



Determinants of Export Volume in Indonesia's Textile and Textile Products Industry: An Analysis Using the Gravity Model

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Abstract

Indonesia's textile and textile products (TTP) industry plays a vital role in the national economy, contributing significantly to employment and foreign exchange. However, since 2016, the export volume of TTP has declined, raising concerns about competitiveness and structural resilience. This study investigates the macroeconomic determinants of Indonesia's TTP export volume to five major trading partners—United States, Japan, South Korea, China, and Germany—over the period 2014–2023. Using the gravity model framework, the analysis incorporates five explanatory variables: GDP per capita, geographical distance, trade openness index, real exchange rate, and population growth rate. Panel data regression is applied, with the Common Effect Model (CEM) selected based on diagnostic tests. The results show that GDP per capita, real exchange rate, and population growth rate positively and significantly affect export volume, while geographical distance and trade openness index exert a negative and significant influence. These findings confirm the relevance of the gravity model in explaining bilateral trade flows and highlight the importance of purchasing power, exchange rate stability, and demographic expansion in driving exports. Conversely, logistical barriers and intensified competition in liberalized markets may suppress export performance. The study offers policy insights for enhancing Indonesia's export strategy through market diversification, improved logistics, and industrial competitiveness.

Keywords: *Textile exports; Gravity model; GDP per capita; Real exchange rate; Trade openness; Population growth; Indonesia; Panel data regression*

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I. Introduction

International trade remains a fundamental pillar of global economic integration, enabling countries to exchange goods and services, optimize resource allocation, and benefit from comparative advantages. Theoretical foundations laid by Ricardo's comparative advantage and Smith's absolute advantage have evolved into more complex frameworks, such as the gravity model, which explains bilateral trade flows based on economic size and geographical proximity (Krugman, Obstfeld, & Melitz, 2018; Tinbergen, 1962). For developing economies like Indonesia, exports are not merely a source of foreign exchange but a strategic instrument for industrial development, employment generation, and macroeconomic stability (Helpman & Krugman, 1985; Zhang, Saghaian, & Reed, 2023).

Indonesia's export structure is predominantly driven by the non-oil and gas sector, which consistently contributes over 85% of total export value (BPS, 2025). Within this sector, the textile and textile products (TTP) industry plays a pivotal role. As a labor-intensive industry, TTP absorbs a significant portion of the workforce and contributes substantially to national income. In 2023, the industry generated USD 11.6 billion in export value, accounting for 4.7% of total non-oil and gas exports, and employed over 3.87 million workers (Kementerian Perindustrian, 2024). Indonesia ranks 13th globally in textile production, with key export destinations including the United States, Japan, Germany, China, and South Korea (OECD, 2023).

Despite its strategic importance, Indonesia's TTP export performance has been declining. Between 2014 and 2023, export volumes fluctuated, with a notable downward trend beginning in 2016. In 2023, the export volume reached its lowest point in a decade at 1.69 million tons, down from 2.1 million tons in 2014 (BPS, 2025). This decline is compounded by the fact that import volumes have consistently exceeded exports since 2016, indicating a persistent trade deficit in the TTP sector. Such imbalances not only weaken the sector's contribution to the national trade balance but also reflect structural inefficiencies and declining competitiveness (Ragimun, 2018; Setyawan, 2023).

Several factors contribute to this deteriorating performance. Indonesia's heavy reliance on a few primary markets—particularly the United States—exposes its exports to external shocks, including demand fluctuations and protectionist trade policies. Moreover, the country faces increasing competition from emerging textile exporters such as Vietnam and Bangladesh, which benefit from lower production costs,

favorable trade agreements, and stronger integration into global value chains (Rahman, Shahriar, & Kea, 2019). The COVID-19 pandemic further exacerbated these challenges by disrupting global supply chains and reducing international demand for textile products. According to APSyFI, over 30 textile factories in Indonesia closed between 2022 and 2024, resulting in more than 11,000 layoffs (Emeria, 2024).

In response to these challenges, a deeper understanding of the macroeconomic determinants influencing Indonesia's TTP export volume is essential. The gravity model offers a robust framework for analyzing bilateral trade flows, positing that trade between two countries is positively related to their economic size and negatively related to the distance between them (Anderson & Van Wincoop, 2004; Shepherd, 2016). This study extends the gravity model by incorporating additional macroeconomic variables that are theoretically and empirically relevant: GDP per capita, geographical distance, trade openness index, real exchange rate, and population growth rate.

