






Research on Factors Affecting Indonesia's Tea Exports

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Abstract. This study aims to analyze the factors influencing the export value of Indonesian tea commodities using the Gravity Model approach. The independent variables include GDP per capita, exchange rate, population size, and economic distance across a panel of nine importing countries from 2013 to 2023. The research applies a Random Effects panel data regression model, validated through the Hausman test and accompanied by diagnostic tests for heteroskedasticity, autocorrelation, and normality. The results reveal that economic distance has a statistically significant and positive effect on Indonesia's tea exports, indicating that stronger economic integration or linkages positively affect trade volumes. Conversely, GDP per capita, exchange rate, and population size show no statistically significant influence on tea exports, suggesting the possibility of non-economic or commodity-specific factors moderating these traditional gravity model predictors. Overall, the model is jointly significant with an R-squared of 27.98%, indicating a moderate explanatory power. The findings support the relevance of the Gravity Model in explaining trade flows but highlight the importance of economic closeness over purely macroeconomic size in the case of Indonesia's tea export sector.

Keywords: Indonesian Tea Exports, Gravity Model, Panel Data, GDP Per Capita, Exchange Rate, Population Size, Economic Distance, Trade Flows, International Trade.

1 Introduction

International trade is vital for economic growth, particularly for developing countries like Indonesia, where exports significantly contribute to GDP and economic competitiveness. In Indonesia, the agricultural sector remains a cornerstone of the national economy, contributing around 12.53% to GDP in 2023 and showing consistent growth [1] [2]. Among agricultural commodities, tea holds an essential position due to its role in generating foreign exchange, providing employment, and supporting rural development [3]. Despite its potential, the Indonesian tea industry faces multiple challenges,

including declining plantation areas caused by land conversion and aging plants, reduced productivity, and weakening export performance [4]. Globally, the tea industry is experiencing oversupply averaging 65,000 tons of unsold tea annually which has created price instability and reduced profitability for producers [5]. Once the fifth-largest global tea producer, Indonesia has dropped to eighth place as of 2023, with exports declining to major destinations like Russia, Malaysia, Pakistan, and the UK. Nevertheless, the domestic tea market is expanding, projected to grow from \$1.41 billion in 2023 to \$1.85 billion by 2029, driven by demand for specialty teas [6]. To strengthen competitiveness, Indonesia must focus on quality improvement, value-added diversification, and developing geographically indicated teas leveraging its high catechin content. The study identifies key problems, including declining tea performance, weak export-import outcomes, adverse impacts on farmers, and intensifying global competition. Accordingly, it seeks to analyze Indonesia's tea competitiveness based on comparative and competitive advantages, identify factors influencing export values, and assess the impact of macroeconomic variables GDP per capita, exchange rates, economic distance, and population size on Indonesia's tea exports.

2 Literature Review

2.1 International Trade

International trade involves the exchange of goods and services between countries to fulfill needs that domestic production cannot satisfy [7]. Every nation has unique endowments such as natural resources, climate, labor, and technological capacities that shape what it can efficiently produce. These differences create comparative advantages, encouraging nations to specialize in producing certain commodities for export while importing goods they cannot efficiently produce. International trade arises from differences in supply and demand across countries due to variations in income, preferences, and resource availability [8]. Trade allows countries to increase their income, foster industrial growth, and strengthen global economic integration [9].

2.2 Theory of Export Demand

Export demand reflects the relationship between the quantity of goods consumers abroad are willing to purchase at various price levels [10]. It is influenced by several factors such as price, consumer income, tastes, population, and expectations. Generally, when prices increase, the demand for exports decreases due to reduced affordability. Export demand can be expressed as the difference between domestic production and domestic consumption, adjusted by available stock from the previous year.

2.3 Gravity Model

The Gravity Model of Trade applies Newton's law of universal gravitation to economic exchanges, positing that trade between two countries is directly proportional to their economic sizes (usually measured by GDP) and inversely proportional to the distance

between them [11] [12]. Distance acts as a proxy for trade costs, such as transportation expenses, cultural barriers, and policy differences.

