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DETERMINANTS OF ASEAN FISHERY TRADE (A Gravity Model Approach)

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ABSTRACT

Indonesia is known as an archipelagic country with vast marine potential. International trade has been a key driver of rapid economic growth. Economic integration among ASEAN countries has brought significant benefits, particularly in the fishery products sector. This study aims to analyze the factors influencing the flow of fishery trade among ASEAN countries. The total number of data observations is 100, with the central destination countries including Malaysia, Singapore, Vietnam, Thailand, the Philippines, East Timor, Brunei Darussalam, Cambodia, Myanmar, and Laos. The research employs panel data from ASEAN member states covering the period from 2003 to 2022, including variables such as each ASEAN country's GDP, GDP per capita, population, exchange rates, and economic distance. The analysis is conducted using the gravity model approach, with the Random Effects Model (REM) applied to process the data. The findings reveal that the exchange rate has a positive and significant effect on fishery trade flows among ASEAN countries. This suggests that currency fluctuations play a key role in facilitating trade. Conversely, economic distance has a negative and significant effect, indicating that greater geographical and economic gaps between countries hinder the volume of fishery trade. However, other variables, such as GDP, GDP per capita, and population, do not exhibit a statistically significant impact on fishery trade flows. These results underscore the importance of exchange rates and geographical proximity in shaping trade patterns within the ASEAN fishery sector. The study provides empirical evidence that while macroeconomic indicators such as GDP and population size are often considered critical in trade analysis, their influence on fishery trade flows among ASEAN countries is limited. Understanding the role of these factors is essential for evaluating trade dynamics and addressing challenges in regional fishery trade.

Keywords: economic distance: exchange rate: fishery sector: gravity mode: international trade.

INTRODUCTION

International trade plays a crucial role in the global economy, with countries exchanging goods and services to enhance their economic welfare. In the ASEAN region, inter-country trade has been a major driver of rapid economic growth. Economic integration among ASEAN countries has brought significant benefits, not only through the elimination of tariff and non-tariff barriers but also through increased cooperation and collaboration across various economic sectors. One sector with significant potential for development through ASEAN inter-country trade is the fisheries sector. ASEAN is a region rich in fisheries resources, with Indonesia among the world's largest fish-producing countries. Fishery products, such as fresh and processed fish, and other seafood, are key commodities exported to various countries, both within and outside the ASEAN region. Therefore, understanding the factors influencing the trade flow of fishery products is crucial for optimizing the economic potential of this sector.

Indonesia is known as an archipelagic country with vast marine potential. This potential extends across approximately 5.8 million km² of maritime zones, consisting of archipelagic waters (2.3

million km²), territorial waters (0.8 million km²), and the Exclusive Economic Zone (2.7 million km²). According to data from the Badan Pusat Statistik (2023), Indonesia's fishery production reached approximately 23.21 million tons. Seaweed is the primary commodity, with a production volume of 8.02 million tons. The export value of Indonesia's fishery products in 2023 reached USD 5.6 billion, with key commodities including shrimp, tuna, skipjack, squid, cuttlefish, octopus, crab, and seaweed. The average annual growth rate of Indonesia's fishery production is 2.07%. The fishery sector's contribution to the national Gross Domestic Product (GDP) is 2.54%, with a GDP value of IDR 407 trillion. This data highlights the significant importance of the fishery sector to Indonesia's economy, both in domestic production and in international trade. Sustained support and development in this sector are crucial to enhancing competitiveness and the economic welfare of communities dependent on the fishery industry.

Several previous studies have shown that factors such as economic distance and exchange rates significantly affect international trade. Pradipta & Firdaus (2014) stated that economic distance can hinder trade because the greater the distance between two countries, the higher the transportation costs. Additionally, exchange rates affect trade by making a country's products cheaper or more expensive in the international market, depending on whether the exchange rate appreciates or depreciates.

