Analysis of Factors Determining Intra-ASEAN Product Trade Flows : Gravity Model Approach

Analisis Faktor Penentu Aliran Perdagangan Produk Intra-ASEAN : Pendekatan Gravity Model

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ABSTRACT
International trade encourages the creation of economic cooperation regionally. Integration of the ASEAN Economic Region by initiating the ASEAN Free Trade Area (AFTA) is expected to increase intra-ASEAN trade. However, the contribution of trade between ASEAN countries to ASEAN trade value has experienced stagnant growth and is still dominated by trade between countries outside the ASEAN region. The aim of this research is to determine the factors that influence trade flows between ASEAN countries so that they can encourage the value of trade between ASEAN countries. The data used in this research is panel data consisting of 10 ASEAN member countries for 17 years which is explained using a gravity model approach. The research results show that the GDP variables of exporting countries, population of export destination countries and trade openness have a significant positive influence on the value of trade between ASEAN countries. ASEAN countries need to consider a country's trade openness when formulating international trade policies in order to have a positive impact on increasing trade value.
Keywords: ASEAN, gravity model, regional trade.

ABSTRAK
Perdagangan internasional mendorong terciptanya kerjasama ekonomi regional. Integrasi ekonomi Kawasan ASEAN dengan menginisiasi ASEAN Free Trade Area (AFTA) diharapkan dapat meningkatkan perdagangan intra-ASEAN. Namun, kontribusi perdagangan intra-ASEAN terhadap nilai perdagangan ASEAN mengalami pertumbuhan yang stagnan dan masih didominasi dengan perdagangan antarnegara diluar kawasan ASEAN. Penelitian ini memiliki tujuan untuk mengetahui faktor apa saja yang menentukan aliran perdagangan intra-ASEAN sehingga dapat mendorong nilai perdagangan intra-ASEAN. Penelitian ini menggunakan data panel yang menganalisis 10 negara anggota ASEAN dalam periode 17 tahun dan dianalisis dengan pendekatan model gravity. Dari hasil olahan data ditemukan bahwa variabel GDP negara eksportir, populasi negara tujuan ekspor dan trade openness memiliki pengaruh positif yang signifikan terhadap nilai perdagangan intra-ASEAN. Kerjasama ekonomi ASEAN diharapkan

dapat mendorong kebijakan untuk meningkatkan keterbukaan antar negara anggota sehingga dapat mengoptimalkan nilai perdagangan intra-ASEAN.
Kata Kunci: *ASEAN, gravity model, perdagangan regional.*

INTRODUCTION

International trade plays an important role in the dynamics of the global economy that affects the economy of a country. The exchange of resources between countries forms political, social and cultural relations globally. This cross-border interaction allows a country to utilize comparative and competitive advantages in optimizing resources to achieve mutual benefit (Krugman & Obstfeld, 2009). International trade encourages the creation of economic cooperation both bilaterally and regionally.

ASEAN (Association of Southeast Asian Nations) is a regional cooperation organization between countries in the Southeast Asian region agreed on August 8, 1967 through the Bangkok Declaration and pioneered by five Southeast Asian countries, namely Indonesia, Malaysia, Singapore, the Philippines and Thailand. ASEAN has a population of 698,7 million people, which is around 8,5% of the world's total population (ASEANstats, 2025). The main purpose of establishing ASEAN is to encourage the creation of peace, security, stability and prosperity in the Southeast Asian region. ASEAN is a new force to be able to survive and develop into an economic region.

