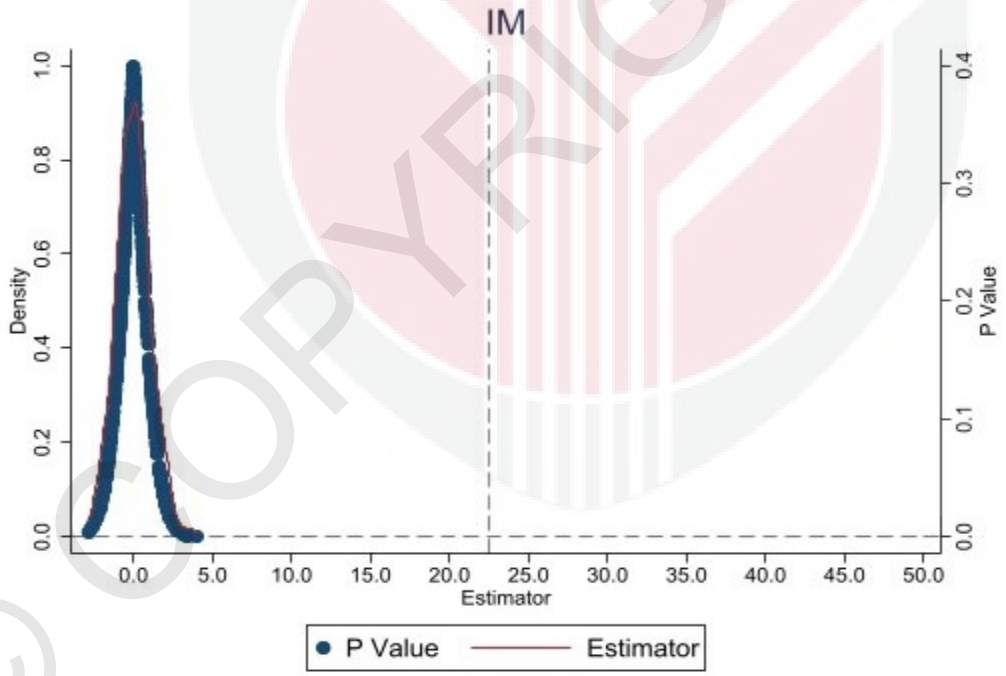

Figure 4.7 : Density Plot of the Permutation Distribution (Model 3.3)

To sum up, the Monte Carlo permutation results for model 3.1, model 3.2 and model 3.3 strongly validate the significant positive impact of CAFTA on China's total trade value (TV) with ASEAN countries, China's exports value to ASEAN countries (EX) and China's imports value from ASEAN countries (IM). These findings show the robust impact of CAFTA on China-ASEAN bilateral trade flows.

CHAPTER 5

SUMMARY OF THE STUDY, THE MAJOR FINDINGS, IMPLICATIONS, RECOMMENDATIONS FOR FUTURE RESEARCH

This chapter mainly summarizes this study, main findings, implications, and recommendations for future research

5.1 Summary of the Study

ASEAN has become China's largest trade partner. China's trade intensity with ASEAN has been getting closer and closer, especially after the establishment of China-ASEAN free trade area (CAFTA). China-ASEAN bilateral commodity trade flows play a more and more important role in promoting economic growth in China and in ASEAN countries. Thus, it is of great significance to study China's bilateral commodity trade flows with ASEAN. This research mainly has three objectives, which are described as following:

The first objective is to examine the role of monetary freedom and trade liberalization in promoting China-ASEAN trade flows. In this objective, China's trade flows with ASEAN, China's exports to ASEAN and China's imports from ASEAN are selected as the dependent variables. Monetary freedom index and trade freedom index (trade liberalization) reported by the Heritage Foundation is selected as the two main explanatory variables. Based on the gravity model of trade, GDP per capita, population, distance, trade cost, common language, common border, and membership of WTO are selected on control variable in the models. A panel data set of eight ASEAN countries is used in this objective, namely, Cambodia, Indonesia, Malaysia, Laos, Philippines, Singapore, Thailand, and Vietnam. Brunei and

Myanmar are excluded due to some data shortage. Data time period is during 2000-2021. The feasible generalized least squares (FGLS) estimation is applied to solve the issue of heteroskedasticity and autocorrelation in panel data set.