GDP per capita serves as a proxy for purchasing power in the destination country. Higher income levels are generally associated with increased demand for imported goods, including textiles, which are often considered semi-luxury or lifestyle products in high-income markets. Empirical studies have shown that economic growth in importing countries leads to increased consumption of foreign goods, particularly in sectors like apparel and fashion (Bussière et al., 2011; Krugman et al., 2018).

Geographical distance represents a structural barrier to trade. Longer distances typically entail higher transportation costs, longer delivery times, and increased risks, all of which can reduce the competitiveness of exported goods. In the case of Indonesia, the archipelagic nature of the country further complicates logistics, making distance a critical factor in determining export feasibility and cost-effectiveness (Rodrigue, 2020; CEPII, 2025).

The trade openness index measures the extent to which a country is integrated into the global economy. While greater openness is generally expected to facilitate trade, the relationship is not always linear. In some cases, increased openness may lead to heightened competition from foreign producers, potentially crowding out domestic exports. This phenomenon has been observed in Indonesia's TTP sector, where liberalization has coincided with a surge in low-cost textile imports from countries like China (Widyastuti & Pangestu, 2015; Rodrik, 2016).

The real exchange rate captures the relative price of domestic goods in foreign markets, adjusted for inflation. A depreciated real exchange rate makes exports more competitive by lowering the price of domestic goods in terms of foreign currency. Conversely, an appreciated exchange rate can reduce export competitiveness. Empirical studies have consistently shown that exchange rate movements significantly influence export performance, particularly in price-sensitive sectors like textiles (Bahmani-Oskooee & Wang, 2008; Nugroho & Irawan, 2019).

Population growth rate in the destination country is included as a demographic variable that reflects market expansion potential. Rapid population growth, especially in younger age cohorts, tends to increase demand for consumer goods, including clothing and household textiles. While the effect may vary depending on income levels and urbanization, population dynamics are increasingly recognized as important determinants of trade flows (Bloom et al., 2017; Herzer et al., 2016).

This study employs a panel data regression approach using the Common Effect Model (CEM) to analyze Indonesia's TTP exports to five major destination countries over the period 2014–2023. The use of panel data allows for a more comprehensive and robust analysis by capturing both cross-sectional and temporal variations. Moreover, the selection of five key trading partners ensures that the analysis reflects diverse economic, geographic, and policy contexts.

The research aims to answer two key questions: (1) Do GDP per capita, geographical distance, trade openness index, real exchange rate, and population growth rate simultaneously influence the volume of Indonesia's TTP exports? (2) What is the partial effect of each of these variables on export volume?

The significance of this research lies in its potential to inform both theoretical and practical perspectives. Theoretically, it contributes to the literature on gravity models by incorporating additional macroeconomic variables and applying them to a sector-specific context. Practically, the findings can guide policymakers and industry stakeholders in formulating targeted export strategies, improving competitiveness, and diversifying markets.

II. Research Methodology

This study employs a quantitative approach with an associative research design to investigate the macroeconomic determinants of Indonesia's textile and textile products (TTP) export volume to five major

trading partners—namely the United States, Japan, South Korea, China, and Germany—over the period 2014–2023. The analytical framework is based on the gravity model of international trade, which posits that bilateral trade flows are positively influenced by the economic size of trading partners and negatively affected by geographical distance. To enhance the explanatory power of the model, additional macroeconomic variables are incorporated, including trade openness index, real exchange rate, and population growth rate.

The study utilizes panel data regression, combining cross-sectional and time-series data to capture both spatial and temporal variations. Three panel regression models are considered: Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). Model selection is conducted through Chow test, Hausman test, and Lagrange Multiplier (LM) test. Given the characteristics of the data and the results of diagnostic testing, the Common Effect Model is selected as the most appropriate specification.

The dependent variable is the annual export volume of Indonesia's TTP industry to the selected countries, measured in thousand tons. The independent variables include GDP per capita of the destination country (X_1), geographical distance (X_2), trade openness index (X_3), real exchange rate (X_4), and population growth rate (X_5). Export volume data is sourced from UN Comtrade and BPS Indonesia, covering HS codes 50–63, which encompass a wide range of textile products including raw materials, yarns, fabrics, garments, and household textiles.