ASEAN Free Trade Area (AFTA) is one of the initiatives to strengthen economic integration in the ASEAN region. AFTA was agreed on January 28, 1992 with the main objective of eliminating trade barriers between ASEAN countries. The main focus of AFTA is to create a free trade zone among ASEAN countries by reducing trade tariffs among member countries. Before AFTA, ASEAN countries had limited trade integration despite being in the same region. The establishment of ASEAN laid the groundwork for cooperation, but real economic impact only came after AFTA was created in response to global pressures, competition, and the need to be economically competitive. AFTA helped transform ASEAN into a more cohesive economic bloc, benefiting its members through increased trade and investment.
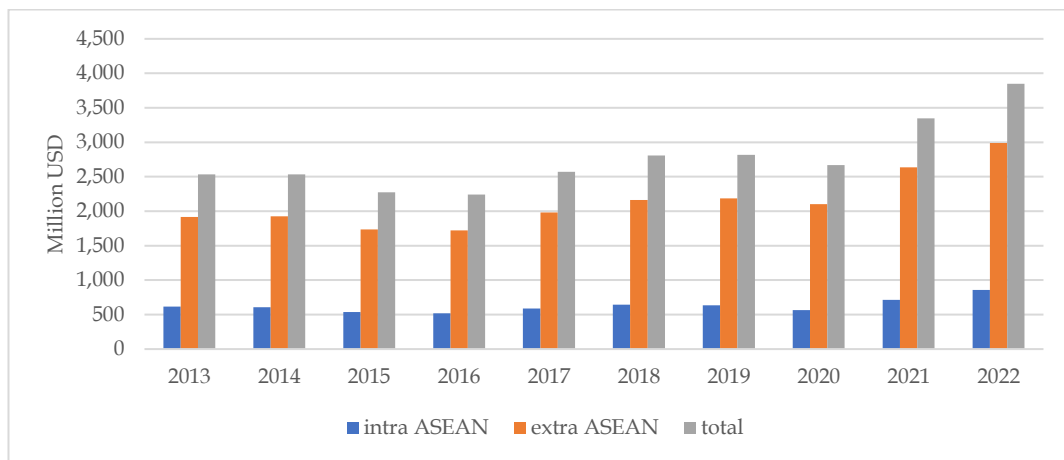
Figure 1. ASEAN Trade Value from 2013 to 2022
Source : ASEAN Stastistical Yearbook, 2023

Trade outside the ASEAN region (extra ASEAN) still has a significant role in the economy of ASEAN member countries, driven by global economic growth and dependence on external markets. ASEAN continues to pursue the strengthening of its economic integration, with the expectation that intra-regional trade will play an increasingly significant role in the future and contribute to long-term economic growth and stability across the region. Based on Figure 1, it is known that the value of ASEAN trade has tended to increase from year to year, but the contribution of intra-ASEAN trade is still relatively stagnant.
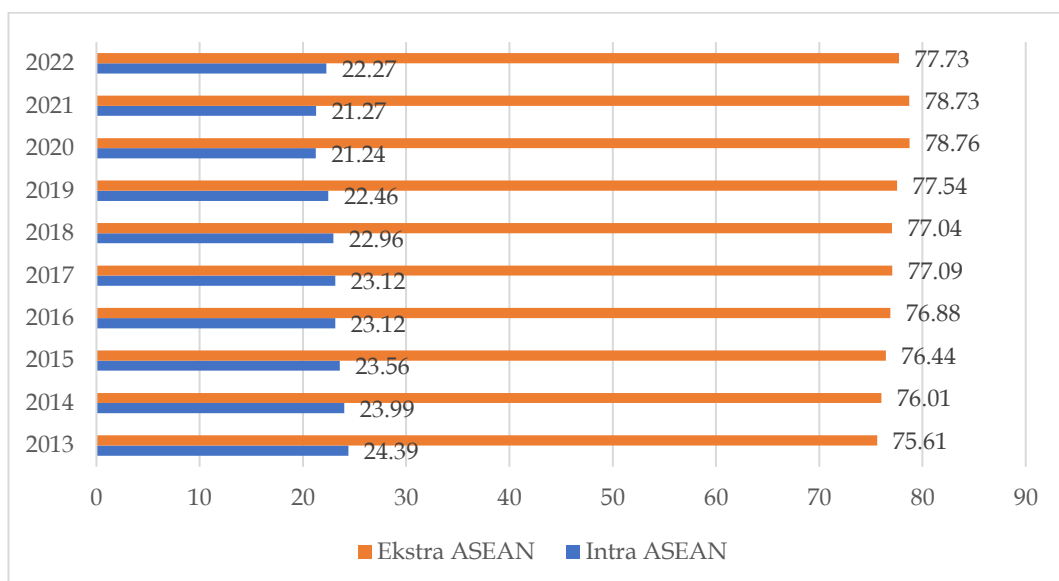

Figure 2. Value and Contribution of Intra and Extra-ASEAN Trade from 2013 to 2022
Source : ASEAN Statistical Yearbook, 2023

Intra-ASEAN trade has remained stagnant in the range of 21–24 percent over the past period (figure 2). In 2022, intra-ASEAN trade contributed only 22.27%, while extra-ASEAN trade accounted for as much as 77.73%. ASEAN's largest trading partners in 2022 were China, with a trade value of USD 722.1 billion or 18.77% of ASEAN's total trade, and the United States, with USD 420.4 billion or 10.93% of the total trade (ASEAN, 2023).

