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Assessing the Effects of the ASEAN Free Trade Area and ASEAN-China Free Trade Agreements on Manufacturing Industries in ASEAN

Colin Wong Koh King[1], Liew Khim Sen[2]

[1]Faculty of Economics, Business & Accounting, *i*-CATS University College, Jalan Stampin Timur, 93350 Kuching, Sarawak, Malaysia, [2]Department of Economics, Faculty of Economics & Business, Universiti Malaysia Sarawak 94300 Kota Samarahan, Sarawak

Email: colinwkh@icats.edu.my, ksliew@unimas.my

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Abstract

This study examines the effects of the ASEAN Free Trade Agreement (AFTA) and the ASEAN-China Free Trade Area (ACFTA) on manufacturing trade within ASEAN. It aims to evaluate how these trade agreements influence the growth of manufacturing trade flows between ASEAN members and China. Using a gravity model and panel data from 1999 to 2015, the analysis includes ten ASEAN countries, China, and key trading partners. Key factors such as GDP, population, and geographic proximity are considered to determine their impact on bilateral trade. The findings show that AFTA and ACFTA significantly boost trade flows. GDP and population positively influence trade volumes, while geographic barriers, such as landlocked status and greater distance, hinder trade. The study also identifies a complementary relationship within the regional supply chain, where ASEAN exports lower-value goods to China and imports higher-value products in return. These results highlight the role of trade agreements in promoting economic integration and enhancing ASEAN's standing in the global manufacturing network. The study provides valuable insights for policymakers seeking to maximize the benefits of trade agreements to foster regional economic growth and cooperation, laying the foundation for stronger trade ties and sustainable development.

Keywords: ASEAN, AFTA, ACFTA, Gravity Model, Manufacturing Trade

Introduction

Thailand, Singapore, Malaysia, the Philippines, and Indonesia formed the Association of Southeast Asian Nations (ASEAN) in Bangkok in 1967. The current membership was completed in 1984 with Brunei Darussalam, 1995 with Vietnam, 1997 with Lao PDR and Myanmar, and 1999 with Cambodia.

The establishment of ASEAN was intended to boost commerce, advance industrial and agricultural growth, and raise living conditions throughout the region. Additionally, it aims to promote collaboration in the fields of government, science, technology, economics, society,

and culture. Its goals include boosting social advancement, promoting cultural development, and quickening economic growth. In order to facilitate integration and collaboration on a larger scale, ASEAN also aims to establish strong alliances with regional and global organisations that have comparable objectives.

Despite their diverse histories, ASEAN members are united through the ASEAN Free Trade Agreement (AFTA), a pivotal trade pact. The average import tariff system plays a crucial role in assessing each country's economic openness and trade profitability, which are key factors influencing the success of AFTA. To sustain intra-ASEAN trade, economic integration is essential for optimizing resource utilization and unlocking trade potential.

AFTA was established in 1992 with the goal of removing both tariff and non-tariff obstacles between the member states of ASEAN. Following blocs including the European Union and the North American Free Trade Agreement (NAFTA), this initiative aims to strengthen ASEAN's position in the global economy, increase the region's economic competitiveness, and draw in foreign direct investment. AFTA also places a strong emphasis on leveraging ASEAN's natural economic strengths and collaborative potential to expand industrial ties within the region, especially for small and medium-sized businesses (SMEs).

Launched in 2001, the ASEAN-China Free Trade Area (ACFTA) provides growing ASEAN countries like Cambodia, Vietnam, Lao PDR, and Myanmar with favourable benefits and flexible arrangements. Signed in 2002, the agreement became operative in 2010. By that point, the average tariff for Chinese imports from the member nations of ASEAN had dropped from 9.8% to as little as 0.1%, with 93% of commodities exchanged with China and the remainder among the ASEAN-6 countries being free from tariffs.

The range of commodities that could receive zero tariffs expanded significantly among the CLMV countries (Vietnam, Lao PDR, Myanmar, and Cambodia) between 2000 and 2024. Approximately 90% of goods traded under the ACFTA are currently tax-free, underscoring the agreement's contribution to regional trade flows and economic integration.

This expansion has improved the inclusion of fewer developed ASEAN nations into international supply chains, promoting growth and development in their economies in addition to increasing intraregional trade. The ACFTA's ongoing development, which includes updated protocols and policies aimed at lowering non-tariff trade barriers and promoting more seamless trade flows, reflects the region's rising reliance on digital trade and services.
The fact that the volume of trading between ASEAN and China has more than tripled since 1995 shows how crucial the ACFTA remains for promoting trade and economic expansion in Southeast Asian nations and beyond. China became ASEAN's main trading partner by 2020, and ASEAN became China's biggest trading partner. Trade between ASEAN and China still accounts for a lesser portion of the region's overall international trade, despite this notable increase. This is mainly because member nations have varying degrees of consumer market expansion and competitive trade regimes.