GDP per capita is measured in USD and obtained from the World Bank Development Indicators (WDI). Geographical distance is calculated in kilometers between Jakarta and the capital cities of the destination countries, sourced from CEPII. The trade openness index is expressed as the ratio of total trade (exports + imports) to GDP, in percentage terms, and sourced from Our World in Data. Real exchange rate is calculated using the formula $RER = e \times (P / P^*)$, where e is the nominal exchange rate, P is the domestic price level, and P^* is the foreign price level, with data obtained from UNCTAD. Population growth rate is expressed as the annual percentage change in population, also sourced from WDI.

Prior to estimation, classical assumption tests are conducted to ensure the validity of the regression model. These include tests for normality (Shapiro–Francia), multicollinearity (Variance Inflation Factor), heteroskedasticity (Breusch–Pagan), and autocorrelation (Wooldridge test). The results confirm that the model satisfies the assumptions of Best Linear Unbiased Estimator (BLUE), indicating that the estimates are consistent and efficient.

The total number of observations is 50, derived from 10 years of data across five countries. All data sources are publicly accessible and verified for consistency. Statistical analysis is performed using STATA 14, which provides robust tools for panel data estimation and diagnostic testing.

This methodological framework enables a rigorous examination of the structural and macroeconomic factors influencing Indonesia's TTP export performance, offering insights that are both theoretically grounded and policy-relevant.

III. Results and Discussion

3.1 Results

This study analyzes panel data from five major export destinations of Indonesia's textile and textile products (TTP) industry—namely the United States, Japan, South Korea, China, and Germany—over the period 2014–2023. Table 1 presents the descriptive statistics of the variables used in the regression model.

Table 1. Descriptive Statistics

	Y	X ₁	X ₂	X ₃	X ₄	X ₅
<i>Mean</i>	168639108	38652,47	8679,6	52,3158	109,4154	0,2743501
<i>Maximum</i>	355792397,08	82304,62	16363	96,53	152,993	0,8657026
<i>Minimum</i>	29382916,07	7781,066	5200	23,07	58,12489	-0,4873708
<i>Std. Dev</i>	92833907	18926,12	4417,035	23,71261	24,74411	0,3719421
<i>Observation</i>	50	50	50	50	50	50

Sumber: Data diolah, 2025 (Lampiran 2)

The data show significant variation across countries and years, indicating the suitability of panel data regression for this analysis.

Model Selection and Estimation

To determine the most appropriate panel data regression model, the study conducted Chow, Hausman, and Lagrange Multiplier (LM) tests. Due to the time-invariant nature of the distance variable (X2), the Fixed Effects Model (FEM) was not suitable. The LM test indicated that the Common Effects Model (CEM) was the most appropriate, with a p-value of 1.0000 (>0.05).

1. Regression Results

Using the Common Effects Model (CEM), the regression equation is as follows:

$$\ln(Y) = 27,95865 + 0,3610124 \ln(X1) - 0,8602405 \ln(X2) - 1,606927 \ln(X3) + 0,0074562 (X4) + 0,404453 (X5)$$

Table 2. Common Effect Model (CEM) Estimation Results

Common Effect Model (CEM) Estimation Results				
Variabel	Koefisien	Std. Error	t-Hitung	Nilai p
Ln_X1	0,3610124	0,1010536	3,57	0,001
Ln_X2	-0,8602405	0,1753477	-4,91	0,000
Ln_X3	-1,606927	0,883799	-18,18	0,000
X4	0,0074562	0,0017392	4,29	0,000
X5	0,404453	0,1545512	2,62	0,012
C	27,95865	1,105627	25,29	0,000
R-Squared	0,8920		F-Statistic	72,67
Adj. R-Squared	0,8797		Prob (F-Statistic)	0,0000
Root MSE	0,23941			

Model Fit:

- $R^2 = 0.8920$
- Adjusted $R^2 = 0.8797$
- F-statistic = 72.67 ($p < 0.0001$)

These results indicate that the model explains 89.2% of the variation in export volume, with all independent variables statistically significant at the 5% level.

Classical Assumption Tests

- Normality: Shapiro-Francia test results for all variables yielded p-values > 0.05 , indicating normally distributed residuals.
- Multicollinearity: All VIF values were below 10 (mean VIF = 2.91), indicating no multicollinearity.
- Heteroskedasticity: Breusch-Pagan test yielded a p-value of 0.1597 (> 0.05), indicating homoskedastic residuals.
- Autocorrelation: Wooldridge test yielded a p-value of 0.2512 (> 0.05), indicating no autocorrelation.