Evolution of the Model. Tinbergen (1962) [11] was the first to apply this model empirically, finding that large economies trade more and that proximity enhances trade flows. Anderson (1979) [13] later refined it by including per capita income, recognizing the influence of purchasing power and income distribution. Eaton and Kortum (2002) [14] introduced productivity differences as a determinant of trade, accounting for technological disparities between countries. Baier and Bergstrand (2001) [15] further expanded the model by incorporating trade policy variables such as tariffs and trade agreements, highlighting the role of institutional and political factors in shaping trade relationships.

Modern Extensions. Helpman, Melitz, and Rubinstein (2008) [16] introduced firm-level heterogeneity, explaining that only highly productive firms engage in international trade due to the fixed costs of exporting. Subsequent studies also integrated non-economic variables like language, colonial ties, and cultural proximity to improve model accuracy [17] [18]. Krugman (1980) [19] and Salvatore (2019) [20] emphasized the role of exchange rates, showing that currency fluctuations can significantly impact trade competitiveness.

The rise of global value chains (GVCs) and foreign direct investment (FDI) has expanded the Gravity Model's relevance. Baldwin and Lopez-Gonzalez (2015) [21] noted that trade increasingly occurs through value-added networks rather than direct exports, meaning that intermediate goods and multinational production now shape trade flows.

2.4 Factors Affecting Export Value

GDP per Capita. GDP per capita measures a country's average income and reflects the population's purchasing power [22]. It serves as an indicator of both production capacity and demand potential. Higher GDP per capita typically correlates with stronger export performance, as it indicates greater production capabilities and higher levels of consumption [23]. For Indonesia, rising GDP in destination countries can stimulate demand for tea exports, while higher domestic GDP enhances production efficiency and export capacity.

Exchange Rate. Exchange rates determine the relative price of goods between trading nations. A depreciation of the exporter's currency makes its goods cheaper and more competitive abroad, while appreciation makes exports relatively expensive [24] [25]. Fluctuations in exchange rates can therefore influence export volumes and trade balances. For tea exports, stable exchange rates are crucial for maintaining price competitiveness in foreign markets.

Population. Population represents both a potential market and a factor of production. A larger population in destination countries increases potential demand for imported

goods, while domestically it provides labor for production. According to Salvatore (2019) [25], population growth in export destinations raises consumption needs, often leading to increased imports when domestic production cannot meet demand. For Indonesia's tea exports, populous markets such as Pakistan or the United States offer large opportunities for expansion.

Economic Distance. Economic distance captures the cost-related barriers that arise from geographical separation between trading partners. Greater distance increases transportation and transaction costs, which can reduce trade volumes [25]. However, Lawless (2010) [26] and Doanh et al. (2022) [27] found that distance can have a positive effect if strong trade relationships or long-term agreements exist between distant partners. In such cases, stable partnerships may offset logistical challenges, maintaining consistent trade flows despite distance.

2.5 Theoretical Framework

This study integrates the concepts of competitiveness and the Gravity Model to analyze Indonesia's tea exports. The theoretical framework includes five independent variables: GDP per capita, exchange rate, population, economic distance, and competitiveness affecting the dependent variable, namely the export value of Indonesian tea.

Tea remains one of Indonesia's key plantation commodities and an important source of foreign exchange. However, despite global tea consumption increasing from 6.89 million tons in 2022 to a projected 7.44 million tons in 2025 [5], Indonesia's tea exports have declined significantly from IDR 2.7 trillion in 2010 to IDR 1.35 trillion in 2022. Meanwhile, tea imports have surged, reaching USD 29.76 million (approximately IDR 446 billion) and a volume of around 11,000 tons in 2022, with Vietnam supplying over 53% of Indonesia's imported tea [28].

This decline indicates a weakening competitiveness in the global tea market, even as the global tea market value is expected to rise from IDR 3,300 trillion in 2022 to about IDR 4,000 trillion by 2025. The study employs a panel data regression approach using the Gravity Model to assess the determinants of Indonesian tea export performance specifically for green and black tea in its main export destinations.

The findings aim to provide insights and policy recommendations to the Indonesian government to enhance the quality, quantity, and global competitiveness of its tea products. By improving productivity, ensuring quality consistency, and strengthening trade partnerships, Indonesia can leverage its natural advantages and reestablish its position as a leading tea exporter in the international market.