Thailand, Malaysia, and Vietnam have been China's top ASEAN trade partners since 2024. This pattern highlights the region's expanding economic connections and supply chain convergence. Malaysia continues to be a major source of imports for China, but Vietnam has

emerged as the top destination for Chinese exports. The ongoing growth in trade demonstrates the close economic ties between China and ASEAN nations as well as the critical role the ACFTA plays in promoting regional economic cooperation.

The ASEAN-China Free Trade Area's (ACFTA) zero-tariff policy has helped to boost the trade relationship between ASEAN and China in spite of ongoing global financial difficulties. China's Ministry of Commerce reported that commerce between ASEAN nations and China exceeded US$900 billion by 2023. A US$60 billion trade surpluses, fuelled by US$480 billion in exports and US$420 billion in imports, demonstrated China's dominant position in ASEAN trade.

Regional integration, developments in technological innovation, and an emphasis on sustainability have all contributed to the significant expansion and strategic advancements in ASEAN manufacturing trade since 2024.

1. **Robust Growth in Intra-ASEAN Trade:** Enhanced regional supply chain integration and infrastructure improvements are crucial in sustaining the strong expansion of intra-ASEAN trade. This interconnected trade network serves as a safeguard against external economic fluctuations, bolstering the region’s resilience amid global uncertainties.
2. **Evolving ASEAN-China Trade Relations:** China continues to be ASEAN's largest trading partner, with total trade reaching approximately US$900 billion in 2023. The ASEAN-China Free Trade Area (ACFTA) has played a pivotal role in enhancing manufacturing trade, with key ASEAN nations like Thailand, Vietnam, and Malaysia leading trade activities with China. This growth is predominantly pronounced in sectors such as electronics, automotive components, and machinery.
3. **Expansion in Electronics and High-Tech Manufacturing:** ASEAN has emerged as a global hub for electronics production, with Thailand, Vietnam, and Malaysia taking the lead. The region’s role in the high-tech supply chain has been solidified by investments driven by increasing demand for semiconductors, consumer electronic devices, and components for electric vehicles.
4. **Advancements in Digital and Smart Manufacturing:** The adoption of Industry 4.0 technologies is accelerating across ASEAN, driving the growth of digitalization and smart manufacturing. Industries are increasingly incorporating automation, artificial intelligence, and IoT-enabled production processes, enhancing efficiency, reducing costs, and attracting foreign direct investment.
5. **Sustainable Manufacturing and Green Supply Chains:** Sustainability has become a priority as ASEAN businesses align their manufacturing practices with global standards for reduced carbon emissions and eco-friendly supply chains. Countries like Singapore and Thailand are at the forefront of green manufacturing, promoting environmentally responsible industrial practices and attracting green investments.
6. **Growing Significance of Regional Free Trade Agreements:** The Regional Comprehensive Economic Partnership (RCEP), the world’s largest free trade agreement, has greatly strengthened ASEAN’s position in global industrial trade. Encompassing the 10 ASEAN member states and five additional countries, RCEP has created a formidable economic bloc, expanding trade and investment opportunities across the region. By reducing tariffs and simplifying cross-border processes, such agreements are making ASEAN an increasingly attractive destination for industrial investments.

7. **Enhancing Infrastructure and Logistics Investments:** ASEAN's growing status as a manufacturing hub is bolstered by advancements in infrastructure, particularly in transportation and logistics. Strategic initiatives such as port upgrades and the ASEAN Smart Logistics Network are streamlining supply chain operations across member states, fostering greater efficiency and connectivity.
8. **Movement Towards Diversified Supply Chains:** Political uncertainties and supply chain disruptions are accelerating the shift of production from China to ASEAN countries by numerous multinational corporations. Nations such as the Philippines, Vietnam, and Indonesia have emerged as attractive alternatives, making significant strides in positioning themselves as competitive manufacturing hubs.

This study examines the impact of the ASEAN-China Free Trade Area (ACFTA) on ASEAN countries and explores the relationship between the ASEAN Free Trade Area (AFTA) and manufacturing trade within the region. It highlights the importance of assessing whether AFTA effectively promotes manufacturing trade among its member states. The findings aim to enhance understanding of regional trade dynamics and determine AFTA's role in supporting the economic growth of ASEAN nations.

This study is being motivated by the increasing importance of the manufacturing sectors of ASEAN countries in the transforming regional and international trade structures. Even if the ASEAN-China Free Trade Area (ACFTA) and the ASEAN Free Trade Area (AFTA) possessed a significant role in determining trade policy, there is still no practical agreement over how much these agreements have encouraged the manufacturing trade with China and among ASEAN member countries. Given the recent changes in worldwide supply chains, trade diversification initiatives, and intensifying competition in high-tech industries, this is especially important. The ASEAN economies' pursuit of increased participation in worldwide production networks and deeper integration makes an in-depth assessment of these trade agreements more crucial than ever.

By applying an augmented gravity model framework and a panel dataset covering the periods of 1999–2015, this study contributes to the body of literature by evaluating the trade-creating and trade-diverting effects of AFTA and ACFTA on manufacturing trade flows. The research provides a thorough and nuanced understanding of the agreements' efficiency through breaking down the analysis across different member configurations and taking into account key structural characteristics. Policymakers and regional policymakers are able to benefit substantially from the findings, particularly when it comes to strengthening trade facilitation, encouraging manufacturing progression, as well as to strengthen the strategic position of ASEAN countries within the global manufacturing arena.