However, other studies provide different perspectives on the determinants of trade in fishery products. Destiningsih et al. (2020) emphasized the importance of trade agreements in facilitating exports, highlighting that preferential trade agreements within ASEAN have significantly increased fishery exports. Meanwhile, Aprilia et al. (2023) state that export prices, the population of the importing country, real exchange rates, and non-tariff policies have a significant effect on the volume of Indonesian export demand. A more recent study by Tran et al. (2017) analyzed the impact of global market demand on Indonesia's fishery trade. Their findings suggest that rising consumer demand for sustainable, certified seafood products influences export competitiveness. This perspective contrasts with earlier studies that focused primarily on cost-related trade barriers.

Comparing these studies, it is evident that while economic distance and exchange rates remain fundamental determinants, trade facilitation policies and market preferences are becoming increasingly important. This shift implies that policy interventions should not only focus on reducing logistical costs but also on aligning Indonesia's fishery industry with international market standards. A comprehensive approach incorporating all these factors will be necessary to enhance Indonesia's competitiveness in ASEAN and global fishery trade. Previous studies have investigated economic distance and exchange rates in global trade. However, most previous studies applying the gravity model to international trade analysis have primarily focused on the agricultural sector in general or on bilateral trade between major economies, with limited attention to the fisheries sector within the ASEAN region. Research that applies the gravity model to examine the determinants of fishery product trade flows among ASEAN countries remains scarce. Therefore, this study offers a high degree of originality by addressing this gap and focusing on the application of the gravity model in analyzing inter-country fishery trade within ASEAN.

Based on these issues, this study aims to analyze the factors influencing the flow of fishery trade among ASEAN countries. The findings of this study are expected to make a significant contribution to the literature on international trade, particularly in the context of inter-country trade in the fishery sector within ASEAN. Moreover, the findings can serve as a basis for policymakers in formulating more effective strategies to enhance the competitiveness of Indonesian fishery products in international markets. By understanding the influence of each variable, it is hoped that the most influential factors can be identified and policy strategies can be developed to overcome obstacles and maximize trade potential.

MATERIAL AND METHODS

This study of agricultural product trade flows uses secondary data from various institutions, the internet, and literature, collected from books and other sources. The data used is panel data with a total of 100 observations, which is a combination of cross-section data and time series data, with a time span of ten years, from 2003 to 2022, while the cross-section data includes export and import trade data between ASEAN countries, GDP value, population, exchange rate, and economic distance. The ASEAN countries in question are Malaysia, Singapore, Vietnam, Thailand, the Philippines, East Timor, Brunei Darussalam, Cambodia, Myanmar, and Laos. Secondary data on export and import trade between ASEAN countries and the agricultural sector consists of total export and import trade data with HS code 03**.** This study uses the gravity model as an analytical framework to identify the factors that influence the value of Indonesian fishery exports to various ASEAN destination countries.

The gravity model is an approach in international economics used to predict trade flows between two countries or regions (Irwandi & Purwanti, 2024). Therefore, the gravity model was chosen for this study because it can capture the influence of economic size and other factors on international trade patterns.

Table 1. Type and source of data

No	Data	Data Source	Unit
1	Import and export	ITC Trademap	USD
2	GDP	GDP	USD
3	Population	World bank	Individuals
4	Exchange rates	World bank	
5	Distance between countries	CEPII	Km/USD

Source: Processed Data, 2024

Gravity Model: This research applies a panel-data regression model test using three approaches: Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). To select the most appropriate model, three tests are conducted based on probability values Chow Test The Chow Test is used for panel data to determine whether FEM or CEM is more appropriate, with the hypotheses: H0: CEM is more accurate: Prob > 0.05, H1: FEM is more accurate: Prob < 0.05, Hausman Test The Hausman Test is used for panel data to describe whether REM or FEM is more appropriate, with the hypotheses: H0: REM is more accurate: Prob > 0.05, H1: FEM is more accurate: Prob < 0.05, LM Test The LM Test is for panel data to determine and test whether CEM or REM is more appropriate, with the hypotheses: H0: CEM is more accurate: Prob > 0.05, H1: REM is more accurate: Prob < 0.05.

