Revealed Comparative Advantage and Factors Influencing ASEAN Rice Exports in 2003-2022

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Abstract
Rice plays a crucial role in maintaining food security in ASEAN, making the study of rice exports essential. This research aims to identify the factors influencing rice export competitiveness and the comparative advantages of ASEAN countries in rice trade from 2003 to 2022. It addresses fluctuations in rice exports and inconsistencies in existing literature. The study employs quantitative methods, including Revealed Comparative Advantage (RCA) analysis, descriptive statistics, inferential statistics, panel data regression, and classical assumption tests to ensure the reliability of regression results. Key factors analyzed include GDP, currency exchange rates, rice prices, population, production, and tariffs. The results of this study show that Myanmar has the highest Revealed Comparative Advantage (RCA) in rice exports among ASEAN countries, while Indonesia has the lowest RCA. Factors such as GDP, currency exchange rates, rice production volume, and rice prices positively and significantly affect the value of rice exports. On the contrary, rice tariffs have a negative and significant impact on rice exports. The conclusion of this study is that to increase rice exports, ASEAN countries need to invest in agricultural mechanization, infrastructure, technology, as well as improve rice logistics and quality. In addition, they must maintain currency stability, reduce tariffs through free trade agreements, and encourage innovation in the rice supply chain.
Keywords: *rice, comparative advantage, export factor, RCA.*
JEL: *Q10, F14, F17, O13*

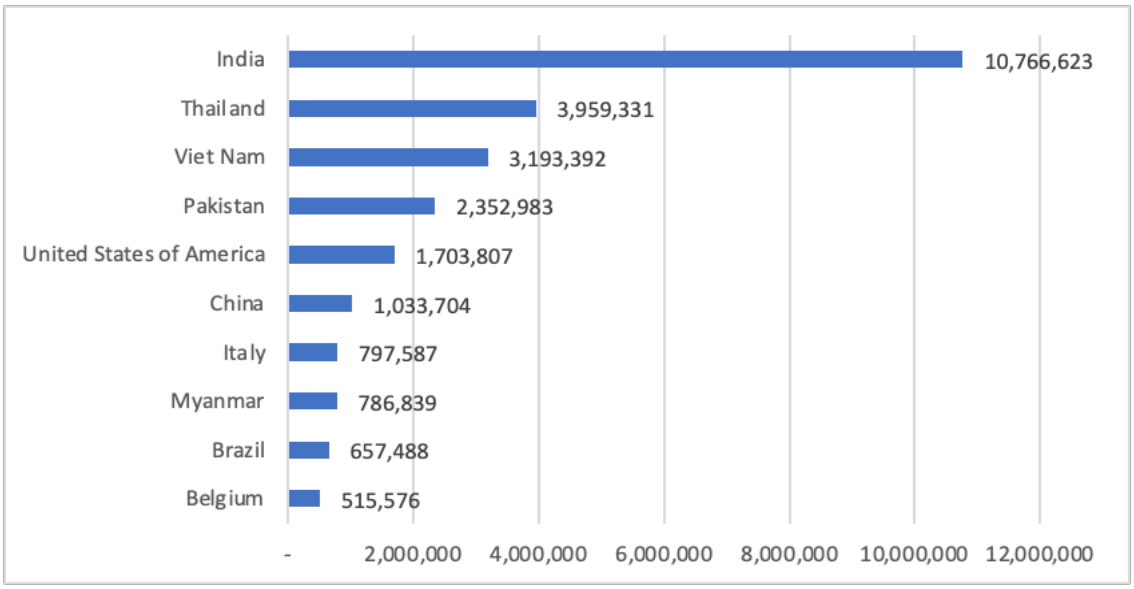
A. INTRODUCTION

The Association of Southeast Asian Nations (ASEAN) is a regional intergovernmental organization in Southeast Asia, comprising ten countries. The primary goal of ASEAN is to enhance economic growth, social progress, and regional stability. One significant area of cooperation within ASEAN is the focus on food, agriculture, and forestry. The ASEAN Economic Forum 2015 envisioned ensuring better food security and nutrition across the region and establishing ASEAN as the world's rice centre.

ASEAN countries are highly dependent on rice as a staple food. The rice crisis of 2007-2008 emphasized the need for policymakers in ASEAN to address food security issues to prevent similar crises in the future. This global food crisis prompted coordinated efforts among rice stakeholders to manage rice price volatility caused by policy changes, supply distortions, and climate change. These efforts aim to improve regional food security and ensure economic and social stability in ASEAN (Wailes & Chavez, 2022).

The figure below is the data with the ten largest rice exporting countries in the world in 2022. Based on the figure, there are three ASEAN countries that fall into this category, such as Thailand, Vietnam, and Myanmar. These three countries show that ASEAN countries can compete in the global market. Therefore, ASEAN has the potential to become a rice export centre in line with the vision of the ASEAN Economic Forum 2015.

Increasing rice exports is crucial for driving economic growth in ASEAN member countries. Countries with surplus rice production, such as Thailand and Vietnam, can leverage international markets to boost revenue and achieve economic goals. Rice exports can also expand markets and create mutually beneficial trade opportunities within ASEAN and with external trading partners. Enhancing rice exports strategically can improve



Source: International Trade Centre Organization, 2023

Figure 1 Ten Countries with the Most Rice Exports in the World in 2022 (Ton)

ASEAN's competitiveness and role in the global market, contributing positively to regional economic growth (Hermawan, 2013).