ASEAN has made efforts to enhance intra-regional trade over the past few decades; however, its contribution remains relatively small compared to extra-ASEAN trade. The research indicates that a gap was found between the ideal (calculated) and the actual ratio of intra-regional and extra-regional export space, which hints that despite the many years of regional integration, there is still a significant amount of space for ASEAN countries to further strengthen the intra-regional market (Cuyvers, 2025). Although economic integration has taken place within ASEAN, intra-ASEAN trade has not shown significant growth. Instead, it has led to an increase in trade with countries outside the ASEAN region (extra-ASEAN). Based on information from the Ministry of Trade (2023), the implementation of the Common Effective Preferential Tariff (CEPT), which is part of the ASEAN Free Trade Area (AFTA) agreement, has resulted in the application of 0–5% tariffs on 99% of products by Brunei Darussalam, Indonesia, Malaysia, the Philippines, Thailand, and Singapore. Meanwhile, ASEAN member countries such as Cambodia, Laos, Vietnam, and Myanmar are still in the process of reducing tariffs. In addition, non-tariff barriers such as differences in regulations and technical standards among countries remain significant obstacles to intra-regional trade in Southeast Asia. Based on this background, this study aims to identify the key determinants of intra-ASEAN trade that should be considered in efforts to improve and promote better intra-ASEAN trade performance.

RESEARCH METHODS

This study uses data collected from the sources listed in Table 1 as secondary data. The data used is a combination of cross-sectional and time series data, referred to as panel data.

Table 1. Types and Data Sources

Data Types	Sources
Export Import	UN Comtrade
GDP, Population	World Development Indicator- World Bank
Exchange rate	Official Exchange Rate-Nilai Tukar
Geographic distance	CEPII
Trade openness	The Global Economy

Source : Data processed 2023

According to Sihombing et al., (2021) the advantage of using panel data regression is that it can increase the degree of freedom value, this can overcome the constraint of missing variables (omitted variables). In addition, it will have an impact on reducing bias in estimating the model because the data is quite large. The data used is the total trade value of accumulated exports and imports of products. The study took the scope of ASEAN countries, namely Indonesia, Thailand, Malaysia, the Philippines, Singapore, Brunei Darussalam, Laos, Cambodia, Vietnam, Myanmar and data observed for 17 years from the period 2005 to 2021.

This study uses the panel data regression with Gravity modelling. The gravity model is a basic model that has previously been widely applied in international trade research and is an analysis that can analyse a nation's economic integration decisions in conducting trade (Asharuddin et al., 2023). The Gravity Model adapts from Newton's principle of gravity which explains that the attractive force between two objects depends on the mass of each object and the distance between them. The law is mathematically denoted:

$$Fij = G\frac{MiMj}{Dij^2}$$

Information :
Fij   : Force of attraction between two objects
Mi dan Mj   : Mass of the two objects
Dij   : Distance between the two objects

Transformed into the Gravity Model (Bergeijk & Brakman, 2010) as follows:

$$Tij = \frac{GDP_i^\alpha GDP_j^\beta}{D_{ij}^\theta}$$

Information :
Ti   : bilateral trade value of countries I and j

GDP   : *Gross Domestic Product* as a measure of economic mass
Dij   : bilateral distance between the two countries
αβθ   : parameter

Parameters α, β, and θ are estimated in the log-linear model reformulation. This equation explains bilateral trade using economic size and distance. The larger the two trading partners, the greater the trade flow. The greater the distance between the two countries, the smaller the bilateral trade flow (Bergeijk & Brakman, 2010). Bilateral trade flow from region i to region j is a multiplicative (or log-linear) function of the Gross Domestic Product (GDP) of the two countries, the bilateral distance between the two countries and a series of dummy variables assumed to reflect the cost of trade between the two regions (Bergeijk & Brakman, 2010).