This study uses a gravity model with REM (Random Effects Model). The choice of the REM model is based on the assumption that country-specific effects are random and uncorrelated with independent variables such as GDP, population, and exchange rates. REM is more efficient for panel data with many countries and moderate time intervals, and there is no need to estimate fixed effects for each country, which saves degrees of freedom. If the country effect is insignificant or not correlated with the independent variable, REM is more appropriate than FEM; otherwise, FEM is more suitable. The gravity model is used to analyze the impact of economic integration on trade and serves as an analytical tool to estimate the volume of imports and exports within a region (Asharuddin et al., 2024; Ayuda et al., 2022; Muharami & Novianti, 2018a, 2018b; Nurhayati et al., n.d., 2018; Yuniarti, 2019). The gravity model accounts for trade patterns and potential constraints, including transportation costs, national and international barriers, geographical and cultural characteristics, and other regulatory challenges that affect international trade. Thus, the theoretical foundation of the gravity model is developed to achieve the most accurate results. The reduced gravity model is then developed based on trade theories such as the Heckscher-Ohlin model. This model posits that trade values are influenced by variables such as GDP, per capita income, population size, exchange rates, and distance. This approach is used to analyze the factors influencing the trade flow of fishery products among ASEAN countries.

$$\begin{aligned}\text{Ln (Trade)} = {} & \alpha+\beta_1 \text{Ln}(GDP_{it})+\beta_2 \text{Ln}(GDP_{jt})+\beta_3 \text{Ln}(GDPPC_{it})+\beta_4 \text{Ln}(GDPPC_{jt})+\beta_5 \text{Ln}(POP_{it})+ \\ & \beta_6 \text{Ln}(POP_{jt})+\beta_7 \text{Ln}(EXC_{it})+\beta_8 \text{Ln}(DIST_{it})+\varphi_{ijt} \end{aligned} \quad (1)$$

Notes : Ln(Trade): Natural logarithm of the pepper trade value with four trading partner countries in the year t (USD), Ln(GDPit): Natural logarithm of the origin country's GDP in year t (USD), Ln(GDPjt): Natural logarithm of the partner country's GDP in year t (USD), Ln(GDPPCit): Natural logarithm of the origin country's GDP per capita in year t (USD), Ln(GDPPCjt): Natural logarithm of the partner country's GDP per capita in year t (USD), Ln(POPit): Natural logarithm of the origin country's population in year t (USD), Ln(POPjt): Natural logarithm of the partner country's population in year t (USD), Ln(EXCit): Natural logarithm of the exchange rate (USD), Ln(DISTit): Natural logarithm of the economic distance between the origin country and the partner (Km/USD), µijt : galat (*error term*), α: Intercept, β: Slope

RESULTS AND DISCUSSION

Estimation of Trade Flows Using the Gravity Model

This study aims to analyze the factors influencing trade in the fishery sector between Indonesia and ASEAN countries and to determine the positive or negative effects of these factors on trade. In analyzing panel data, two models are commonly used: the Fixed-Effects Model (FEM) and the Random-Effects Model (REM). To find the model that best represents the variables statistically, Chow, LM, and Hausman tests were conducted on the gravity model. The Chow test results showed a p-value of 0.000, which is less than the 5% significance level (0.05), indicating that REM is better than FEM. Furthermore, the Hausman test results showed a p-value of 0.001, which is lower than the 5% significance level (0.05), indicating that REM is better than FEM. Thus, based on both tests, REM was selected as the best model for analyzing the factors affecting trade flows of Indonesian fishery commodities in ASEAN countries.

The use of the Random Effects Model (REM) in the study of international trade in fish to the ASEAN market was chosen for several reasons that support the model's efficiency and accuracy. Firstly, REM assumes that country-specific factors, such as trade policies or geographical conditions, are uncorrelated with independent variables such as GDP, exchange rate, or population. This assumption allows the model to account for random effects across countries without the need to estimate fixed effects for each country. Second, by using panel data from several ASEAN countries over a long time span (2003-2022), REM achieves higher efficiency by reducing the number of parameters to be estimated, resulting in more robust and efficient estimates. REM can also capture cross-country variation in factors that affect trade, such as exchange rates or economic distance, without having to account for individual countries' fixed effects, which is particularly suitable for international trade analysis. In addition, REMs allow for more flexible and generalisable results, which is important in the context of ASEAN, which comprises countries with diverse conditions. Lastly, if variables such as GDP or population do not show a significant effect on fish trade, REM remains the preferred choice because it does not need to account for country-specific effects directly, thereby allowing the model to remain efficient even if some variables are insignificant (Rambe & Malau, 2023). For these reasons, REM is considered the most suitable model to analyse the factors affecting fish trade among ASEAN countries.