As an ASEAN country that is included in the 10 largest rice export producing countries in the world, Thailand is the ASEAN country that has the largest exported value compared to Vietnam and Myanmar. Thailand's exported value fluctuates every year, where in 2019 its exported value reached 4,206,796, but experienced a decline in 2020, 2021 then rose again in 2023 to reach 5,115,919. Then followed by Vietnam, which continued to experience an increase in exported value in 2019 reaching 2,434,252 until 2023, which continued to increase to 3,857,624. Meanwhile, Myanmar is fluctuating, with the largest decline in 2021 reaching 670,698 (ITC, Trade statistics for international business development).

Based on the literature review, it is evident that many factors affect rice exports in ASEAN countries, including GDP, exchange rates, rice prices, production, and population. These variables are chosen as independent variables in this study due to their relevance in previous studies. However, inconsistencies in the research literature regarding the most dominant factors affecting rice export competitiveness necessitate further investigation.

The research seeks to answer the following questions: Which ASEAN countries possess the highest and lowest comparative advantages in rice exports from 2003 to 2022? Additionally, how do various factors such as GDP, currency exchange rates, rice prices, population, production, and tariffs impact rice exports in the ASEAN region.

The research aims to address two primary objectives. First, it seeks to identify ASEAN countries with high and low comparative advantages in rice exports from 2003 to 2022. Understanding these dynamics will help policymakers and stakeholders focus efforts on enhancing competitiveness. Second, the study aims to analyze the impact of various factors on rice exports, including GDP, currency exchange rates, rice prices, population, production, and tariffs. By understanding these influences, the research provides insights into improving rice export strategies in the ASEAN region.

In conclusion, rice plays a vital role in food security and economic growth in ASEAN.

Analyzing the factors affecting rice exports and identifying countries with competitive advantages is crucial. This study aims to provide a comprehensive understanding of these dynamics, offering valuable insights for enhancing ASEAN's rice export competitiveness and contributing to regional economic stability and growth. By achieving these objectives, the research will help ASEAN countries better navigate the complexities of the global rice market, ensuring food security and economic prosperity for the region.

B. LITERATURE REVIEW

This section discusses theories related to the Revealed Comparative Advantage (RCA) of rice in ASEAN and the factors affecting rice exports in ASEAN countries. The key theories include Comparative Advantage Theory, Purchasing Power Parity, Supply Theory, Gravity Model, and Trade Barrier Theory.

David Ricardo's theory of comparative advantage (1817) suggests that countries should specialize in producing goods where they have a comparative advantage, meaning lower production costs compared to other countries. This theory asserts that even if a country is more efficient in producing all goods, international trade can benefit all parties by allowing each country to focus on their comparative advantages. Specialization enhances productivity and economic growth while enabling countries to import goods produced more efficiently elsewhere.

Purchasing Power Parity (PPP) theory explains exchange rate movements based on changes in the price levels of different countries. It predicts that changes in domestic price levels will correlate with currency depreciation or appreciation. According to this theory, price levels would be the same globally if measured in a single currency. In the context of exports, PPP helps predict how exchange rate fluctuations impact export prices (Krugman & Obstfeld, 2003).

Supply theory, a fundamental economic principle, explains the relationship between price and production quantity. Higher prices incentivize producers to increase output to maximize profits. This theory, coupled with demand theory, determines market equilibrium. In the context of rice exports, if international rice prices rise, producers are likely to increase production, boosting export quantities.

The gravity model in international trade explains the relationship between the size of two countries and the distance between them concerning their trade volume. This model suggests that trade flows are proportional to the economic size of countries (measured by GDP) and inversely related to the geographic distance between them. For instance, larger populations can reduce exports due to increased domestic demand and government policies prioritizing national food security. However, a large population can also drive higher production, potentially increasing exports if the surplus is available (Chaney, 2011).

According to Krugman & Obstfeld (2003), trade barrier theory discusses how barriers such as transportation costs and government trade restrictions influence international trade by creating price differences between countries. High transportation costs and trade barriers can limit the movement of goods and affect relative prices, impacting the competitiveness of exports.

Several previous studies have used RCA to analyze the export competitiveness of commodities, though literature specifically addressing RCA of rice in ASEAN is sparse. For example, other research (Maqbool et al., 2021) examined RCA exports in electrical engineering across five ASEAN countries, finding that Singapore had the highest RCA while Indonesia had the lowest. Another study(Naing et al., 2021), the comparative advantage of watermelon in five ASEAN countries found Laos and Myanmar had the highest comparative advantage.

Various studies discuss factors affecting rice exports in ASEAN. Bui (Bui & Chen, 2017)examined the impact of rice prices, demand, population, distance between importing

and exporting countries, and the GDP of exporting countries on Vietnam's rice exports to 120 countries using the gravity model. Their research found that population, production quantity, and GDP positively influenced rice exports, while distance negatively affected exports. Conversely, other research (Yusiana et al., 2022)found that the GDP of exporting countries negatively impacted rice exports from Thailand.