The second objective is to analyze the impact of logistics performance and trade facilitation improvement on China's exports to and imports from ASEAN. In this objective, the explained variables are China's trade flows with ASEAN, China's exports to ASEAN and China's imports from ASEAN. The main explanatory variables are logistics performance index and trade facilitation index. Based on the gravity model of trade, this research also selects GDP per capita, population, distance, China's tariff rate towards trade partner, and trade partner's tariff rate towards China as the control variables. A panel data set during 2009-2019 of six ASEAN countries is used for the analysis, namely, Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam. The data of Brunei, Laos, Myanmar and Cambodia are excluded in this objective due to data shortage of some variables. The feasible generalized least squares (FGLS) estimation is applied to solve the issue of heteroskedasticity and autocorrelation in panel data set.

The third objective is to quantify the trade creation effect of China-ASEAN free trade area (CAFTA) on China-ASEAN trade flows. The explained variables are China's trade flows with ASEAN, China's exports to ASEAN and China's imports from ASEAN. The main explanatory variable is CAFTA, which is indicated by DID in the model. Based on the gravity model of trade, this research also selects GDP per capita, population, distance, China's tariff rate towards trade partner, and trade partner's tariff rate towards China as the control variables. In this objective, a panel

data set of China's trade with 162 countries is employed. Propensity score matching (PSM) is used to selects the control group countries for the difference-in-differences (DID) estimation method. The data time period is during 2000-2021. To ensure the reliability of the PSM-DID regression results, Monte Carlo permutation test is also employed.

5.2 The Major Findings

The empirical results of the models in three objectives allow this research to draw the following findings:

First, monetary freedom has a positive and significant impact on China-ASEAN bilateral trade flows. The positive relationship indicates that when monetary policies allow for greater price stability and reduced inflation, it fosters an environment conducive to increased bilateral trade. Moreover, it is also found that trade liberalization has significantly contributed to the bilateral trade flows between China and ASEAN countries, which suggests that more liberal trade policies in ASEAN countries, such as fewer tariff and non-tariff barriers, have strengthened the trade flows between China and ASEAN countries.

Second, logistics performance is significantly associated with China-ASEAN bilateral trade flows. It implies that improvement in logistics infrastructure and services significantly promotes trade growth between China and ASEAN countries. It is also found that trade facilitation has a significant and positive impact on China-ASEAN bilateral trade flows. This indicates that improvements in customs procedures, regulatory frameworks, and border controls lead to increased trade flows;

efficient trade facilitation plays in reducing trade barriers and promoting smoother cross-border exchanges.

Third, the establishment of China-ASEAN free trade area (CAFTA) has significantly promoted the trade flows between China and ASEAN countries. The total trade value increases by approximately 41 to 44 billion US dollar on average. The trade creation effect of CAFTA in China's imports from ASEAN is slightly larger than that in China's exports from ASEAN. This finding implies that the reduction of tariff and non-tariff barriers, and investment from member countries under CAFTA are contributed to free trade flows between China and ASEAN countries.

Finally, this research finds that economic growth, indicated by GDP per capita, has a positive and significant impact on China-ASEAN bilateral trade flows. This is because better economic growth is associated with high consumption power, which allows people to consume more imported goods. Population is also found to have a positive and significant impact on China-ASEAN bilateral trade flows. Large population means large market size, and is a large consumption market for imported goods. Distance is found to have a negative correlation between China-ASEAN bilateral trade flows because longer distance increases trade costs, which hinders trade flows. Tariff rate is also found to have a significant and negative effect on China-ASEAN bilateral trade flows, this is because tariffs discourage trade by increasing costs, disrupting supply chains, and creating economic inefficiencies, which collectively lead to lower trade flows.