Literature Review

Abafita and Read (2021) analyze factors shaping the international coffee trade from 2001 to 2015, focusing on 201 trading partners and 18 major exporters. Using gravity modelling with Ordinary Least Squares (OLS) and Poisson Pseudo-Maximum Likelihood (PPML) estimators, they identify exporter and importer GDP, population, shared borders, and cultural ties as key drivers of coffee trade, while distance acts as a barrier. Other positive influences include arable land, infrastructure, the global financial crisis, and currency devaluation in exporting

countries. The study finds no significant impact of Regional Trade Agreements (RTAs) but notes that tariffs by importers reduce trade flows.

Abdul Kamal et al. (2022) examines the trade effectiveness and potential of Pakistan and ASEAN countries in the Chinese market (2003–2019) using an extended gravity model with PPML estimation. The study finds that market size, distance, trade openness, comparative advantages, and shared borders significantly influence trade. Vietnam and Cambodia show the strongest competitive advantages, while Brunei, Pakistan, Myanmar, Laos, Thailand, and the Philippines also have substantial trade opportunities in China. Market dispersion is noted as a factor affecting Pakistan's export performance.

Abozaied et al. (2024) assess the economic impact of China's "One Belt, One Road" (OBOR) initiative on Egypt, one of its long-established trade partners. Analyzing bilateral trade data from 1960 to 2022 with an enhanced gravity model, the study finds that the OBOR initiative has led to a significant and positive increase in trade volume between Egypt and China. The research also underscores the importance of GDP and geographic proximity in fostering bilateral trade.

Akça (2024) examines factors influencing Türkiye's manufacturing exports to its top 30 trading partners (2003–2018) using a gravity model with PPML estimation. The study finds that economic size is the main driver of exports, while distance and landlocked locations hinder trade. Shared borders, cultural similarities, and trade agreements positively impact exports, but barriers include institutional quality, Türkiye's trade freedom, and partner nations' WTO membership.

Az-Zakiyah et al. (2024) examines the impact of trade liberalization between ASEAN and China on their export flows using the gravity model. The study reveals that ASEAN exports benefit significantly from ASEAN countries' openness to China, while China's openness to ASEAN has a less pronounced effect on ASEAN exports. Overall, the findings demonstrate that trade liberalization between the two regions has positively influenced exports from both ASEAN and China, highlighting the critical role of trade openness in enhancing bilateral export performance.

Bharti and Nisa (2023) explore the impact of regional trade agreements on India's exports, using a gravity model to analyze 20 years of panel data (2001–2019) from 30 countries. The study finds that results derived from the Poisson Pseudo-Maximum Likelihood (PPML) method are more robust compared to those from the traditional Ordinary Least Squares (OLS) approach. The findings imply that India benefits more from economic integration with its South Asian trading partners than from acting independently. However, the level of globalization at the national scale has minimal influence on fostering trade among a select group of countries.

Emikönel (2021) uses an extended gravity model to analyze trade between China and 97 countries (2008–2019). The study investigates how demographics, geographic distances, and per capita incomes in ASEAN and APEC countries affect Chinese trade, as well as the role of energy imports in industrial manufacturing. The findings show that trade boosts GDP and population growth, while distance negatively impacts trade. Consistent with gravity theory,

APEC, ASEAN, and OPEC show positive effects. The study also highlights OPEC's role in supporting Chinese exports by providing energy for manufacturing and adding value to intermediate goods.

Hoan and Hung (2024) analyze the factors influencing Vietnam's textile exports post-WTO accession using a gravity-based trade model. Their study examines panel data from 2007 to 2019, focusing on trade flows between Vietnam and its main trading partners. The results indicate that factors such as trade agreements, economic size, income per capita, workforce participation, logistical efficiency, and foreign direct investment (FDI) inflows positively impact Vietnam's textile exports. However, FDI inflows do not have a positive effect on textile exports.

Loganathan et al. (2021) investigate the potential effects of the Bilateral Trade and Investment Agreement (BTIA) within the existing trade environment using a structural gravity model. Employing the Poisson Pseudo Maximum Likelihood (PPML) estimator to address the limitations of ordinary least squares (OLS), the study analyzes 19 years of merchandise export data (2001–2019) from the Gravity database. The findings suggest that the BTIA could result in both trade creation and trade diversion, highlighting the need for a reassessment of India's trade strategy.

Putra and Nasrudin (2023) investigate the determinants of Indonesia's tuna export volume using a gravity model. The analysis reveals that Indonesia's GDP boosts export volume, while economic distance negatively impacts it. The GDP of destination countries shows little influence, but exports rise with the industrial share of these economies. Key factors shaping Indonesia's tuna exports include its GDP, economic distance, real exchange rates, the industrial GDP share of importing nations, and the revealed comparative advantage index.