Regarding exchange rates, Yusiana (Yusiana et al., 2022)found a positive correlation between exchange rates and export volumes in Thailand using the gravity model. However, a separate study by Yusiana again (Yusiana et al., 2023) on rice exports in ASEAN, China, Japan, and South Korea using panel data analysis found that exchange rates negatively impacted export volumes. Rice prices also have mixed impacts on exports. Other research (Yusiana et al., 2022)found that world rice prices negatively influenced Thailand's rice exports, while Egypt (Ismaiel Ali Ismaiel et al., 2023)found that international rice prices positively affected Egypt's rice exports.

Population size also influences rice exports differently. Research in Vietnam (Nhung & Wang, 2022)found a positive correlation between population growth and rice exports. Conversely, Ismaiel et al. (2023) found that population growth in rice export and import countries negatively affected rice exports in Egypt. Rice production levels in importing countries can also impact exports. Yusiana et al. (2022) found that increased rice production in importing countries negatively affected Thailand's exports. Similarly, Yusiana et al. (2023) found that rice production in ASEAN countries negatively affected their exports. Tariffs generally have a negative impact on rice exports. Previous research (Wardani et al., 2018) found that tariffs hinder food industry exports in Indonesia and overall trade efficiency.

This research aims to understand the factors influencing rice exports in ASEAN and the comparative advantages of these countries. The framework combines various theoretical approaches to analyze the competitiveness of rice exports, including Comparative Advantage Theory, PPP, Supply Theory, Gravity Model, and Trade Barrier Theory. These theories are broken down into six explanatory variables: exchange rates, GDP per capita, world rice prices, population, production, and tariffs.

Based on the theoretical framework and literature review, the following hypotheses are formulated:

H1: Gross Domestic Product has a positive effect on the value of rice exports in ASEAN.

H2: Currency depreciation increases rice exports in ASEAN.

H3: Production has a positive effect on the value of rice exports in ASEAN.

H4: Population negatively affects the value of rice exports in ASEAN.

H5: Price has a positive effect on the value of rice exports in ASEAN.

H6: Tariffs negatively affect the value of rice exports in ASEAN.

In summary, the literature review highlights the complexities of factors influencing rice exports in ASEAN. Different theoretical approaches and empirical findings underscore the need for comprehensive analysis. This research aims to provide insights into the factors affecting rice exports and the comparative advantages of ASEAN countries, ultimately contributing to enhancing the region's competitiveness and ensuring food security.

C. RESEARCH METHODS

This quantitative research consists of dependent and independent variables. The dependent variable in this study is rice exports in ASEAN countries from 2003 to 2022. This research uses annual export data in tons from all ten ASEAN countries.

This study has two main objectives. The first is to examine rice exports in ASEAN using the Revealed Comparative Advantage (RCA) method. For this, the study uses four independent variables: rice export values in each ASEAN

country, agricultural export values in each ASEAN country, total world rice export values, and total world export values of all commodities. The second objective is to examine factors affecting rice exports, including GDP, exchange rates, international rice prices, population, production quantity, and tariffs.

The population includes all ASEAN member countries: Thailand, Vietnam, Singapore, Philippines, Myanmar, Malaysia, Laos, Indonesia, Brunei Darussalam, and Cambodia, from 2003 to 2022. The sample includes the entire population, thus covering all ASEAN countries during this period. The study uses secondary data from various international organizations, including the International Trade Centre (ITC), the World Bank, and the Food Agricultural Organization (FAO). Data variables include rice export values, total export values, global rice exports, global export values, GDP per capita, exchange rates, rice prices, production quantities, and tariffs.

Secondary data collection is conducted by accessing existing sources of information previously collected by other parties. These sources provide relevant data related to rice exports and other influencing factors. The use of secondary data accelerates the analysis process and ensures data accuracy and reliability. The study employs quantitative methods including RCA analysis, descriptive statistics, inferential statistics, panel regression, and classical assumptions testing.

Comparative advantage is a condition in which a country has a relative advantage in producing a good or service compared to other countries, measured by lower opportunity costs. Opportunity cost here refers to the amount of another good or service that can be produced using the same resource (Krugman & Obstfeld, 2003). One way to calculate RCA is to use the Balassa index. The Balassa Index is a tool used in international economics to measure a country's comparative advantage in producing and exporting certain goods or services (Balassa, 1965).

$$\mathbf{RCA} = \frac{\boldsymbol{Xij/Xj}}{\boldsymbol{Xiw/Xw}}$$

Xij = Export value of commodity i from Country j
Xj = Total value of exports from Country j
Xiw = Value of commodity exports i in the world
Xw = Total value of world exports

Calculating the Revealed Comparative Advantage (RCA) of ten countries in ASEAN. After that, it is sorted from smallest to largest. Then, determine which countries have the largest rice RCA and which countries have the smallest rice RCA.

Descriptive statistics organize, summarize, and present data numerically to provide an overview of the data distribution patterns, such as mean, median, mode, range, variance, and standard deviation (Lind et al., 2008). Inferential statistics estimate traits of a population based on sample data. Techniques include the coefficient of determination (R-squared), F-test, and t-test to evaluate the influence of independent variables (GDP, exchange rate, rice price, population, production, tariff) on the dependent variable (rice export).

Panel data regression combines cross-sectional and time series data to observe units over time. Three estimation models are used: Random Effect Model (REM), Fixed Effect Model (FEM), and Common Effect Model (CEM). Before determining the model, tests are carried out first (chow test, Hausman test and Lagrange Multiplier). The Chow Test is used to determine whether the Common Effect Model or the Fixed Effect Model is more suitable for estimating panel data. The Hausman Test is employed to choose between the Fixed Effect Model and the Random Effect Model, ensuring the selection of the most appropriate model based on the nature of the data. Lastly, the Lagrange Multiplier Test is applied to assess whether the Random Effect Model is superior to the Common Effect Model. Together, these tests help in identifying the most accurate and reliable model for panel data

regression analysis, thereby enhancing the robustness of the study's findings.