Three panel data regression approaches that can be used in the model, namely common effect model (CEM), fixed effect model (FEM), and random effect model (REM). The best model statistically can be decided using several statistical tests, namely the Chow test, the Lagrange Multiplier (LM) test and the Hausman test.

The Chow test is a statistical F test used in determining the suitability of the model between the common effect model or fixed effect model. In the Chow test, the assumptions used are as follows:

H0   : Common effect model

H1   : Fixed effect model

When the p-value is lower than the significance level, the null hypothesis (H0) is rejected. It is concluded that the fixed effect model is more appropriate to use. The Lagrange Multiplier (LM) test is a statistical test in determining the best model between the random effect model or the common effect model and that found by Breusch-Pagan (Sihombing, 2021). The assumptions of this test are:

H_0 : Common effect model

H_1 : Random effect Model

The H0 rejection criterion is by using statistics comparing the chi-square value. If the Prob>chi value is less than the real level, then it can be stated that H1 is accepted and H0 is rejected.

The Hausman test is a statistical test for consideration of choosing a model between a fixed effect model or a random effect model. The assumptions tested are:

H_0 : Random effect model

H_1 : Fixed effect model

The H0 rejection criterion uses statistics comparing the chi-square value. If the Prob>chi value is less than the real level, then it can be stated that H1 and the selected fixed effect model can be accepted.

International trade is empirically influenced by exchange rate factors, government effectiveness, and trade openness (Suryanto, 2022). The selection of this variable is based on the reason why transactions are carried out based on the country's capabilities. Each country in the study acts as a reporter country and a partner country. The gravity model equation in this study is shown as follows:

$$\ln(X_{ijt}) = a_0 + a_1 \ln(GDP_{it}) + a_2 \ln(GDP_{jt}) + a_3 \ln(Pop_i) + a_4 \ln(Pop_j) + a_5 \ln(Diseco_{ij}) + a_6 \ln(Exc_{ijt}) + a_7 TO_{It} + a_8 TO_{jt} + \varepsilon_{ijt}$$

Information :

X_{ijt} : The value of trade between ASEAN countries in the year t (USD)

GDP_{it} : GDP of exporting country in year t (USD)

GDP_{jt} : GDP of trading partner countries in year t (USD)

$Diseco_{ijt}$: Economic distance between ASEAN countries in year t (Km/USD)

Pop_i : Population of exporting countries (jiwa)

Pop_j : Population of trading partner countries (jiwa)

Exc_{ijt} : Currency exchange rate in year t (Rp/ER_j)

TO_{it} : Trade openness of exporting countries in year t (%)

TO_{jt} : Trade openness of trading partner countries in year *t* (%)

ε_{ijt} : *Error term*

i   : Exporting country

j   : Trading partner countries or export destination countries

The following are independent variables used in this research model, namely:

GDP of exporting countries. Theoretically, GDP can describe national output production. The higher the GDP of a country, the higher the production of

goods and services, so it has an influence on the export value to meet the international market. This variable is thought to have a positive influence on the value of trade.

GDP of trading partner countries. Theoretically, an increase in GDP has a positive relationship with increasing people's purchasing power. The increasing level of income of the destination country for exports will increase the demand for goods.

Economic distance. Economic distance can be a proxy for the amount of costs incurred for trade transactions due to the absolute distance factor. The greater the distance will affect the amount of trade costs between two countries, so the value of trade transactions will be smaller. This variable is thought to have a negative effect on the value of trade.

Population of exporting countries. This variable is thought to have a positive effect. The size of the population of producing countries is thought to have an impact on increasing production, thus encouraging an increase in the value of trade in terms of exports.

Population of trading partner countries. The magnitude of this variable describes the magnitude of the potential or size of the market. The larger the population of the destination country for exports, the greater the demand for goods from abroad to meet the needs of that country. The hypothesis can have a positive effect on trade flows.

Exchange rate. The decline in the exchange rate is thought to have an impact on increasing exports because the price of products abroad becomes expensive but for trading partners it becomes cheaper.

The ratio of openness to trade of the exporting country. Trade openness or the openness of a country to international trade. Mathematically assessed by dividing the aggregate value of exports and imports by Gross Domestic Product in a period of time (Fujii, 2019). This variable describes the level of openness of the exporting country to other countries. Trade openness ratio of trading partner countries. A value that describes the level of trade openness of trading partner countries or export destinations.