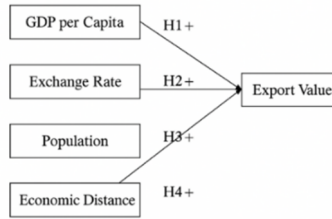


Fig. 1. Research framework

3 Methodology

This study investigates the factors influencing the export value of Indonesian tea using a panel data regression model based on the Gravity Model of Trade. A quantitative research design is adopted, employing numerical data to identify relationships between economic variables affecting tea exports. The study utilizes panel data from 2013–2023 across Indonesia's main tea export destinations, allowing analysis of both temporal and cross-country variations. The Gravity Model, inspired by Newton's law, serves as the theoretical foundation positing that trade between two countries is positively related to their economic sizes (e.g., GDP per capita) and inversely related to economic distance or trade barriers.

The study uses two types of variables. The dependent variable is the export value of Indonesian tea (*exporttea*), representing total export earnings to each destination country. The independent variables include: (1) GDP per capita (*gdp*) reflecting the purchasing power of consumers in destination countries; (2) exchange rate (*exchangerate*) the relative value of the destination currency to the Indonesian Rupiah; (3) population (*population*) indicating potential market size; and (4) economic distance (*economicdistance*) capturing relative economic differences and potential trade barriers between Indonesia and its trading partners.

Data were collected from reputable international sources. Export data (value and volume) were obtained from UN COMTRADE, while economic indicators such as GDP per capita, exchange rates, and population were sourced from the World Bank. The dataset covers a ten-year period (2013–2023) and includes 22 observations across two main destination countries, measured annually.

The analytical process involves descriptive statistics including mean, standard deviation, and range to summarize variable distributions and trends. Subsequently, panel data regression analysis was applied to estimate the relationship between export value and the independent variables. Two econometric models were tested: the Fixed Effects (FE) model, which controls for country-specific characteristics that remain constant over time, and the Random Effects (RE) model, which assumes uncorrelated country effects. The Hausman test determined that the FE model was more appropriate, as it effectively accounts for unobserved heterogeneity across countries. To ensure model reliability, the Wooldridge test for autocorrelation was conducted and confirmed no serial correlation in the residuals, indicating model validity.

In addition to heteroskedasticity, autocorrelation, and normality tests, this study also examined multicollinearity among the explanatory variables using the Variance Inflation Factor (VIF) [29]. The results indicate high VIF values for GDP per capita and population, as expected given that both variables capture different dimensions of economic size. From an econometric perspective, multicollinearity does not bias coefficient estimates but inflates their standard errors, making it more difficult to obtain statistically significant t-statistics. In line with the standard gravity-model literature, GDP per capita, population, and exchange rates are conceptually central determinants of trade flows and therefore were retained in the baseline specification despite high VIF values. Rather than mechanically dropping variables or applying dimensionality reduction techniques, the analysis interprets the individual coefficients for GDP, exchange rate, and population with caution and places greater emphasis on the sign, magnitude, and robustness of the economic distance variable, which is less affected by collinearity and remains precisely estimated.

4 Findings

This chapter presents the empirical results of the panel data regression analysis on factors influencing the export value of Indonesian tea from 2013–2023 across nine major importing countries (Australia, China, Germany, Malaysia, Poland, Russia, Thailand, the USA, and Vietnam). Both Fixed Effects (FE) and Random Effects (RE) models were tested, with diagnostics confirming the appropriateness of the Random Effects Model (REM) as the primary estimator.

4.1 Descriptive Statistics

The descriptive results summarize variations in tea export value (ExportTea), GDP, exchange rate, population, and economic distance among the sampled countries.