Once the model is selected, the next step is to test with classic assumptions. Panel data regression is a statistical method used to estimate the relationship between dependent and independent variables over time, combining cross-sectional and time-series data. Estimates can be made using Ordinary Least Squares (OLS) or Generalized Least Squares (GLS) depending on model assumptions (Wooldridge, 2012). The OLS approach assumes combined data reflects actual conditions, while the Fixed Effect Model accounts for constant differences between objects, and the Random Effect Model addresses fixed effect limitations by applying random effects to residuals. Model selection involves the Chow test to compare fixed models with combined regression and the Hausman test to choose between fixed and random effects. Classical assumption testing in regression models includes checking for normality, non-multicollinearity, homoscedasticity, and no autocorrelation, ensuring data fits a normal distribution, there are no perfect linear relationships between explanatory variables, the variance of errors remains constant, and disturbances do not correlate over time (Gujarati, 2003). Validating these assumptions ensures accurate and reliable empirical data analysis.

The regression model applied in this study is as follows:

$$Y_{it} = \beta 0_{it} + \beta 1X1_{it} + \beta 2X2_{it} + \beta 3X3_{it} + \beta 4X4_{it} + \beta 5x5_{it} + \beta 6x6_{it} + \mu it$$

Description:

Y = Rice export value
β0 = Constanta
β1, β2, β3, β4, β5, β6, β7 = Independent Variable Coefficient
i = ASEAN
t = 2003-2022
X1 = Gross Domestic Product per Capita
X2 = Exchange Rate
X3 = Rice Price
X4 = Population
X5 = Rice Production
X6 = Tariff
μ = Error

To get linear results, the Tukey method is used. Tukey's (1977) transformation method proposed the use of power transformations for variables x and y, where lambda Λ can have positive, zero, or negative values (Lane et al., 2003). This transformation aims to achieve a relationship as linear as possible between x and y. The positive transformation of lambda is suitable for linear or quadratic transformation. For lambda equal to 0, logarithmic transformations generally use 0. While for negative lambda, transformations use power roots to maintain the order of the data. Therefore, in this study the square root is used to maintain the sequence and also to approach linearity.

$$Y_{it}^{(1/2)} = \beta 0_{it}^{(1/2)} + \beta 1X1_{it}^{(1/2)} + \beta 2X2_{it}^{(1/2)} + \beta 3X3_{it}^{(1/2)} + \beta 4X4_{it}^{(1/2)} + \beta 5x5_{it}^{(1/2)} + \beta 6x6_{it}^{(1/2)} + \beta 7x7_{it}^{(1/2)} + \mu it$$

The equation is the equation after in square power root.

D. RESULT AND DISCUSSION

ASEAN, a major global producer and consumer of rice, plays a crucial role in the global rice market through its economic integration within the ASEAN Economic Community (AEC), enhancing productivity and market expansion (Hermawan, 2013). From 2003 to 2022, ASEAN rice exports grew significantly, peaking at 9.08 million USD in 2008, but faced fluctuations from 2015 onwards, ending at 8.51 million USD in 2022, while global exports rose to 30.04 million USD. In 2022, Brunei Darussalam and the Philippines had minimal exports, while Vietnam and Thailand were the largest exporters, with Vietnam and Thailand providing substantial export subsidies to maintain international competitiveness, a practice also seen in countries like India, Pakistan, and the United States (Sawit, 2009)

Table 1 Descriptive Statistic

Statistic	X1	X2	X3	X4	X5	X6	Y
Mean	72.043	52.695	18.57	7005.058	3764.363	2.454	524.43
Median	55.775	35.260	17.29	6937.033	3584.035	2.412	56.289
Maximum	187.65	152.54	31.52	16598.230	7812.234	4.087	2550.9
Minimum	24.050	1.118	10.25	595.017	26.249	0.346	0.000
Std. Dev.	44.834	52.931	5.185	4592.424	2468.441	0.774	774.03
Skewness	1.574	0.420	1.217	0.466	0.075	-0.318	1.264
Kurtosis	4.345	1.629	3.647	2.409	1.698	3.428	2.984
Jarque-Bera	78.157	17.223	42.31	8.128	11.454	3.914	42.620
Probability	0.000	0.000	0.000	0.017	0.003	0.141	0.000
Observations	160	160	160	160	160	160	160

Source: Own elaboration using EViews 12

In this study there are two objectives, first determine which countries have the largest and smallest Revealed Comparative Advantage rice. In addition, to find out what factors affect the rice export of each country in ASEAN. Therefore, the results of the data analysis will be explained below.

1. Descrptive Statistic

Descriptive statistical analysis in this study was carried out to provide an overview of the existing variables. The table below is the result of the descriptive analysis. Descriptive analysis with variables already at the square power root, as in point 3.5.6.

The analysis of rice export data and related economic factors in ASEAN provides a detailed understanding of the trade dynamics within the region. Key variables such as GDP per capita, exchange rates, rice prices, population, production, and tariffs exhibit significant variability and deviations from normality, as indicated by their respective descriptive statistics. The GDP per capita shows a right-skewed distribution with a high standard deviation and outliers, confirmed by a Jarque-Bera test statistic indicating significant deviation from normality.