Factors Influencing the Flow of Fishery Trade Among ASEAN Countries.

The model estimation results show a coefficient of determination of 0.721, indicating that the independent variables explain 72.16% of the dependent variable, while the remaining 27.84% is explained by variables outside the model. The probability value (F statistic) is 0.00, which is less than the significance levels (α) of 1%, 5%, and 10%. This demonstrates that the independent variables used in the model collectively have a significant effect on the dependent variable. Based on the model estimation conducted, the model equation formed is as follows:

$$\begin{aligned}\text{Ln (Trade)} = {} & 65{,}105 + 4{,}712\text{Ln}(GDP_{it}) - 0{,}337\text{Ln}(GDP_{jt}) - 1{,}718\text{Ln}(GDPPC_{it}) - 0{,}109\ \text{Ln}(GDPPC_{jt}) - \\ & 2{,}100\text{Ln}(POP_{it}) - 9{,}710\text{Ln}(POP_{jt}) + 0{,}325\text{Ln}(EXC_{it}) - 1{,}560\ \text{Ln}(DIST_{it}) + \varphi_{ijt} \qquad (2)\end{aligned}$$

Table 2. Factors influencing fishery trade flows among ASEAN countries

Variabel	Coef.	Std. Error	Prob.
C	65.105	38.753	0.093
Ln(GDPit)	4.712	6.811	0.489
Ln(GDPjt)	-0.337	7.032	0.962
Ln(GDPPCit)	-1.718	6.745	0.799
Ln(GDPPCjt)	-0.109	7.299	0.988
Ln(POPit)	-2.100	6.752	0.756
Ln(POPjt)	-9.710	6.723	0.149
Ln(Excit)	0.325	0.038	0.000***
Ln(DISTit)	-1.560	0.129	0.000***

Note: *significant at the 10% level α; ** significant at the 5% level α; *** significant at the 1% level α

1. The GDP has no significant effect on the export of Indonesian fish in the ASEAN market

Although GDP provides an overview of a country's economic health, factors more directly related to trade, policies, and more specific sectors (such as fisheries) have a greater impact on the flow of Indonesian fish exports in the ASEAN market. The insignificant effect of GDP (Gross Domestic

Product) on Indonesian fish exports in the ASEAN market can be explained by several factors. Although GDP reflects the size of a country's economy, other factors such as trade policy, exchange rates, and logistics infrastructure often have a more direct impact on export flows. In the context of fish exports, for example, exchange rates and transportation costs may be more influential than a country's overall size. In addition, fish exports may be influenced by other more specific factors, such as product quality, fisheries regulations, and market demand in the destination country, which are not always directly related to GDP. In the ASEAN market, countries with large GDPs are not necessarily the main markets for Indonesian fish, as factors such as geographical proximity, bilateral trade relations, and trade agreements such as the ASEAN Free Trade Area (AFTA) play a greater role in driving exports. In addition, GDP does not always reflect all factors that affect exports, such as income distribution imbalances or dependence on sectors not directly related to fisheries. Therefore, even if a country has a high GDP, other trade barriers, such as transportation costs and trade policies, can be more decisive for the volume of Indonesian fish exports (Irwandi et al., 2021; Darsono et al., 2018; Miftah Akbar & Widyastutik, 2022).

Based on the estimates in Table 2, the GDP variable does not affect trade flows among ASEAN countries in the fishery sector. This may be because the fishery sector constitutes only a small part of the overall economy, contributing 2.6% to the economy (Badan Pusat Statistik, 2023). GDP encompasses all economic activities, including industries, services, and other sectors, so changes in GDP do not always reflect the condition of the fishery sector specifically. These findings contrast with those of Yulianto & Djermor (2018), who found that an increase in the origin country's GDP positively affects the partner country's exports to the origin country. Conversely, an increase in the partner country's GDP will positively affect its exports to the origin country. GDP reflects the mass or size of an economy engaged in international trade (Ayuda et al., 2022). A rising GDP indicates that a country demands a larger quantity of goods or services. The real GDP of the importing country increases export volume, as the real GDP of the export destination reflects that country's market potential. Ardiyanti (2015) also reported that the real GDP of the importing country positively affects the increase in Indonesia's shrimp exports.