Moyo (2024) investigates the effect of the Free Trade Agreement (FTA) on intra-exports within the Southern African Development Community (SADC), using a gravity model and a difference-in-difference estimator. Analyzing data from 2001 to 2019, the study finds that the full implementation of the SADC FTA has had little to no impact on export performance, as the export gap between FTA-member and non-member countries remains small. This finding holds across both overall and sector-specific exports.

Ramaswamy et al. (2021) use a gravity model to study the impact of free trade agreements (FTAs) on trade flows in 31 Asian economies from 2007 to 2014. The findings indicate that some FTAs have negative effects on trade, with GDP and population identified as significant factors. Trade costs, represented by distance, are shown to hinder trade. The study implies that improving trade flows within the region by reducing both tariff and non-tariff barriers, enhancing transportation infrastructure, and boosting productivity could lead to greater trade and GDP growth.

Singh (2021) examines the impact of the India–ASEAN Free Trade Agreement (IAFTA) on trade creation and diversion using a gravity model that includes multilateral resistance factors. The analysis covers panel data from 45 countries, including India, 10 ASEAN members, and 34 key trading partners, spanning 1996 to 2018. The study assesses bilateral trade through imports

and exports, finding that IAFTA has a stronger effect on import creation compared to export creation, indicating its significant role in fostering new trade flows.

Tang et al. (2023) examine China's trade dynamics with ASEAN and the EU, identifying distinct patterns. China exports high-tech electrical and electronic goods to ASEAN, imports medium-tech products from the EU, and high-tech goods from ASEAN. The study highlights China's competitiveness in low-tech manufacturing and high-tech electronics but notes weaker performance in medium-tech industries. High-tech trade complementarity is strong between China and ASEAN, while low-tech complementarity is evident with the EU. Key factors influencing these trade relationships include human development, trade freedom, financial flexibility, and per capita income.

Tian (2024) investigates trade prospects between mainland China and Nepal, assessing the feasibility of the Lanzhou-Kathmandu South Asian rail-road goods transit (LKSARFT) using a stochastic frontier gravity model. The analysis shows a decline in export and bilateral trade over time, with bilateral trade efficiency fluctuating over 18 years while export trade potential remained steady. Despite Nepal's strong trade potential with China, the study highlights that trade barriers imposed by China on Nepal are more restrictive than those affecting overall bilateral trade.

Wani (2024) identifies GDP and trade openness as key drivers of annual export flows among BRICS countries. The study reveals that while the BRICS formation has significantly influenced bilateral trade, intra-industry trade surpasses intra-BRICS trade. Geographical distance poses a challenge to trade expansion. To enhance trade among BRICS nations, the study highlights the importance of fostering economic cooperation through infrastructure development, free trade agreements (FTAs), and stronger people-to-people connections. These findings emphasize the critical role of collaboration in advancing trade and economic growth within the BRICS bloc.

Wirya Purba et al. (2024) analyze factors influencing Indonesia's paper exports to ASEAN using panel data from 2010 to 2019. The study finds that population growth, real GDP growth, and exchange rates positively impact export values, while higher export prices and economic distance have negative effects. All variables show statistically significant influence on export values at a 95% confidence level.

Methodology

Data Description

The estimation data covers 16 years (1999–2015) and includes China and 10 ASEAN exporting countries: Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. The analysis also incorporates a range of industrialized and developing countries, along with 79 importers from various regions of Asia.

Data Sources

The statistics on bilateral manufacturing trade, presented in constant United States dollars, are sourced from the United Nations International Trade Statistics Database (2016). Data on the top 10 ASEAN manufacturing goods is provided by the United Nations COMTRADE database (2016). Population and GDP figures are obtained from the World Bank (2016).

Information on territory, language, landlocked or island status, and distance measures is provided by the Centre d'Études Prospectives et d'Informations Internationales (CEPII, 2016).

Model Specification

The aim of AFTA and ACFTA, inclusive of non-ASEAN member countries, is to evaluate whether these agreements have expedited manufacturing trade among ASEAN nations. The study follows the Vinerian framework for assessing integration effects, utilizing two separate categories of FTAs as dummy variables to capture the impacts of export and import creation and diversion.

The volumes of manufacturing trade from country *i* to country *j* are typically explained by the basic form of the gravity equation, which shows that these volumes are influenced by factors such as economic size, population, distance, shared borders and languages, and the status of being island or landlocked nations, among others. Therefore, the following model is estimated in this study:

$$\ln MT_{ijt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln POPL_{it} + \beta_4 \ln POPL_{jt} + \beta_5 \ln DIST_{ij} + \beta_6 LANG_{ij} + \beta_7 BORDER_{ij} + \beta_8 LLOCK_{it} + \beta_9 LLOCK_{jt} + \beta_{10} ISL_{it} + \beta_{11} ISL_{jt} + \varepsilon_{ijt} \quad (1)$$

where,

MT_{ijt} = Total manufacturing trade at time t between the countries that import and export (i and j), respectively;

GDP_{it} = The exporting country's GDP during the time period *t*;

GDP = The importing country's GDP during the time period *t*;