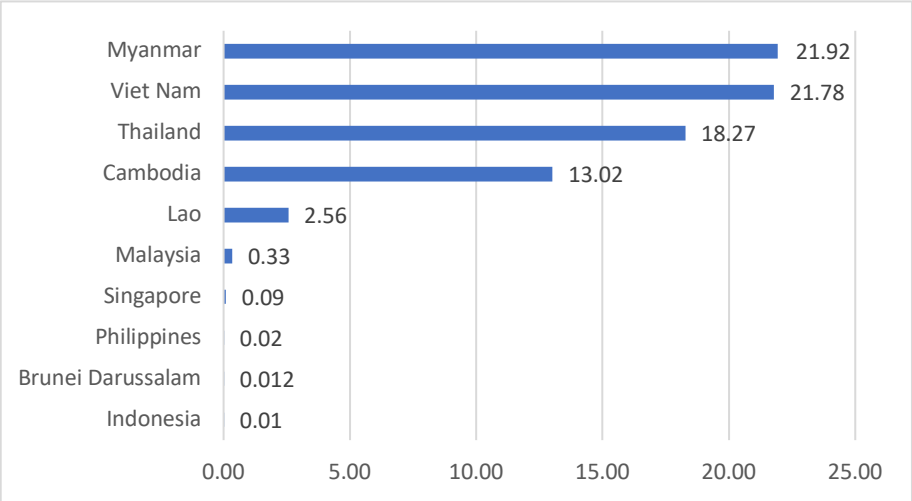
Exchange rates also exhibit wide variability and a right-skewed distribution, while rice prices show moderate variability with a slight right-skew and some outliers. Population and production values demonstrate substantial variability, with the population having a near-symmetrical distribution and production showing minimal skewness. Tariff values display moderate variability with a slightly left-skewed distribution and presence of outliers.

The export value of rice in ASEAN is highly right-skewed, indicating substantial variability and a higher tendency for extreme values. The distribution of these variables provides essential insights into their behavior and potential impact on further analyses, highlighting the need for careful consideration of their distributions in econometric modeling and policy formulation. Understanding these dynamics is crucial for enhancing rice trade strategies and ensuring economic stability in the ASEAN region.

2. Revealed Comparative Advatange

The competitiveness of a commodity from a particular country can be assessed through its comparative advantage in production. One method of analysis to determine this comparative advantage is by employing the Revealed Comparative Advantage or RCA method (Balassa, 1965). The outcomes of RCA calculations indicate a country's comparative advantage in exporting a specific commodity through the value of its RCA for that commodity.

From the RCA diagram above, it can be seen that Myanmar has the highest RCA with a value of 21.92, while Indonesia has the lowest RCA with a value of 0.0104. The high RCA score



Source: Own elaboration using data from (ITC, 2023)
Figure 2 Average of Rice RCA (2003-2022)

indicates that Myanmar has a significant comparative advantage in rice exports compared to other countries. On the other hand, the lowest RCA value for Indonesia signifies that the country has a lowest comparative advantage of rice exports.

Myanmar has a large rice export potential and a high level of Comparative Advantage (RCA) in ASEAN. Myanmar has a high RCA due to supportive policies, natural resource potential, and high global demand. Therefore, Myanmar can continue to increase its rice exports and maintain a high RCA in ASEAN (World Bank, 2014).

Indonesia faces challenges in increasing its rice exports despite being one of the largest producers in ASEAN and having a low RCA of rice. Factors such as unstable climatic conditions, reliance on inefficient traditional agricultural practices, suboptimal agricultural policies, and limited infrastructure and distribution are major obstacles. To address this, strategic measures such as investment in modern agricultural technology, agricultural policy reform, infrastructure improvement, and promotion of innovations in climate change adaptive agricultural management are needed (Jend, 2008).

3. Model Estimation

Before determining which model to use in this research, stationary tests were employed to verify the stationarity of the data series. Stationarity refers to a property of a stochastic process where statistical properties such as the mean and autocovariances do not change over time (Hamilton, 1994). The Data Panel has three regression models, namely Common Effect Model (CEM), Fixed Effect Model (FEM) and Random Effect Model (FEM). To determine which model is the best, there are 3 tests to do, namely, Chow test, Haussman test, and Lagrance test.

From the results (Appendices 1 and 2), the probability of 0.000 is less than 0.05. Thus, H0 is rejected and H1 will be used, therefore, Fixed Effect Model is selected. From the results of the data above, the probability of 0.0001 is less than 0.05. Thus, H1 is rejected and H0 will be used, therefore, FEM is selected.

The Lagrange Multiplier test is no longer needed in this study, because the Lagrange Multiplier test compares REM and CEM. While the two models have been rejected in the Chow test and the Haussman test. Therefore, the best model for this research is the Fixed Effect Model (FEM). Based on the previous model selection, the Fixed Effect Model (FEM) model has been selected. Through this approach it can be concluded that the object as well as the regression coefficient used in this study have constants that remain in magnitude for various periods of time. Table 4 is the result of regression

using the selected model, the Fixed Effect Model (FEM).