5.3 Implications

Based on the findings of the three objectives, some implications are drawn to improve China-ASEAN bilateral trade and to promote the economic cooperation between China and ASEAN countries.

First, it is suggested for ASEAN developing countries to improve their monetary freedom to increase convenience for bilateral trade flows. Moreover, in order to promote closer trade between China and ASEAN, the use of RMB for settlement in China-ASEAN trade activities can be further promoted. Third, it is still necessary to further reduce trade barriers and improve trade freedom. As the free trade agreement between China and ASEAN involves large tariff reductions, there are still some industries with trade barriers, such as technical trade barriers in the electro-mechanical industry. Technical trade barriers reduce the volume of trade between the two sides and have a negative impact on both trade and economic cooperation between the bilateral countries. In order to have closer trade cooperation, both China and ASEAN should further reduce trade barriers and enhance trade freedom.

Second, it is suggested that China and other developing ASEAN countries still need take more measures to improve their logistics performance and trade facilitation. China and ASEAN can cooperate in logistics infrastructure by promoting the construction of highways and railroads between China and ASEAN countries, as well as strengthening the construction of sea and air transportation facilities to improve transportation efficiency. In addition, China and ASEAN countries can also strengthen customs cooperation and establish a regional customs database and

administration system.

Third, it is recommended to deepen the freedom of merchandise trade in the free trade area to increase more trade flows among CAFTA member countries. To promote the trade flows between China and ASEAN countries, it is necessary to reduce the tariff rate more. Especially the developing ASEAN countries need reduce the trade barriers and improve their trade freedom to increase the trade flows between China and ASEAN. Moreover, in the context of Regional Comprehensive Economic Partnership (RCEP), it is suggested that China and ASEAN countries take this opportunity for more closer cooperation in global value chain and economic area. Based on the large trade creation effect of CAFTA on China-ASEAN bilateral trade flows, it is also recommended for China to sign more free trade agreements with other countries and reduce current tariff among FTA members to increase bilateral trade.

Finally, to strengthen the bilateral trade between China and ASEAN, both China and ASEAN need to continuously develop their economies. China is currently in the midst of industrial upgrading and industrial transformation, and some enterprises are gradually shifting to the Southeast Asian countries. ASEAN developing countries can take the advantage of their comparative advantages in labor costs to attract more Chinese enterprises to invest and build factories. Under the premise of maintaining economic growth, the quality of economic growth is also crucial. Both China and ASEAN need to continuously increase investment in science and technology to promote continuous innovation, and accelerate the continuous upgrading of industrial structure to change the mode of economic growth and enhance the level of

economic development. The upgrading of industrial structure can realize the upgrading of export industrial structure and change the mode of countries' exports, thus optimizing the bilateral trade structure between China and ASEAN and achieving efficient allocation of resources.

5.4 Recommendations for Future Research

This research has not explored other factors which also impact China-ASEAN trade flows, such as foreign direct investment, and global value chain. It also has not examined the trade creation effect of CAFTA in each industry. Future researches regarding China-ASEAN bilateral trade flows can be conducted through the examination of China's detailed trade flows with ASEAN countries separately (country by country) to make a comparison, and through the investigation of China's trade flows with ASEAN countries in different industries. In addition, there are still some other factors which affect China-ASEAN bilateral trade flows yet are not examined in this research. Future study can analyze other influencing factors which contribute to China-ASEAN bilateral trade flows significantly.