$POPL_{it}$ = Population of the exporting country in the time period *t*;

$POPL_{jt}$ = Population of the importing country in the time period *t*;

$DIST_{ij}$ = The distance between the exporting and importing countries;

$LANG_{ij}$ = A binary variable equal to 1 if the two countries share a common language, and 0 otherwise;

$BORDER_{ij}$= A binary variable that takes the value 0 if the two nations do not share a border and 1 if they do;

$LLOCK_i$= A binary variable that returns 0 otherwise and 1 if the exporting nation is landlocked (has no seaports or direct sea access);

$LLOCK_j$= A binary variable that returns 0 otherwise and 1 if the importing nation is landlocked (has no seaports or direct sea access);

ISL_i = This binary variable has a value of 1 if the exporting nation is an island nation and 0 otherwise;

ISL_j= A binary variable set to one if the importing country *j* is an island nation, and zero otherwise; and

ε_{ij}= error terms.

AFTA dummy variables are commonly incorporated into the baseline model to evaluate the impact of AFTA adoption on overall manufacturing trade flows. Accordingly, the following represents the augmented gravity equation:

$$\ln MT_{ijt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln POPL_{it} + \beta_4 \ln POPL_{jt} + \beta_5 \ln DIST_{ij} + \beta_6 LANG_{ij} + \beta_7 BORDER_{ij} + \beta_8 LLOCK_{it} + \beta_9 LLOCK_{it} + \beta_{10} ISL_{it} + \beta_{11} ISL_{jt} + \varphi_1 AFTA\_1_{ijt} + \varphi_2 AFTA\_2_{ijt} + \varphi_3 AFTA\_3_{ijt} + \varepsilon_{ijt}$$

(2)

Equation (2) represents an augmented gravity model that incorporates AFTA dummy variables. In year t, the binary variable AFTA_1 equals 1 if both countries i and j are AFTA members; otherwise, it is 0. If country i joins AFTA in year t while country j is not a member, the dummy variable AFTA_2 takes a value of 1; otherwise, it is 0. Conversely, if country i is not an AFTA member but country j is in year t, the binary variable AFTA_3 is assigned a value of 1; otherwise, it is 0.

To assess the impact of the ASEAN-China Free Trade Area (ACFTA) on intra-ASEAN manufacturing trade flows, the analysis should incorporate regressions alongside aggregate manufacturing trade data. Accordingly, the augmented gravity equation is specified as follows:

$$\ln MT_{ijt}=\beta_0+\beta_1 \ln GDP_{it}+\beta_2 \ln GDP_{jt}+ \beta_3 \ln POPL_{it}+\beta_4 \ln POPL_{jt}+\beta_5 \ln DIST_{ij}+\beta_6 LANG_{ij} + \beta_7 BORDER_{ij} + \beta_8 LLOCK_{it} + \beta_9 LLOCK_{it} +\beta_{10} ISL_{it} +\beta_{11} ISL_{jt} +\Phi_1 ACFTA\_1_{ijt}+\phi_2 ACFTA\_2_{ijt}+ \phi_3 ACFTA\_3_{ijt}+\varepsilon_{ijt}$$

(3)

The binary variable ACFTA_1 equals 1 if either country i or country j is a member of ACFTA in year t; otherwise, it equals 0. Similarly, ACFTA_2 is assigned a value of 1 if country i is an ACFTA member while country j is not in year t; otherwise, it is 0. Conversely, ACFTA_3 equals 1 if country i is not a member but country j is in year t; otherwise, it is assigned a value of 0. The core model incorporates binary FTA variables, namely AFTA and ACFTA, to determine their impact on overall intra-trade flows within the ASEAN manufacturing sector. Accordingly, the augmented gravity equations are presented as follows:

$$\ln MT_{ijt}=\beta_0+\beta_1 \ln GDP_{it}+\beta_2 \ln GDP_{jt}+ \beta_3 \ln POPL_{it}+\beta_4 \ln POPL_{jt}+\beta_5 \ln DIST_{ij}+\beta_6 LANG_{ij} + \beta_7 BORDER_{ij} + \beta_8 LLOCK_{it} + \beta_9 LLOCK_{it} +\beta_{10} ISL_{it} +\beta_{11} ISL_{jt} +\varphi_1 AFTA\_1_{ijt}+\varphi_2 AFTA\_2_{ijt}+\varphi_3 AFTA\_3_{ijt} +\Phi_1 ACFTA\_1_{ijt}+\phi_2 A$$

(4)

The second specification employs a model estimated with dyadic fixed effects, incorporating time-fixed effects to capture macroeconomic influences. The models are outlined as follows:

$$\ln MT_{ijt}= \beta_0+\beta_1 \ln GDP_{it}+\beta_2 \ln GDP_{jt}+ \beta_3 \ln POPL_{it}+\beta_4 \ln POPL_{jt}+ \phi_1 AFTA\_1_{ijt} + \phi_2 AFTA\_2_{ijt}+\varphi_3 AFTA\_3_{ijt}+\delta_t+\pi_{ij}+\mu_{ijt}$$