RESULTS AND DISCUSSION

Before performing regression calculations from selected panel data, the author conducted descriptive statistical analysis. Descriptive statistical analysis is used to see an overview of 765 observations of dependent and independent variables used in the panel data regression model, namely as follows:

Table 2 Descriptive Statistical Analysis of Dependent and Independent Variables

Variable	Obs	Mean	Std. dev.	Min	Max
InTrade	765	18,87092	6,241553	-6,90776	24,8894
LnGDPi	765	25,68057	1,543138	22,63165	27,69466
LnGDPj	765	25,05151	1,396005	22,63165	26,85495
LnPopi	765	17,24872	2,094372	12,81285	19,42774
LnPopj	765	16,72216	1,355971	12,81235	18,55066
LnDisteco	765	3,87003	1,558487	0,75612	6,089961
LnExc	765	1,167802	5,40613	-8,88416	9,754097
Toi	765	2,124555	3,605973	6,68E-13	23,56025
Toj	765	0,053397	0,361609	3,46E-15	9,835812

Sources : Data Processed, 2024

Based on table 2, the average value of intra-ASEAN trade is 18,87092 with a standard deviation of 6,241553 it is indicating substantial variation across countries. The logarithmic GDP of the exporting and importing countries averages 25,68057 and 25,05151 respectively, reflecting relatively high and balanced economic levels among member states. Population size in logarithmic has mean values of 17,24872 and 16,72216. The average economic distance is 3,87003, while the real exchange rate shows a high variability with a standard deviation of 5,40613. The openness index of the origin country has a higher average 2,124555 compared to that of the destination country, which is 0.053397 suggesting that exporting countries are generally more open to trade. Overall, the data reflects the diverse economic conditions and trade characteristics among ASEAN member countries.

The flow of intra-ASEAN product trade is determined by various factors. These factors need to be analysed to determine the determinants of trade flows. This study processes panel data in three models that have been tested statistically to determine the most fit model to describe the diversity in the research discussion.

Table 3. Statistical Model Test Results

Test	Prob	Results
Chow Test	0,0000	FEM
LM Test	0,0000	REM
Hausman Test	0,0000	FEM

Sources : Data Processed, 2024

The results of the Chow test indicate that the F probability is lower than the 5% significance level (0.00 < 0.05). This value suggests that the panel data analysed using the FEM approach is better than the CEM. In the LM test, the probability value is also lower than the significance level (0.00 < 0.05), meaning that the REM model is considered more appropriate and accurate compared to the CEM model. Subsequently, a Hausman test was conducted, with the probability value lower than the 5% significance level (0.00 < 0.05), indicating that the panel data analysed with the FEM approach is better than the REM. Based on these results, the FEM model was selected for this study.

Table 4. Gravity Model Test Results with Fixed Effect Model

Variabel	Coefficient	t-statistic	Prob
InTrade	4,540702	3,48	0,001**
LnGDPi	-1,407780	-0,63	0,527
LnGDPj	2,492992	0,33	0,744
LnPopi	7,240578	8,91	0,000**
LnDisteco	-4,203159	-1,48	0,141
LnExc	0,133999	1,08	0,282
Toi	0,712116	7,58	0,000**
Toj	0,220815	0,57	0,572
Cons	-244,4972	-2,71	0,007
R-squared	0,4497		
Prob (F-statistic)	0,0000		

Sources : Data Processed, 2024
Keterangan :
**significance at 1% level

The output from Stata for the Fixed Effect Model estimation presented in Table 4, with an F-stat probability value lower than the 5% significance level (0.00 < 0.05), indicates that the model is statistically valid and incorporates multiple independent variables that have a significant impact on the research model. The R-squared value of 0.4497 suggests that the model accounts for 44.97% of the variance in intra-ASEAN trade flows. The independent variables found to have a

significant effect in this model include the exporter's GDP, the trading partner's population, economic distance, and the exporter's trade openness.