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APPENDICES

Appendix 1

China's Merchandise Trade Volume with ASEAN (2001-2021) in Table

YEAR	China's exports to ASEAN (billion US$)	growth rate	China's imports from ASEAN (billion US$)	growth rate	China's total trade with ASEAN (billion US$)	growth rate
2001	18.38		23.21		41.59	
2002	23.58	0.28	31.20	0.34	54.78	0.32
2003	30.93	0.31	47.33	0.52	78.25	0.43
2004	42.90	0.39	62.97	0.33	105.87	0.35
2005	55.37	0.29	74.99	0.19	130.36	0.23
2006	71.31	0.29	89.53	0.19	160.84	0.23
2007	94.72	0.33	108.51	0.21	203.23	0.26
2008	114.32	0.21	117.00	0.08	231.32	0.14
2009	106.30	-0.07	106.71	-0.09	213.01	-0.08
2010	138.16	0.30	154.68	0.45	292.84	0.37
2011	170.08	0.23	193.02	0.25	363.10	0.24
2012	204.27	0.20	195.87	0.01	400.14	0.10
2013	244.04	0.19	199.56	0.02	443.60	0.11
2014	272.05	0.11	208.24	0.04	480.29	0.08
2015	277.29	0.02	194.47	-0.07	471.77	-0.02
2016	256.00	-0.08	196.31	0.01	452.31	-0.04
2017	279.50	0.09	235.95	0.20	515.45	0.14
2018	319.00	0.14	269.38	0.14	588.39	0.14
2019	359.51	0.13	282.35	0.05	641.86	0.09
2020	383.67	0.07	301.97	0.07	685.64	0.07
2021	483.53	0.26	395.15	0.31	878.68	0.28
Average growth rate		0.18		0.16		0.17
average growth rate during 2001-2009		0.25		0.22		0.24
average growth rate during 2010-2021		0.14		0.12		0.13

Source from UNCTAD Database

Appendix 2

Detailed Trade Intensity Indexes of China and ASEAN

	China's intensity with its main partners					ASEAN's intensity with its main partners				
Year	ASEAN	Japan	S.Korea	US	EU	China	Japan	S.Korea	US	EU
2001	1.22	2.97	2.05	1.10	0.42	1.52	2.38	1.61	0.97	0.37
2003	1.29	2.66	1.93	1.22	0.44	1.83	2.31	1.55	0.94	0.33
2005	1.26	2.24	1.85	1.29	0.49	1.82	2.24	1.53	0.86	0.32
2007	1.40	1.89	1.82	1.33	0.51	1.84	2.29	1.46	0.87	0.31
2009	1.52	1.85	1.73	1.44	0.52	1.64	2.16	1.63	0.82	0.31
2011	1.40	1.66	1.52	1.38	0.56	1.61	2.16	1.49	0.70	0.31
2013	1.65	1.53	1.50	1.35	0.48	1.50	2.14	1.52	0.74	0.32
2015	1.81	1.56	1.67	1.28	0.48	1.62	2.25	1.43	0.78	0.35
2017	1.73	1.59	1.67	1.39	0.49	1.71	2.07	1.55	0.81	0.35
2019	1.97	1.50	1.66	1.23	0.51	1.81	1.96	1.51	0.96	0.33
2021	1.97	1.41	1.59	1.30	0.54	1.88	1.92	1.39	1.16	0.32

The number in the above table is calculated by authors based on merchandise trade data from the UNCTAD Database.
The calculation equation is $TII_{ij}=(X_{ij}/X_j)/(M_j/M_w)$.
Here TII_{ij} refers to the trade intensity index between country i and country j. X_{ij} refers to country i's exports to country j. X_i refers to country i's total export volume. M_j stands for country j's total imports and M_w indicates the total imports of the world. When the trade intensity index (TII) is larger than 1, it shows the trade intensity between country i and country j is high. When the trade intensity index (TII) is smaller than 1, it shows the trade intensity between country i and country j is low and loose.