2. GDP per capita has no significant effect on the export of Indonesian fish in the ASEAN market

The insignificant effect of GDP per capita on Indonesian fish exports in the ASEAN market can be due to several factors. Although GDP per capita is often used as an indicator of a country's economic welfare, other more specific factors in international trade, such as trade policy, exchange rates, and non-tariff barriers, can have a greater effect on the flow of fish exports. In the ASEAN market, demand for Indonesian fish may be more influenced by factors such as consumer preferences, fisheries policies, and the quality of fish products than by per capita income, which reflects purchasing power in general. In addition, although countries with high GDP per capita may have strong purchasing power, this does not necessarily imply that fish exports will increase significantly, as fish consumption is also influenced by cultural factors and food policies that differ across countries. In addition, variables such as the exchange rate, which affect the price competitiveness of Indonesian fish in the ASEAN market, as well as ease of market access, may be more influential in shaping the volume of fish exports than GDP per capita itself. Thus, although GDP per capita may reflect the level of economic well-being, other factors more closely related to trade and the fisheries sector have a greater impact on Indonesian fish exports to the ASEAN market (Ardine et al., 2023; Rault et al., 2016). Meanwhile, Ramadhani & Ruchba (2024) found that GDP has a positive influence on shrimp commodity exports in both the short and long terms.

3. The population has no significant effect on the export of Indonesian fish in the ASEAN market

The insignificant effect of the population of both Indonesia and ASEAN countries on Indonesia's fish exports to the ASEAN market can be explained by several factors. Although population size is often considered the primary determinant of market size and demand, in the context of fish exports, other factors may play a greater role. First, the demand for fish may depend not only on population size but also on specific market conditions, such as consumer preferences, dietary habits, and the availability of alternative protein sources in each ASEAN country. In many ASEAN countries, fish consumption patterns may not be proportional to population size due to regional differences, income levels, and cultural preferences (Astagia et al., 2022).

In addition, the structure of the fishing trade is influenced by factors such as trade agreements, tariffs, and logistical infrastructure, which can more strongly affect export flows than population size. For example, ASEAN countries are often bound by trade agreements, such as the ASEAN Free Trade Area (AFTA), which can simplify trade flows without accounting for population

size. Other factors, such as exchange rates, transportation costs, and government policies in the fisheries sector, can also have a direct impact on trade volume, beyond population size.

Furthermore, the population sizes in exporting and importing countries may not adequately reflect the demand for certain types of fish, as economic factors such as income distribution and the availability of alternative sources of protein have a greater influence on market demand for fish. Therefore, although population size is an important demographic indicator, its direct influence on fish exports in this context may be limited compared to more specific trade and market factors.

Additionally, the population variable does not affect trade flows in the fishery sector. The population variable does not significantly affect international trade flows in the fishery sector, as several specific factors influence this trade. A large population does not necessarily correlate with high demand for fishery products in international markets. Other factors, such as consumption preferences, income levels, and fish-eating culture, have a greater influence on the demand for fishery products than population size alone. Trade agreements, tariffs, and export-import regulations more significantly determine fishery trade volumes than a country's population size. Global market demand for fishery products is primarily determined by major markets such as the European Union, the United States, and Japan, which may have more favorable trade agreements and strict quality standards. Therefore, the population of ASEAN countries may not have a significant influence on the fishery sector trade flows. These findings contrast with Rambe & Malau (2023), who stated that there is a negative influence between population and export volume due to shifts in consumer preferences.

4. The Exchange Rate has a significant effect on the export of Indonesian fish in the ASEAN market

The exchange rate positively affects Indonesia's export flows to ASEAN countries for several reasons, including price competitiveness and trade benefits. When the rupiah's exchange rate decreases against the currencies of ASEAN export destinations, export products, including fish, become cheaper and more competitive in international markets. This benefits Indonesian exporters, as lower product prices can attract more buyers from ASEAN countries. In addition, the lower exchange rate makes Indonesian goods more affordable for ASEAN countries, increasing demand for Indonesian fish products in these markets. Export destination countries such as Malaysia, Singapore, or Vietnam, which have stronger currencies, will see Indonesian fish prices as lower than in other countries, thereby increasing Indonesia's export volume (Astagia et al., 2022; Darsono et al., 2018; Wicaksana et al., 2022).