Based on the regression results, it was determined that the regression equation used in this study is:

$$Y^{(1/2)} = -33.02 + 10.26X1^{(1/2)} + 6.26X2^{(1/2)} + 10.97X3^{(1/2)} - 0.28X4^{(1/2)} + 0.39X5^{(1/2)} - 76.92X6^{(1/2)} + \mu it$$

A regression model using the square power root transformation of the X and Y variables addresses common statistical issues by reducing skewness and kurtosis, bringing the data distribution closer to normality, and achieving more linear relationships between variables. The regression output includes coefficients, standard errors, t-statistics, and p-values for the relationships between the export value (Y) and several predictor variables: GDP per capita (X1), Exchange rate (X2), Price (X3), Population (X4), Production (X5), and Tariff (X6).

The constant term (C) has a coefficient of -33.02679, which is not statistically significant due to its high standard error and non-significant p-value. The coefficients for GDP per capita (X1), exchange rate (X2), and price (X3) are 10.26439, 6.267063, and 10.97382, respectively. Squaring these values indicates significant positive impacts on the export value, with GDP per capita increasing it by approximately 105.36 units, the exchange rate by 39.27 units, and price by 120.42 units. These relationships are statistically significant, with p-values indicating high significance.

The coefficient for population (X4) is -0.289329, indicating that an increase in population decreases the export value by approximately 0.084 units, a highly significant relationship. Production (X5) has a coefficient of 0.398320, translating to an increase in export value by 0.159 units, also highly significant. The tariff (X6) coefficient is -76.92539, suggesting a substantial negative impact on export value, reducing it by approximately 5918.09 units, with significant statistical evidence. These findings illustrate the critical impacts of these variables on rice export values in ASEAN, considering the square power root transformation.

4. Classical Assumption

Regression models must meet certain conditions to be valid, known as the Best Linear Unbiased Estimation (BLUE). Classical assumption tests in multiple linear regression include the Normality Test, Heteroskedasticity Test, Multicollinearity Test, and Autocorrelation Test. However, in panel data regression, only multicollinearity and heteroscedasticity tests are necessary (Napitupulu et al., 2021).

Multicollinearity refers to a high correlation between two or more independent variables. The multicollinearity results show that all variables have a correlation of less than 0.90, indicating no multicollinearity issues.

Heteroscedasticity tests check for differences in the variance of residuals across observations. If the variance is constant, it is called homoscedasticity; if it varies, it is heteroscedasticity. According to Napitupulu, heteroscedasticity occurs when the residual value exceeds 500 or falls below -500. The heteroscedasticity test results show that the residual values range from -30 to 30, indicating no heteroscedasticity issues in the regression model.

5. Statistical Inference

Based on the selection of models above, we get Fixed Effect Model (FEM) as the best model. In the statistical inference section, we will discuss the t test, F test and R squared tests, from the results of the previous model.

Based on the table above, GDP per capita (X1), price(X3), population(X4), production(X5), and tariff(X6) have the following probability values, 0.000, 0.000, 0.000, 0.0146, 0.000, 0.000, 0.0005. This value is below the significant value of 0.05. That is, GDP per capita, exchange rate, price, population, and tariffs have a significant effect on the value of rice exports in ASEAN. It can be concluded from the six independent variables studied, all variables are significant.

Table 2 Fixed Effect Model regression results

Variable	Description	Coefficient	Std. Error	t-Statistic	Prob.
C	Constant	-33.02679	354.7393	-0.093102	0.9260
X1	GDP per capita	10.26439	2.888104	3.554022	0.0005
X2	Exchange rate	6.267063	2.150564	2.914148	0.0041
X3	Price	10.97382	5.357935	2.048144	0.0423
X4	Population	-0.289329	0.065917	-4.389286	0.0000
X5	Production	0.398320	0.064879	6.139420	0.0000
X6	Tariff	-76.92539	29.77321	-2.583712	0.0108

Source: Author's elaboration using Eviews 12

The F test is a test of regression coefficients simultaneously. Tests are carried out to determine the effect of all independent variables contained in the regression model on the dependent variable. Test F in this study aims to test whether the independent variable has an effect on the dependent variable.

Table 3 F-test

Statistic	Value
F-statistic	410.880
Prob(F-statistic)	0.000000

Based on the regression output, it can be seen that the probability value of F stat is 0.000. The value is below the significance value of 5% or 0.05. Therefore, it can be concluded that the independent variables used in this study simultaneously affect the dependent variable. Thus, GDP per capita, exchange rate, population, tariff, rice price and the value of rice exports in ASEAN simultaneously in the period 2003-2022.

The R squared or Coefficient of determination is used to determine how much influence the independent variable has in explaining the entire dependent variable. The determination efficiency rate is converted into percent. Here is the result of the Coefficient of Determination (R2).

Table 4 R-Squared

Statistic	**Value**
R-squared	0.973394
Adjusted R-squared	0.971025

Based on the table, an R-squared of 0.973394 is obtained, this shows that there is a fairly high relationship between GDP per capita, exchange rate, population, tariff, and rice price on the value of rice exports of ASEAN countries in 2003-2022. Because the value 0.9644 means that all independent variables can explain the dependent variable by 97.33%. Thus, there are 2.67% other influences outside the independent variable studied.