(5)

$$\ln MT_{ijt}= \beta_0+\beta_1 \ln GDP_{it}+\beta_2 \ln GDP_{jt}+ \beta_3 \ln POPL_{it}+\beta_4 \ln POPL_{jt}+ \phi_1 ACFTA\_1_{ijt}+ \phi_2 ACFTA\_2_{ijt} + \phi_3 ACFTA\_3_{ijt} + \delta_t+\pi_{ij}+\mu_{ijt}$$

(6)

$$\ln MT_{ijt}= \beta_0+\beta_1 \ln GDP_{it}+\beta_2 \ln GDP_{jt}+ \beta_3 \ln POPL_{it}+\beta_4 \ln POPL_{jt}+ \phi_1 AFTA\_1_{ijt}+\phi_2 AFTA\_2_{ijt}+ \varphi_3 AFTA\_3_{ijt}+\phi_1 ACFTA\_1_{ijt}+ \phi_2 ACFTA\_2_{ijt_9}+ \phi_3 ACFTA\_3_{ijt}+\delta_t+\pi_{ij}+\mu_{ijt}$$

(7)

The panel data approach allows the study to address time-varying multilateral resistance terms and mitigate endogeneity bias in gravity equations by incorporating country-time effects alongside country-pair fixed effects, as recommended by Baier and Bergstrand (2007). The gravity equations are thus presented as follows:

$$\ln MT_{ijt} = \beta_0 + \phi_1 AFTA\_1_{ijt} + \phi_2 AFTA\_2_{ijt} + \varphi_3 AFTA\_3_{ijt} + \pi_{ij} + \epsilon_{it} + \psi_{jt} + \mu_{ijt} \quad (8)$$

$$\ln MT_{ijt} = \beta_0 + \phi_1 ACFTA\_1_{ijt} + \phi_2 ACFTA\_2_{ijt} + \phi_3 ACFTA\_3_{ijt} + \pi_{ij} + \epsilon_{it} + \psi_{jt} + \mu_{ijt} \quad (9)$$

$$\ln MT_{ijt} = \beta_0 + \phi_1 AFTA\_1_{ijt} + \phi_2 AFTA\_2_{ijt} + \varphi_3 AFTA\_3_{ijt} + \phi_1 ACFTA\_1_{ijt} + \phi_2 ACFTA\_2_{ijt} + \phi_3 ACFTA\_3_{ijt} + \pi_{ij} + \epsilon_{it} + \psi_{ijt} \quad (10)$$

The fourth model incorporates both country-time and country-pair fixed effects to account for biases stemming from unobserved time-dependent multilateral resistance factors. This methodology separates the impact of free trade agreements on total manufacturing trade flows at the same time as minimizing bias from omitted variables.

The gravity framework employed in this study examines the relationship between key determinants such as GDP, population, and distance on bilateral manufacturing trade. Building on the sensitivity analysis conducted by Yamarik and Ghosh (2005), this study incorporates additional robust variables demonstrated to be relevant in previous research.

Empirical Results

The study utilizes panel gravity estimates through the pooled OLS method, time and dyadic random effects models, time and dyadic fixed effects models, time-dependent multilateral resistance terms, and country-pair fixed effects models to analyze the influence of AFTA and ACFTA agreements on overall manufacturing trade flows. The findings are summarized in Table 1.

The variance inflation factors (VIF), ranging from 1.12 to 9.03, confirm that multicollinearity is not a concern in the model. The Breusch-Pagan-Godfrey heteroskedasticity test, with an F-statistic of 5161.62 and a Chi-square value of 8978.43, reveals the presence of heteroskedasticity. Furthermore, the Breusch-Godfrey Serial Correlation Lagrange Multiplier test indicates strong evidence of AR(2) serial correlation, as shown by an F-statistic of 16064.18 and an LM statistic of 14873.20, rejecting the null hypothesis.

The study combines pooled OLS, random effects, and fixed-effects models, including country-pair and time-fixed effects, to address biases and accurately assess the impact of AFTA and ACFTA on bilateral manufacturing trade flows.

Among the models analyzed, models 3 and 4 are deemed more appropriate than models 1 and 2. However, model 3 outperforms model 4 based on the adjusted R-squared and root-mean-square error (RMSE) metrics, as shown in Table 1.

Time and Dyadic Fixed Effects

The study reveals that a 1% rise in GDP leads to a 0.014% decline in total manufacturing trade and a 0.660% growth in overall manufacturing trade, reflecting the combined GDP effects of both exporting and importing nations.

Martinez-Zarzoso (2003) analyzes total manufacturing trade flows by considering the populations of both importing and exporting countries. The study reveals that a 1% increase in population leads to a 1.723% and 0.395% increase in bilateral industrial trade, respectively. Both agreements have produced pure trade creation effects, as indicated by the positive coefficients of the AFTA and ACFTA dummies in Column (3), which displays the results for the time-based and dyadic fixed effects models.