In addition, exchange rate fluctuations also affect investment decisions and long-term contracts in international trade. If the exchange rate is favourable to Indonesia, exporters can earn higher profits from international transactions, which in turn can increase the frequency and volume of exports. However, this positive impact is temporary and highly dependent on exchange rate stability. Excessive fluctuations in the exchange rate can create uncertainty for exporters, reducing market confidence and affecting purchasing decisions. Therefore, although the exchange rate can increase the flow of Indonesian fish exports to ASEAN countries, exchange rate stability remains important to maintain trade continuity.

The exchange rate shows a significantly positive result, with a p-value of -0.000 < 0.01. A positive and significant exchange rate indicates that exchange rate changes have a meaningful effect on international trade in the fishery sector. The exchange rate is influenced by factors such as political stability, trade policies, and global economic conditions. This finding differs from Pohan et al. (2024) and Soviandre et al. (2023), who found that the exchange rate variable was not significant and did not affect trade flows. International trade is generally not significantly affected by exchange rate changes (Suryanto & Kurniati, 2022). These findings aligned with those of Suryana et al. (2014), which indicated that the exchange rate variable is significant and positively affects trade flows. On the other hand, fluctuations in the rupiah exchange rate against the US dollar determine the prices of all commodities in export and import activities (Wijayanti & Rachmanto, 2023).

5. Economic distance has a significant effect on the export of Indonesian fish in the ASEAN market

Economic distance in international trade refers to trade costs arising from the geographic distance between countries. These trade costs include transportation expenses that increase with distance. Indicates that economic distance has a positive effect and is significant on international trade (Meiri et al., 2013). Research by Pradipta & Firdaus (2014) indicates that economic distance negatively affects international trade. Data analysis shows that, for Indonesia's fishery exports, economic distance has a negative coefficient of 1.56. This means that if the economic distance between Indonesia and the export destination country increases by 1 percent, Indonesia's fishery sector exports will decrease by 1.56 percent, assuming other factors remain constant (ceteris paribus).

This negative impact is significant at the 1% level, indicating that economic distance is an important factor in international trade. The farther the distance between Indonesia and the export destination, the higher the transportation costs, which in turn reduces the volume of fishery sector exports. Therefore, to enhance the trade of fishery commodities, strategies to reduce transportation costs or improve logistical efficiency are necessary to mitigate the negative impact of economic distance. The government and business operators can collaborate to find solutions that reduce the impact of economic distance, such as improving transportation infrastructure, identifying more efficient trade routes, or leveraging technology to optimize logistical processes. Although economic distance presents a significant challenge, various measures can be taken to address its impact and enhance the competitiveness of Indonesian fishery products in international markets. The results of this study contradict those of Hayaz et al. (2024), as economic distance does not significantly affect Indonesia's shrimp trade in the international market.

CONCLUSIONS AND SUGGESTIONS

Based on the analysis, economic distance and exchange rates are the only factors that significantly influence the trade flows of fishery products among ASEAN countries, with economic distance having an adverse effect and exchange rates having a positive effect. In contrast, other variables such as the GDP of the exporting and importing countries, GDP per capita, and population show no significant impact. Therefore, investment in efficient transportation infrastructure is essential to reduce trade barriers arising from high economic distance, and maintaining exchange rate stability through appropriate monetary policies, foreign exchange market interventions, and businesses' adoption of hedging strategies is necessary to sustain the international competitiveness of Indonesian fishery products. This study is limited by the research period and the scope of variables considered; therefore, future research should incorporate more recent data, including periods of global shocks such as the COVID-19 pandemic, expand the analysis to include trade policies, regulatory and environmental factors, use more disaggregated product-level data, and consider the role of non-ASEAN trading partners to provide a more comprehensive understanding of global fish trade dynamics.

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