6. Discussion

This section discusses the results of previous data processing in the context of existing theories. Revealed Comparative Advantage (RCA) measures a country's relative advantage in producing a specific good. From 2003 to 2022, Indonesia had the smallest RCA for rice in ASEAN, with a value of only 0.010. This low RCA is due to Indonesia's diversified exports, which include other agricultural products and non-agricultural sectors, making rice exports a smaller portion of the total. According to "Ketimpangan yang Semakin Lebar" (Bursa Efek, 2016), Indonesia's domestic rice production has been hampered by inadequate mechanization, poor infrastructure, and ineffective price stabilization policies, necessitating improved market interventions.

Myanmar had the highest rice RCA in ASEAN from 2003 to 2022, indicating a significant competitive advantage in the international rice market. The study "Myanmar: Capitalizing on Rice Export Opportunities" highlights Myanmar's potential due to its extensive agricultural land and

favorable climate, particularly in the Ayeyarwady delta and the Dry Zone. The government's export liberalization policies, such as eliminating rice transportation permits and reducing export taxes, have boosted rice export volumes. Increased global demand, especially from Asia and Africa, presents further opportunities for Myanmar.

Despite challenges like high logistics costs and quality issues, Myanmar's rice remains competitively priced compared to India and Vietnam, making it a strong contender in the global market. With supportive policies, rich natural resources, and growing global demand, Myanmar can continue to enhance its rice exports and maintain its high RCA in ASEAN.

The regression analysis shows that GDP per capita has a significant positive effect on rice exports in ASEAN, with a coefficient of 10.26 and a p-value of 0.0005. This indicates that for every one-unit increase in GDP per capita, rice exports increase by approximately 105.36 units. This relationship suggests that countries with higher GDP per capita tend to have better agricultural infrastructure and technology, leading to higher quality and quantity of rice production. Improved infrastructure and distribution efficiency also reduce costs, enhancing competitiveness and export volumes. These findings align with previous studies by Bui & Chen (2017), Ismaiel Ali Ismaiel et al. (2023), and Yusiana et al. (2023b), all of which demonstrated the positive impact of GDP on exports. The results support the Comparative Advantage Theory, which posits that economic growth fosters favorable conditions for increased production and exports, thereby contributing to the overall growth of a country's export sector.

The regression analysis shows that the exchange rate has a significant positive effect on rice exports in ASEAN, with a coefficient of 6.26 and a p-value of 0.0041. This indicates that for every unit of currency depreciation, rice exports increase by approximately 39.27 units. Therefore, the hypothesis that currency depreciation increases rice exports in ASEAN countries for the 2003-2022 period is accepted. These findings align with previous studies by Bui & Chen (2015) and Yusiana et al. (2022a), which also found a positive relationship between exchange rates and exports. The results are consistent with the theory of Purchasing Power Parity (PPP). The study further found that when a country's exchange rate appreciates, exports tend to decrease. This can be due to higher prices of exported goods, making them less competitive in the international market, and reduced demand from foreign buyers due to more expensive domestic products. Additionally, decreased profit margins and the search for cheaper imports from other countries can lower export volumes. To mitigate these effects, ASEAN countries should maintain currency stability and implement appropriate monetary policies to manage currency volatility, thereby preserving their export competitiveness.

The regression analysis indicates that rice prices have a significant positive effect on rice exports in ASEAN, with a coefficient of 10.97 and a p-value of 0.00423. This means that for every unit increase in rice price, rice exports increase by approximately 120.42 units. Therefore, hypothesis 3, which states that rice prices positively impact rice exports in ASEAN countries for the 2003-2022 period, is accepted. These findings are consistent with previous studies by Bui & Chen (2017) and Ismaiel Ali Ismaiel et al. (2023), which also found that rice prices positively affect rice exports. Higher rice prices in a country reflect better quality, making the rice more in demand in the international market. Importing countries are willing to pay more for superior products, driving an increase in export volumes. Consequently, the rise in the price of high-quality rice can boost export volumes due to strong global demand for premium products. Good quality rice tends to have a higher price, but because the nature of rice as a basic need is inelastic, people will still buy rice even if the price rises, so the supply of rice will increase to meet people's food needs.

The regression analysis shows that the population variable has a significant negative effect on rice exports in ASEAN, with a coefficient of -0.289329 and a t-stat value of 0.0000. This means that for every unit increase in population growth, rice exports decrease by approximately 0.084 units. Thus, Hypothesis 4, which states that population positively affects rice exports in ASEAN countries for the period 2003-2022, is rejected. Instead, the findings suggest that larger populations can reduce rice exports due to increased domestic demand and government policies prioritizing national food security. The rice commodity tends to have an inelastic elasticity value because rice is a basic necessity, especially in ASEAN countries. Therefore, the increasing population in a country will increase demand for rice even though the price of rice has increased. As a result, to maintain domestic food security, the government will reduce the amount of rice exports. This is consistent with previous studies by Bui & Chen (2017a) and Ismaiel Ali Ismaiel et al. (2023), which also found a negative impact of population growth on rice exports in Vietnam and Egypt, respectively.

Indonesia, the Philippines, and Malaysia, despite being significant rice producers, face limitations in exporting rice due to their large populations and high domestic demand. In contrast, Thailand and Vietnam are major rice exporters due to high productivity and efficient rice production despite their sizable populations. Myanmar also exports rice significantly because of its abundant rice production. Smaller countries like Laos, Cambodia, and Brunei have lower rice export rates, focusing more on domestic needs. Overall, while a larger population generally reduces export capabilities due to increased domestic demand, efficient production and favorable agricultural policies can mitigate this effect and enhance export levels.