Time-Varying Multilateral Resistance Terms and Country-Pair Fixed Effects

The study shows that while manufacturing trade between AFTA member countries and non-member nations decreased, AFTA led to a general rise in trade between members and non-members. The negative coefficient indicates a reduction in trade among non-member countries, while the positive coefficients for ACFTA variables demonstrate clear trade creation effects.

Table 1

Gravity Estimates for Panel Data for Overall Manufacturing Business

	(1) Pooled OLS	(2) t, ij, RE	(3) t, ij, FE	(4) it, ij, ij, FE
$\ln GDP_{it}$	1.1234 [78.03]***	-0.0171 [-1.27]	-0.0140 [-1.01]	
$\ln GDP_{jt}$	0.4627 [32.70]***	0.5918 [63.16]***	0.6603 [70.64]***	
$\ln POPL_{it}$	0.6665 [35.03]***	1.7205 [6.71]***	1.7232 [6.52]***	
$\ln POPL_{jt}$	0.5865 [31.76]***	0.4217 [35.52]***	0.3952 [34.92]***	
$\ln DIST_{ij}$	-0.7891 [-16.04]***	-0.6239 [-14.08]***		
$LANG_{ij}$	2.1224 [17.25]***	1.1600 [13.11]***		
$BORDER_{ij}$	-0.1877 [-1.09]	0.3390 [2.87]***		
$LLOCK_i$	-3.0500 [-32.31]***	0.7175 [1.03]		
$LLOCK_j$	-1.6866 [-17.87]***	-1.6945 [-26.69]***		
ISL_i	0.8665 [12.63]***	-1.0707 [-1.49]		
ISL_j	0.6065 [8.92]***	0.7119 [15.52]***		
$AFTA\_1_{ijt}(\phi_1)$	0.4835 [2.31]**	4.6660 [10.89]***	7.0409 [16.58]***	7.0852 [16.62]***
$AFTA\_2_{ijt}(\phi_2)$	-0.1931 [-1.31]	3.9571 [9.90]***	4.8916 [11.94]***	5.9262 [14.63]***
$AFTA\_3_{ijt}(\phi_3)$	-0.0469 [-0.31]	-0.0761 [-0.32]	0.9241 [3.76]***	-0.0225 [-0.08]
$ACFTA\_1_{ijt}(\varphi_1)$	-1.0631 [-5.35]***	1.3199 [7.40]***	1.2432 [6.77]***	3.7912 [18.55]***
$ACFTA\_2_{ijt}(\varphi_2)$	0.8326 [-10.52]***	1.5735 [12.49]***	1.4173 [10.91]***	3.1285 [23.64]***

$ACFTA\_3_{ijt}$ (φ_3)	-0.4433 [-5.59]***	1.2225 [9.69]***	1.0429 [8.02]***	3.2079 [24.21]***
Constant	-47.589 [-68.91]***	-39.982 [-8.94]***	-47.890 [-10.43]***	4.4509 [11.06]***
Breusch-Pagan Lagrange Multiplier (LM) test	2900000 [0.000]***	17.23 [0.000]***		
Hausman test		0.000 [0.000]***		
AIC		136792.2	136217.4	
N	27676	27676	27676	27676
R-squared	0.5297	0.7883	0.7747	0.6702
Adj *R*-Squared	0.5294	0.7875	0.7738	0.6690
RMSE	4.2085	2.8281	2.9176	3.5293
Wald Test for omitting:	χ2 [p-value]			
AFTA	53.09 [0.0000]	52.43 [0.0000]	40.90 [0.0000]	228.88 [0.0000]
ACFTA	6.41 [0.0002]	66.01 [0.0000]	226.43 [0.0000]	195.45 [0.0000]

Note: t-values are calculated using robust and grouped standard errors, with each coefficient's t-value provided below. To account for heteroskedasticity, White's robust covariance matrix estimator is applied. The data for sectoral exports, the dependent variable, are sourced from the UNCTAD database and reported in US dollars. The binary variable AFTA_1 is set to 1 if both countries *i* and *j* are AFTA members in year t; otherwise, it is 0. If country *i* is an AFTA member and country *j* is not in year t, AFTA_2 is 1, and 0 otherwise. AFTA_3 is 1 if neither country *i* nor *j* is an AFTA member in year t, and 0 in all other cases. For ACFTA, ACFTA_1 takes the value of 1 if both countries *i* and *j* are ACFTA members in year t, and 0 otherwise. ACFTA_2 is 1 if country *i* is an ACFTA member and country *j* is not in year t, and 0 otherwise. Lastly, ACFTA_3 is 1 if country *i* is not a member of ACFTA and country *j* is in year t, and 0 otherwise. Statistical significance is indicated at the 10%, 5%, and 1% levels with *, **, and ***, respectively.