Hypothesis Testing

Simultaneous Test (F-Test)

The F-statistic of 72.67 with a p-value < 0.0001 confirms that GDP per capita, distance, trade openness, real exchange rate, and population growth rate jointly have a significant effect on Indonesia's TTP export volume.

Partial Test (t-Test)

- **GDP per capita (X1):** Positive and significant ($t = 3.57$, $p = 0.001$). Higher income levels in destination countries increase demand for TTP exports.
- **Distance (X2):** Negative and significant ($t = -4.91$, $p = 0.000$). Greater geographic distance reduces export volume due to higher logistics costs.
- **Trade Openness Index (X3):** Negative and significant ($t = -18.18$, $p = 0.000$). Surprisingly, higher openness correlates with lower export volume, possibly due to increased competition from imports.
- **Real Exchange Rate (X4):** Positive and significant ($t = 4.29$, $p = 0.000$). A higher RER makes Indonesian products more price-competitive abroad.
- **Population Growth Rate (X5):** Positive and significant ($t = 2.62$, $p = 0.012$). Growing populations in destination countries expand market size and demand.

3.2 Discussion

This study investigates the determinants of Indonesia's textile and textile products (TTP) export volume to five major trading partners—United States, Japan, South Korea, China, and Germany—using the gravity model framework and panel data regression with the Common Effect Model (CEM). The findings reveal that GDP per capita, real exchange rate, and population growth rate positively and significantly influence export volume, while geographical distance and trade openness index exert a negative and significant impact. These results offer nuanced insights into the structural and macroeconomic factors shaping Indonesia's TTP export performance.

3.2.1 GDP per Capita and Export Volume

The positive and significant relationship between GDP per capita of destination countries and Indonesia's TTP export volume aligns with the gravity model's core premise: larger economies with higher purchasing power tend to import more goods. As GDP per capita increases, consumer demand for diverse and higher-quality textile products also rises, creating opportunities for exporters like Indonesia. This finding corroborates previous studies by Bussière et al. (2011) and Krugman et al. (2018), which emphasize that income growth in importing countries stimulates demand for imported goods, particularly in sectors like apparel and fashion that are sensitive to income elasticity.

In practical terms, Indonesia's TTP exports to high-income countries such as the United States and Germany benefit from these economies' robust consumer markets. The implication is clear: targeting countries with rising GDP per capita should be a strategic priority for Indonesian exporters. Moreover, this result supports the export-led growth hypothesis, suggesting that external demand from wealthier nations can drive domestic industrial expansion (Melitz, 2003; Zhang et al., 2023).

3.2.2 Geographical Distance as a Trade Barrier

The negative and significant impact of geographical distance on export volume is consistent with the gravity model's prediction that trade flows diminish with increasing distance due to higher transportation costs, longer delivery times, and logistical complexities. This finding echoes the work of Anderson and Van Wincoop (2004), who argue that distance remains a persistent barrier to trade despite technological advancements in logistics.

For Indonesia, a geographically dispersed archipelago, the cost of shipping goods to distant markets like the United States (16,363 km) is substantially higher than to nearby countries such as China (5,200 km). These logistical challenges reduce the competitiveness of Indonesian TTP products in distant markets. The result underscores the need for improved infrastructure, streamlined customs procedures, and regional trade agreements to mitigate the adverse effects of distance on export performance (Rodrigue, 2020; CEPII, 2025).

3.2.3 Trade Openness Index and Export Dynamics

Contrary to conventional expectations, the trade openness index exhibits a negative and significant relationship with Indonesia's TTP export volume. This counterintuitive result suggests that greater openness in destination countries does not necessarily translate into increased imports from Indonesia. One plausible explanation is that trade liberalization exposes domestic industries to intense competition from low-cost producers like China and Vietnam, thereby crowding out Indonesian exports (Autor et al., 2013; Ragimun, 2018).

Moreover, the structure of Indonesia's TTP industry—characterized by reliance on imported raw materials and limited technological upgrading—may hinder its ability to compete in liberalized markets. This finding aligns with Rodrik's (2016) argument that premature deindustrialization in developing countries can be exacerbated by trade openness, especially when domestic industries lack the resilience to withstand global competition.