The regression analysis shows that rice production has a significant positive effect on rice exports in ASEAN, with a coefficient of 0.398320 and a t-stat value of 0.000. This means that for every one-unit increase in rice production, rice exports increase by approximately 0.159 units. Therefore, Hypothesis 5, which states that production positively affects rice exports in ASEAN countries for the 2003-2022 period, is accepted. These findings align with the theory of Revealed Comparative Advantage, which suggests that countries benefit from international trade by specializing in goods where they have a comparative advantage. The study confirms that increasing rice production in ASEAN countries enhances the supply available for export, meeting international demand and boosting export volumes. This increase in export volume can ultimately lead to higher incomes and economic growth within the ASEAN region. By maximizing efficient resource use and focusing on comparative advantages, ASEAN countries can strengthen their positions in the global rice market.

The regression results show that tariffs have a significant negative effect on rice exports in ASEAN, with a coefficient of -76.92539 and a t-stat value of 0.005. This means that a one-unit increase in tariffs can reduce rice exports by approximately 5918.09 units. Therefore, Hypothesis 6, which states that tariffs negatively affect rice exports in ASEAN countries for the 2003-2022 period, is accepted. These findings are consistent with previous research by Aryani et al., which indicated that tariff policies hinder market integration and create inefficiencies, aligning with the trade barrier theory.

Tariff regulations make rice from ASEAN countries more expensive for foreign buyers, reducing competitiveness in international markets. To counteract this, ASEAN countries can adopt strategies such as negotiating free trade agreements to reduce or eliminate tariffs on rice exports. Additionally, improving the quality and sustainability of rice production, as well as enhancing logistics and distribution efficiency, can help reduce production and shipping costs, boosting export competitiveness despite the presence of tariffs.

Each ASEAN country has its own regulations for export and import tariffs. For instance, Indonesia's tariff regulations are outlined in the Minister of Finance Regulation No. 39/PMK.010/2022, while Malaysia relies on the Customs Act 1967. Other countries, such as Brunei Darussalam, Cambodia, Laos, Myanmar, the Philippines, Thailand, Vietnam, and Singapore, have their own specific laws and decrees governing tariffs and customs duties. These regulations influence the trade environment and impact the competitiveness of rice exports from these countries.

E. CONCLUSION

The study reveals key findings on the relationship between various economic factors and rice exports in ASEAN from 2003 to 2022. Indonesia has the smallest average Revealed Comparative Advantage (RCA) for rice, while Myanmar has the largest. GDP per capita, exchange rates, rice prices, rice production, and population all have significant positive effects on rice exports, indicating that economic growth, currency depreciation, higher rice prices, increased production, and larger populations boost export values. Conversely, tariffs have a significant negative effect, suggesting that higher trade barriers reduce export capabilities.

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Appendices 1 : Chow Test

Chow Test			
EFFECTS TEST	Statistic	d.f.	Prob.
CROSS-SECTION F	70.9108	(7,146)	0.0000
CROSS-SECTION CHI-SQUARE	237.0507	7	0.0000

Source: Own Elaboration Using Eviews 12

Appendices 2 : Chow Test

Haussman Test			
TEST SUMMARY	Statistic	Chi-Sq Stat	Prob.
CROSS-SECTION RANDOM	140.708390	6	0.0001

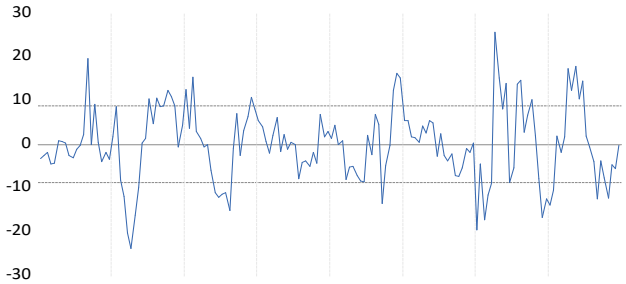
Source: Own Elaboration Using Eviews12

Appendices 3: Multicollinearity result

	X1	**X2**	**X3**	**X4**	**X5**	**X6**	**Y**
X1	1	-0.6263	0.70192	-0.4704	-0.8391	-0.6058	-0.1964
X2	-0.6263	1	-0.2362	0.33854	0.48123	0.23237	0.16616
X3	0.70192	-0.2362	1	-0.3442	-0.6795	-0.6539	-0.2723
X4	-0.4704	0.33854	-0.3442	1	0.80641	0.32628	0.24626
X5	-0.8391	0.48123	-0.6795	0.80641	1	0.60378	0.43850
X6	-0.6058	0.23237	-0.6539	0.32628	0.60378	1	0.42718
Y	-0.1964	0.16616	-0.2723	0.24626	0.43850	0.42718	1

Source: Own elaboration using Eviews 12

Appendices 4 : Heteroscedasticity result



Source: Own elaboration using Eviews 12

Appendices 5 : t-test

Variable	Description	t-Statistic	Prob.
X1	GDP per capita	3.554022	0.0005
X2	Exchange rate	2.914148	0.0041
X3	Price	2.048144	0.0423
X4	Population	-4.389286	0.0000
X5	Production	6.139420	0.0000
X6	Tariff	-2.583712	0.0108

Source: Own elaboration using Eviews 12