Appendix 3

China's and ASEAN's Export Proportion to Their Main Partners in Table

	China's exports proportion to					ASEAN's exports proportion to				
	ASEAN	EU	US	Korea	Japan	China	EU	US	Korea	Japan
2001	0.07	0.14	0.20	0.05	0.17	0.06	0.13	0.18	0.04	0.14
2003	0.07	0.16	0.21	0.05	0.14	0.10	0.12	0.16	0.04	0.12
2005	0.07	0.17	0.21	0.05	0.11	0.11	0.11	0.14	0.04	0.11
2007	0.08	0.18	0.19	0.05	0.08	0.13	0.11	0.12	0.04	0.10
2009	0.09	0.17	0.18	0.04	0.08	0.13	0.10	0.10	0.04	0.10
2011	0.09	0.17	0.17	0.04	0.08	0.15	0.09	0.09	0.04	0.10
2013	0.11	0.13	0.17	0.04	0.07	0.16	0.09	0.09	0.04	0.09
2015	0.12	0.13	0.18	0.04	0.06	0.17	0.09	0.11	0.04	0.09
2017	0.12	0.14	0.19	0.05	0.06	0.18	0.10	0.11	0.04	0.08
2019	0.14	0.15	0.17	0.04	0.06	0.20	0.10	0.13	0.04	0.08
2021	0.14	0.15	0.17	0.04	0.05	0.23	0.09	0.15	0.04	0.07

Note: the export proportion is calculated as country i's merchandise export value to its partner country j divided by country i's total merchandise export value to the world. The above number is calculated by the authors based on data from UNCTAD database.

Appendix 4

China's Average Import Tariff on Its Trade Partner's Products

Year	Pakistan	S.Korea	Bangladesh	Japan	India	Philippines	Malaysia	Thailand	Singapore	Indonesia	Vietnam
2001	10.99	13.56	9.84	13.67	8.08	9.41	12.15	22.27	11.39	12.66	29.34
2002	7.68	8.23	10.75	8.89	6.11	2.14	6.06	8.90	5.91	6.70	5.07
2003	7.01	6.90	6.75	7.24	4.69	1.25	5.14	6.95	4.66	6.76	4.93
2004	6.31	6.21	7.34	6.41	3.45	1.12	5.11	7.36	4.27	7.01	3.11
2005	6.12	5.59	6.71	5.95	3.01	1.15	3.18	4.89	3.86	4.62	2.76
2006	3.67	4.58	3.81	5.23	5.09	0.66	2.59	4.61	2.92	4.23	4.58
2007	3.32	5.13	3.07	9.19	4.19	0.79	3.11	4.70	3.22	4.30	5.83
2008	3.13	4.76	4.27	9.18	3.08	0.54	2.63	3.59	3.22	3.32	4.75
2009	3.19	4.69	4.85	5.76	1.75	0.61	1.47	2.47	0.69	2.56	1.40
2010	2.82	5.54	5.34	10.25	1.84	0.25	1.33	2.55	0.46	2.42	1.59
2011	2.80	11.07	4.00	13.42	1.92	0.40	1.35	2.76	0.44	1.61	3.32
2012	---	---	---	---	---	---	---	---	---	---	---
2013	---	---	---	---	---	---	---	---	---	---	---
2014	4.66	6.49	0.64	7.88	4.50	0.03	0.45	0.37	0.47	0.56	0.83
2015	5.22	6.21	0.44	7.18	3.52	0.04	0.48	1.96	0.34	1.33	0.81
2016	7.40	3.02	0.48	6.25	3.77	0.04	0.47	1.68	0.33	1.15	0.87
2017	5.12	3.47	---	6.12	4.24	---	0.70	---	---	1.68	---
2018	4.83	2.63	0.69	6.09	3.12	0.09	0.45	2.13	0.22	1.41	0.48
2019	3.98	1.91	0.00	4.75	3.20	0.03	0.36	1.51	0.27	1.02	0.50
2020	2.46	1.59	0.02	4.26	3.40	0.04	0.35	1.04	0.22	1.01	0.19
2021	2.78	1.27	3.63	3.97	3.80	0.04	0.30	1.10	0.20	0.81	0.19

(Source: the World Bank).