The exporter's GDP has a positive and statistically significant impact on trade flows. This is evidenced by the probability value for the exporter's GDP variable being lower than the 1% significance level (0.00 < 0.01). This variable provides a coefficient value of 4.540702, meaning that a 1% increase in the exporter's GDP will lead to a 4.54% increase in trade flows between ASEAN countries (ceteris paribus). This result aligns with the study by Jayathilaka et al. (2011), where an increase in GDP indicates growth in the production of goods and services, as well as the expansion of domestic production capacity. The increase in production enhances the export potential of goods, thereby promoting export trade.

The trading partner's population has a positive and statistically significant impact on trade value. The probability value for the trading partner's population variable is lower than the 1% significance level (0.00 < 0.01). The coefficient value for this variable is 7.240578, indicating that a 1% increase in the trading partner's population will lead to a 7.24% increase in trade value between ASEAN countries, holding other factors constant (ceteris paribus). These findings are consistent with the studies by Astuti et al. (2023), and Pohan et al. (2024). A large population reflects a high number of consumers, which serves as a market for goods production. An increase in the trading partner's population will boost consumption and increase demand for goods if the country is unable to meet that demand. This, in turn, will encourage imports and increase trade volume.

Trade openness of exporting countries has a positive and significant effect on trade value. This variable has a probability value lower than the significance level of 1% (0.00 <0.01). This variable has a coefficient value of 0.712116, meaning that a 1% increase in the degree of openness of a country to trade (trade openness) of exporting countries will increase trade value by 0.71% (ceteris paribus). This is in accordance with research by Pertiwi et al., (2019) who have conducted research related to trade openness previously. According to Nam & Ryu (2024) GDP improves with trade volumes, implying the positive effects of trade openness. Trade openness encourages efficient market competition and has an impact on increasing

trade transactions. This situation provides benefits to the country through expanding market access, increasing economic competitiveness, and creating more jobs.

Commodity trade between countries in the world through exports and imports continues to face dynamics (Yuliansyah et al., 2023). The level of openness of a country to trade activities indirectly shows the trade policy in reducing trade restrictions in the country. Countries that implement open market policies in the trade, investment, and banking sectors tend to show better economic performance when compared to countries that are protectionist or reluctant to establish economic relations with other countries (Miller et al., 2019). The higher the value of trade openness, the smaller the country's barriers to trade. This encourages a positive increase in trade intensity in the form of exports and imports which will affect the value of trade. According to Chakrabarti (2018), a higher level of openness can open up opportunities for wider and more diverse product diversification, but can reduce resilience to external shocks due to dependency.

The variables that do not have a significant effect on the results of the model test are the GDP variable of the export destination country, the population of the exporting country, the exchange rate, and the trade openness of the export destination country. The rupiah exchange rate against the US dollar, which fluctuates, determines the price of all commodities in export and import activities (Wijayanti & Rachmanto, 2023) but in this case of intra-ASEAN trade, the exchange rate is not significant to the trade flow. The economic distance variable, which is the main independent variable in the gravity model, shows that it does not have a significant impact on the value of trade. This is not in accordance with the research of Syachbudy et al., (2017) but has an opposite relationship according to the hypothesis.

CONCLUSION

The results of the analysis discussing the determinants of intra-ASEAN trade flows observing 10 ASEAN member countries show that the independent variables in the model that have a significant and positive impact on the value of intra-ASEAN trade are the GDP of the exporting country, the population of the

export destination country or trading partner and the trade openness of the exporting country. Meanwhile, the economic distance variable which is also the main variable in the gravity model does not have a significant effect on the value of intra-ASEAN trade.

The results indicate a significant and positive relationship between the exporter's GDP variable and intra-ASEAN trade value. To increase trade value, efforts from each ASEAN member state are required to enhance the production capacity of exporting countries through productivity improvements that can boost the competitiveness of export products. The population variable of the export destination country also has a significant and positive impact on intra-ASEAN trade value. The population of the export destination country represents the market size that can absorb products. Each ASEAN member country could consider fiscal policy interventions, such as reducing personal taxes, which could increase income and, in turn, enhance the purchasing power of the population for products. This study also shows a significant and positive impact of the exporter's trade openness on trade value. A country's openness to trade indicates that reducing trade barriers can increase intra-ASEAN trade value. The implication is the need to encourage ASEAN economic cooperation focused on reducing or even eliminating barriers that may restrict intra-ASEAN trade flows and improve market access for ASEAN member countries in trade.

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