Table 1. Economic profile and export-tea performance by country

Country	ExportTea (Mean)	GDP (Mean)	Population (Mean)	Key Insights
USA	18.49	11.06	24.5M	Largest and most stable importer with high GDP
Thailand	14.9	8.67	18.1M	Emerging tea market, favorable trade distance
Vietnam	14.9	8.19	18.4M	Low GDP but export-friendly exchange rate
China	15.1	9.19	21.0M	Huge population and stable exchange rate
Germany	15.4	10.73	18.2M	Moderate imports, strong purchasing power
Malaysia	15.7	9.27	17.3M	Stable economy, consistent importer
Poland	15.5	114.38	17.4M	High trade barriers (largest economic distance)

Russia	15.7	387.18	18.8M	Key market with fluctuating exchange rate High-income market, moderate demand
Australia	15.9	11.02	33.9M	

4.2 Random-Effects GLS Regression Results

The Random Effects GLS model examines the influence of macroeconomic variables on Indonesian tea exports. The model is statistically significant (Wald $\chi^2 = 33.22$, $p = 0.000$), explaining 27.98% ($R^2 = 0.2798$) of the variation in exports.

Table 2. Regression analysis results

Variable	Coefficient	Std. Error	z	p-value	Significance
GDP	0.048	0.266	0.18	0.856	Not significant
Exchange Rate	0.094	0.149	0.63	0.528	Not significant
Population	0.309	0.433	0.71	0.475	Not significant
Economic Distance	0.583	0.166	3.51	0.000	Significant
Constant	8.384	9.080	0.92	0.356	–

Only Economic Distance significantly affects tea exports. A positive coefficient (0.583) suggests that countries economically closer or more integrated with Indonesia import more tea. GDP, exchange rate, and population show positive but statistically insignificant effects, indicating limited influence on export value within this dataset.

4.3 Hausman Test (Model Selection)

Table 3. Hausman specification test results

Test Statistic	Chi-Square	df	p-value	Model Chosen
Hausman Test	5.64	4	0.2279	Random Effects

Since $p > 0.05$, the null hypothesis (favoring REM) is accepted. Thus, the Random Effects Model is preferred, confirming no significant correlation between country-specific effects and regressors.

4.4 Model Diagnostics

Table 4. Model diagnostics test results

Diagnostic Test	Statistic	p-value	Result	Interpretation
Breusch-Pagan (Heteroskedasticity)	$\chi^2 = 358.22$	0.000	Significant	Heteroskedasticity present → corrected with robust SE
Wooldridge (Autocorrelation)	F = 22.09	0.0015	Significant	First-order autocorrelation → corrected with cluster-robust SE

Normality (Skewness/Kurtosis)	$\chi^2 = 0.1847$	>0.05	Not significant	Residuals are normally distributed
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Despite minor violations (heteroskedasticity, autocorrelation), corrective measures using robust standard errors ensure model reliability.

4.5 Multicollinearity (VIF Test)

Table 5. Multicollinearity (VIT test)

Variable	VIF	Interpretation
GDP	149.00	Severe multicollinearity
Population	94.26	Severe multicollinearity
Exchange Rate	15.81	Moderate issue
Economic Distance	5.55	Acceptable
Mean VIF	66.16	High multicollinearity overall

The VIF results show severe multicollinearity problems, particularly for GDP per capita and population, and to a lesser extent for the exchange rate. This pattern is consistent with the correlation matrix, which shows a strong correlation between GDP and exchange rate (0.807) and indicates that these variables are capturing related aspects of economic size and macroeconomic conditions. High multicollinearity can inflate standard errors and reduce the statistical significance of individual coefficients, even when variables are theoretically relevant.

In this study, GDP per capita, population, and exchange rate are retained in the model for two main reasons. First, they are core components of the gravity model and widely used in empirical studies on trade and agricultural exports, so excluding them would risk omitting important dimensions of demand and market size. Second, the primary variable of interest economic distance exhibits an acceptable VIF and remains statistically significant and stable across specifications, suggesting that the key substantive conclusion of this research is not driven by collinearity. Nevertheless, the insignificant coefficients for GDP, exchange rate, and population should be interpreted cautiously, as their lack of statistical significance may partly reflect multicollinearity rather than an absence of economic relevance.

Table 6. VIF result

Variable	GDP	Exchange Rate	Population	Economic Distance
GDP	1.000	0.807	-0.089	0.554
Exchange Rate		1.000	-0.037	0.504
Population			1.000	0.134
Economic Distance				1.000

A strong correlation (0.807) between GDP and Exchange Rate confirms the source of multicollinearity detected in the VIF results.