Table 2
The Variance Inflation Factor (VIF) – Total Manufacturing Trade

Variables	Centered VIF
$\ln GDP_{it}$	1.693810
$\ln GDP_{jt}$	1.621465
$\ln POPL;_{it}$	1.786206
$\ln POPL_{jt}$	1.682102
$\ln DIST_{ij}$	1.725722
$LANG_{ij}$	1.104353
$BORDER_{ij}$	1.272978
$LLOCK_i$	1.121784
$LLOCK_j$	1.121751
ISL_i	1.369077
ISL_j	1.346616
$AFTA\_1_{ijt}(\phi_1)$	3.565115
$AFTA\_2_{ijt}\ (\phi_2)$	8.300701
$AFTA\_3_{ijt}\ (\phi_3)$	9.030118
$ACFTA\_1_{ijt}\ (\varphi_1)$	1.397805
$ACFTA\_2_{ijt}\ (\varphi_2)$	1.348232
$ACFTA\_3_{ijt}\ (\varphi_3)$	1.347216

Table 3
The Breusch-Pagan-Godfrey Heteroskedasticity Estimates for the Overall Manufacturing Trade

F-statistic	Prob. F-statistic	Chi-Sq- statistic	Prob>chi2
5161.62	0.000	8978.43	0.000

Table 4
Total Manufacturing Trade: The Breusch-Godfrey Serial Correlation LM Test Results

F-statistic	Prob. F-statistic	LM-statistics	Prob>chi2
16064.18	0.000	14873.20	0.000

Table 5
Results of Trade Impacts on the Total Manufacturing Trade of AFTA and ACFTA

	$AFTA\_2_{ijt}\ (\phi_2 > 0)$	$AFTA\_3_{ijt}\ (\phi_3>0)$
$AFTA\_1_{ijt}(\phi_1 > 0)$	Pure TC (X)	Pure TC (M)
	$ACFTA\_2_{ijt}\ (\varphi_2 > 0)$	$ACFTA\_3_{ijt}\ (\varphi_3 > 0)$
$ACFTA\_1_{ijt}\ (\varphi_1 > 0)$	Pure TC (X)	Pure TC (M)

Note: The coefficient φ_1 of FTA_1 reflects exports between member countries, while φ_2 (the coefficient of FTA_2) represents exports from member countries to non-member countries. Exports from non-member countries to member countries are denoted by φ_3, the coefficient of FTA_3. Trade creation in terms of exports and imports is captured by TC (X) and TC (M), respectively. Export diversion is indicated by XD, and import diversion by MD. The rise

in extra-bloc imports and exports is represented by ME and XE, respectively. The reduction in intra-bloc imports is signified by MC, and the decline in intra-bloc exports is represented by XC. Source: Yang & Martinez-Zarzoso (2014).

Conclusion

This study utilizes the gravity trade model to analyze the effect of the AFTA and ACFTA agreements on total manufactured trade between ASEAN-10, China, and 79 selected trading partners from 1999 to 2015.

The study highlights the positive influence of the GDP and populations of both importing and exporting countries on bilateral manufacturing trade. Shared languages and island status also contribute positively, while landlocked status, shared borders, and distance between countries have negative effects. The GDP and population of importing nations positively impact manufacturing trade, while the GDP, distance, and landlocked status of exporting countries have adverse effects. In Model 3, the GDP and population of importing countries positively affect bilateral manufacturing trade, whereas the GDP of exporting countries has a negative impact. Model 4 omits other variables and focuses solely on estimating dummy variables for free trade agreements.

Overall, the positive results indicate that both AFTA and ACFTA have generated trade creation effects among their member and non-member trading partners.
ASEAN countries have varying competitive advantages, with some focusing on capital-intensive and others on labour-intensive goods. China specializes in high-value products, while ASEAN exports raw materials and labour-intensive goods to China. The ACFTA is expected to boost trade by streamlining supply chains and creating a unified ASEAN-China market.

Recent data on ASEAN's key industrial sectors show that the textile, apparel, and electronics & electrical (E&E) sectors receive the most focus, with Malaysia and Singapore attracting substantial investments in E&E industries. However, China’s strong emphasis on these sectors creates considerable overlap with ASEAN's manufacturing capabilities. Since the 1980s, China has been producing and exporting many of the same products, leading to increased competition in these markets across the region.

China's rise in the global economy during the 1980s established it as a key hub for multinational corporations (MNCs). MNCs leverage China's extensive infrastructure and skilled workforce for large-scale manufacturing, utilizing regional supply networks and focusing on export trade across ASEAN. This integrated network has not only boosted ASEAN's participation in global value chains, particularly in the E&E sector, but also strengthened regional trade connections.

As of 2024, trade between China and ASEAN countries has maintained its growth, continuing the upward trend that began in 1995, with China largely benefiting. The product categories traded between China and ASEAN nations show considerable overlap, particularly in electrical, electronic, and mechanical equipment. The main products exchanged between China and ASEAN fall within the HS84 (machinery and mechanical appliances) and HS85

(electrical machinery and equipment) classifications, according to the 2-digit Harmonized System (HS) code.

These two categories encompass a broad array of highly sought-after products that are crucial to the global electrical and electronics (E&E) industry, such as computers, telecommunications equipment, and consumer electronics. This trade structure highlights China's key role as a major global assembler and exporter of finished goods, while ASEAN contributes intermediate products. The integrated supply chains in manufacturing and technology emphasize the economic integration and mutual reliance between China and ASEAN within the global value chain.

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