Appendix 5

Trade Partner's Average Import Tariff on China's Products

Year	Pakistan	S.Korea	Bangladesh	Japan	India	Philippines	Malaysia	Thailand	Singapore	Indonesia	Vietnam
2001	---	19.89	21.14	5.30	27.36	6.41	7.59	11.51	0.02	4.91	1.21
2002	---	25.31	21.35	4.56	23.61	5.80	4.78	10.92	0.02	5.65	1.21
2003	16.81	27.19	20.82	4.02	21.76	3.74	4.95	10.33	0.03	4.50	1.31
2004	16.14	11.37	18.05	3.60	22.97	3.81	3.90	6.67	0.00	4.93	1.30
2005	14.27	15.94	30.13	3.24	11.80	3.83	3.28	5.95	0.01	4.91	---
2006	13.23	9.30	29.85	3.84	8.86	3.80	3.87	6.20	0.02	4.81	1.62
2007	12.01	9.87	11.81	3.67	9.52	3.03	2.69	5.25	0.00	4.00	2.21
2008	10.46	6.00	10.33	3.20	5.65	5.23	2.00	5.61	0.00	5.20	1.53
2009	12.28	6.65	15.11	3.71	6.36	5.27	1.68	6.05	0.00	2.10	1.45
2010	13.21	5.82	14.49	3.19	5.97	5.26	4.23	5.97	0.00	1.14	3.88
2011	8.94	6.02	14.95	3.26	6.27	1.40	4.74	6.26	0.06	1.14	1.00
2012	8.27	6.39	16.98	3.31	6.38	0.87	4.70	---	0.00	1.02	---
2013	12.76	6.25	16.71	2.28	6.37	0.94	4.47	7.30	0.00	0.96	---
2014	8.26	6.34	---	3.00	---	---	0.71	1.36	0.00	0.98	0.62
2015	8.41	6.87	16.34	2.88	5.85	0.90	---	1.43	0.00	1.00	---
2016	8.59	6.47	---	2.68	6.11	0.90	5.18	---	0.00	1.01	0.64
2017	---	4.41	---	2.52	5.74	0.87	---	---	0.00	0.87	0.07
2018	8.65	4.13	---	2.47	6.35	---	---	---	0.00	0.55	0.04
2019	8.82	---	---	2.98	8.15	0.68	---	---	0.00	0.57	0.08
2020	7.99	3.76	---	2.63	8.16	0.73	5.00	---	0.00	0.67	0.08
2021	7.94	3.39	---	2.36	7.96	0.76	4.81	0.84	0.00	0.69	0.09

(Source: the World Bank).

BIODATA OF STUDENT

Tang Caihong, female, is from Sichuan, China. During September 2007 to June 2011, She completed her bachelor study in Business English. She worked as a international sales representative at Canyearn Medical Equipment Co., Ltd in Sichuan, China from March 2012 to September 2015, to export medical equipment to Southeast Asian countries, South Asia countries, and Middle East countries. From October 2015 to August 2017, she completed her Master Program of Management in Science at Magdeburg University in Germany. Since January 2018, she has been working as a teaching assistant at the School of Economics and Management in Panzhihua University, Sichuan, China. Her main work at Panzhihua University is to give lectures of Business English, International Marketing, China's Foreign Trade to students in Bachelor Program of International Economics and Trade, to supervise students to write their bachelor thesis, and also to guide them attend national competitions in China. She entered the University Putra Malaysia for PhD study in Economics from winter semester of 2021. Her main research focus is on international economics, and published several articles on international journals. She plans to get the PhD degree of Economics in the beginning of 2025.

LIST OF PUBLICATIONS

Tang, C., Rosland, A., Li, J., & Yasmeen, R. (2023). The comparison of bilateral trade between China and ASEAN, China and EU: from the aspect of trade structure, trade complementarity and structural gravity model of trade. *Applied Economics*, 1-13. https://doi.org/10.1080/00036846.2023.2174940 (JCR Q3, impact factor 2.2）

Tang, C., Rosland, A., Yasmeen, R., & Long, Y. (2023). The threshold analysis of economic growth, FDI and trade on environment pollution in China using provincial panel data. *Environment, Development and Sustainability*, 1-20. https://doi.org/10.1007/s10668-023-03670-7 (JCR Q3, impact factor 4.9)

Tang, C., Rosland, A. (2025). The impact of logistics performance and trade facilitation on China-ASEAN bilateral trade flows. *Asian Journal of Economic Modelling*. (Scopus, accepted)