5 Discussion

This study aimed to examine the influence of macroeconomic variables GDP per capita, exchange rate, population size, and economic distance on the export value of Indonesian tea commodities across major destination countries. The hypotheses were tested using a Random Effects (RE) panel data regression, selected based on the Hausman test, with cluster-robust standard errors applied to address heteroskedasticity and autocorrelation. The discussion below interprets the empirical findings in light of the gravity-model framework and prior empirical studies, with a particular focus on the insignificant results for GDP per capita, exchange rate, and population.

Hypothesis 1: Effect of GDP per capita on tea exports

The regression coefficient for GDP per capita is positive (0.0482) but statistically insignificant ($p = 0.856$), indicating that, within the sample considered, higher income levels in destination countries do not significantly increase Indonesia's tea export value. This result does not support Hypothesis 1.

From the perspective of the gravity model, this is somewhat unexpected, as importer GDP or GDP per capita is typically found to be a key driver of trade flows. Studies on tea and agricultural exports generally report a positive and significant effect of economic size on export volumes [30]. For example, gravity-model analyses of Kenyan tea exports and Vietnam's tea exports to their trading partners show that the importing countries' GDP and related income indicators significantly stimulate tea export flows.

Similarly, several studies on agricultural exports (e.g., Egypt, Nigeria, and other emerging economies) find that higher GDP in importing markets tends to increase demand for agri-food imports.

However, other gravity-based studies also document weaker or even negative effects of GDP per capita in specific contexts, particularly when the exported product is a staple or necessity rather than a luxury, or when sample size and product disaggregation reduce statistical power. In such cases, higher income may shift consumption towards differentiated or premium beverages (e.g., specialty coffee), limiting the responsiveness of demand for bulk tea.

In the context of Indonesia's tea exports, the lack of significance for GDP per capita may therefore be interpreted as follows: tea behaves more like a habitual or culturally embedded good than a purely income-driven luxury [31]. Demand may be shaped more by cultural preferences, long-standing consumption habits, and product positioning than by marginal changes in income. Additionally, the severe multicollinearity between GDP per capita, population, and exchange rate inflates standard errors, making it harder to detect a statistically significant GDP effect even if the underlying relationship is positive.

Hypothesis 2: Effect of exchange rate on tea exports

The exchange rate variable also has a positive but statistically insignificant coefficient (0.0939, $p = 0.528$), thus failing to support Hypothesis 2. Classical trade theory suggests that a depreciation of the importer's currency (relative to the Indonesian Rupiah) would increase imports from Indonesia by making Indonesian goods relatively cheaper. In practice, however, the estimated effect is not statistically distinguishable from zero.

Empirical evidence on exchange rates in gravity models is mixed. Several studies on commodity trade and tea exports report that a depreciation of the exporter's currency can significantly boost exports, as found in analyses of Kenyan tea exports and other agri-food trade flows [32].

On the other hand, some research on tea exports and agricultural products finds only weak or statistically insignificant relationships between exchange rate movements and export volumes, particularly when long-term contracts, hedging practices, or low price elasticity of demand dampen the impact of short-run currency fluctuations.

For Indonesian tea exports, the insignificant coefficient suggests that exchange rate movements are not the primary determinant of trade volumes within the studied period and country set. This may reflect several mechanisms: (1) long-term supply contracts and stable buyer–seller relationships in tea markets; (2) relatively low unit prices of bulk tea, which reduce sensitivity to marginal currency changes; and (3) the confounding effect of multicollinearity with GDP and economic distance. As a result, while exchange rates remain theoretically important, their empirical impact in this specific sample appears limited.

Hypothesis 3: Effect of economic distance on tea exports

In contrast to the previous variables, economic distance has a positive and highly significant coefficient (0.5831, $p = 0.000$), strongly supporting Hypothesis 3. This result indicates that Indonesia exports more tea to countries with closer economic linkages or similarity, such as shared regional agreements, complementary trade structures, or relatively lower non-tariff barriers.

This finding is consistent with modern extensions of the gravity model that emphasize not only physical distance but also “economic proximity” and institutional linkages such as shared trade agreements, regulatory convergence, and participation in regional value chains as key determinants of trade flows. Studies on agricultural and tea exports from China, Vietnam, and other emerging exporters similarly highlight the role of trade agreements, institutional distance, and non-tariff measures (e.g., technical barriers to trade) in shaping export performance.

The positive effect of economic distance in this study suggests that stronger economic integration and trade linkages can compensate for geographic separation, supporting sustained trade in relatively low-value but habit-forming commodities such as tea.

Hypothesis 4: Effect of population on tea exports

The population variable has a positive but statistically insignificant coefficient (0.3092, $p = 0.475$), meaning that larger populations in destination countries do not necessarily translate into higher Indonesian tea export values in a statistically robust way. Hypothesis 4 is therefore not supported.

Theoretically, population can exert both positive (“scale effect”) and negative (“absorption effect”) influences on trade: larger populations may expand market size and specialization, but they may also allow countries to rely more on domestic production and import less.

Empirical gravity-model studies confirm that population effects are often ambiguous and context-dependent. Some tea and agricultural export studies find that importer population significantly boosts exports, particularly when domestic production is limited.

Others, however, report mixed or insignificant effects, especially when per capita consumption patterns differ sharply across countries or when high-population markets already have strong domestic tea industries.

In the case of Indonesian tea, the insignificant population effect likely reflects heterogeneity in per capita tea consumption and substitution patterns [33]. Some large-population markets in the sample may prefer coffee or other beverages, or rely on domestic tea production or competing suppliers, reducing the explanatory power of population alone. Moreover, the severe multicollinearity between population and GDP variables further reduces the precision of the estimated population coefficient.

Hypothesis 5: Joint effect of all variables

Despite the insignificance of several individual coefficients, the Wald test ($\chi^2 = 33.22$, $p = 0.000$) indicates that the model is jointly significant, thus supporting Hypothesis 5. In other words, GDP per capita, exchange rate, population, and economic distance collectively explain a significant share of the variation in Indonesian tea exports, even though only economic distance achieves individual statistical significance at conventional levels. The R^2 value of 27.98% is in line with gravity-model applications using disaggregated commodity-level data, where idiosyncratic product-specific factors and unobserved preferences typically limit explanatory power.

Taken together, these results suggest that while the classic gravity variables (GDP, exchange rate, population) are conceptually relevant, their individual effects in the Indonesian tea context are obscured by multicollinearity, small sample size, and commodity-specific consumption patterns. Economic distance and the strength of trade linkages emerge as the most robust determinants of Indonesia's tea export performance across destinations.

6 Conclusion

This study analyzed the determinants of Indonesia's tea export performance from 2013–2023 using the Gravity Model of Trade through a Random Effects panel regression. The key findings reveal that among the four independent variables GDP per capita, exchange rate, population size, and economic distance only economic distance had a statistically significant and positive impact on tea exports. This indicates that Indonesia exports more tea to countries with stronger economic linkages and closer trade relationships, confirming the theoretical expectations of the gravity model. Conversely, GDP per capita, exchange rate, and population were found insignificant, suggesting that income level, currency fluctuations, and market size do not necessarily drive tea demand, likely due to the product's cultural consumption patterns and low income elasticity. Although individual effects were limited, the model as a whole was statistically significant (Wald $\chi^2 = 33.22$; $R^2 = 27.98\%$), explaining a meaningful share of export variation, with robust standard errors addressing heteroskedasticity and autocorrelation issues.

From a policy standpoint, the findings emphasize the need to strengthen trade linkages and reduce barriers with economically aligned countries through improved trade

agreements, mutual standards, and logistics efficiency. Exporters should focus on markets with strong economic ties rather than simply large or wealthy ones, as tea demand depends more on cultural and habitual factors than macroeconomic size. For future research, incorporating additional variables such as cultural affinity, trade policy effects, and per capita tea consumption and expanding the dataset to more countries and commodities could provide a fuller understanding of Indonesia's export dynamics. Despite limitations related to sample size and multicollinearity, this study offers valuable insights for policymakers and exporters in enhancing Indonesia's competitiveness in the global tea market.

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