The policy implication is that trade liberalization must be accompanied by industrial strengthening measures, such as investment in technology, workforce training, and export promotion, to ensure that openness leads to export growth rather than contraction.

3.2.4 Real Exchange Rate and Export Competitiveness

The positive and significant effect of the real exchange rate on export volume confirms the theoretical expectation that currency depreciation enhances export competitiveness by making domestic goods cheaper in foreign markets. This result is consistent with studies by Bahmani-Oskooee and Wang (2008) and Nugroho and Irawan (2019), which demonstrate that favorable exchange rate movements boost manufacturing exports.

In the context of Indonesia's TTP industry, a weaker rupiah increases the attractiveness of its products in international markets, particularly in price-sensitive segments. However, the benefits of exchange rate depreciation depend on the stability of macroeconomic conditions and the elasticity of demand in destination countries. Excessive volatility or inflation can offset the gains from a weaker currency, highlighting the importance of prudent monetary policy and exchange rate management (Bank Indonesia, 2021).

3.2.5 Population Growth Rate and Market Expansion

The positive and significant relationship between population growth rate and export volume suggests that demographic expansion in destination countries contributes to increased demand for TTP products. This finding is supported by Bloom et al. (2017) and Herzer et al. (2016), who argue that growing populations, especially in younger age cohorts, drive consumption of apparel and household textiles.

Countries with rising populations, such as China and the United States, offer expanding markets for Indonesian TTP exports. The implication is that demographic trends should be incorporated into market selection and export strategy. Exporters can tailor their products to meet the preferences of younger consumers and capitalize on the growing demand for fashion and lifestyle goods.

However, the impact of population growth is contingent on income levels and urbanization. In low-income countries, rapid population growth may not translate into higher import demand due to limited purchasing power. Therefore, demographic analysis must be complemented by economic profiling to identify high-potential markets.

3.2.6 Integrated Interpretation of the Gravity Model

The empirical results of this study reinforce the validity of the gravity model in explaining Indonesia's TTP export performance. The model's core variables—economic size (GDP per capita), distance, and trade openness—exhibit statistically significant relationships with export volume, confirming their relevance in trade analysis. Additionally, the inclusion of real exchange rate and population growth rate enriches the model by capturing price competitiveness and demographic dynamics.

The high R-squared value (0.8920) indicates that the model explains a substantial portion of the variation in export volume, suggesting that macroeconomic and structural factors are critical determinants of trade flows. This finding supports the use of gravity models in policy formulation and trade forecasting, particularly for sectors like TTP that are sensitive to external conditions.

IV. Conclusion and Recommendations

Conclusion

This study investigates the macroeconomic determinants of Indonesia's textile and textile products (TTP) export volume to five major trading partners—United States, Japan, South Korea, China, and Germany—over the period 2014–2023, using the gravity model framework and panel data regression with the Common Effect Model (CEM). The analysis incorporates five key independent variables: GDP per capita, geographical distance, trade openness index, real exchange rate, and population growth rate.

The findings reveal that GDP per capita, real exchange rate, and population growth rate have a positive and statistically significant impact on Indonesia's TTP export volume. These results suggest that higher purchasing power in destination countries, favorable exchange rate movements, and demographic expansion contribute to increased demand for Indonesian textile exports. Conversely, geographical distance and trade openness index exhibit a negative and significant influence, indicating that logistical barriers and heightened competition in liberalized markets may suppress export performance.

The empirical evidence supports the theoretical foundations of the gravity model, affirming that economic size and proximity are critical determinants of bilateral trade flows. Moreover, the study highlights the nuanced role of trade openness, which, while generally associated with increased integration, may not uniformly benefit all sectors—particularly those facing intense global competition such as textiles.

From a policy perspective, these findings underscore the importance of targeting high-income and demographically dynamic markets, maintaining exchange rate stability, and improving logistical infrastructure to mitigate the adverse effects of distance. Additionally, strategic trade policies should be designed to enhance competitiveness in open markets, ensuring that liberalization is accompanied by industrial strengthening and innovation.

In conclusion, the study provides a comprehensive understanding of the structural and macroeconomic factors shaping Indonesia's TTP export performance. It offers valuable insights for policymakers, industry stakeholders, and future researchers seeking to enhance the resilience and global competitiveness of Indonesia's textile sector.

Recommendations

Based on the empirical findings and theoretical implications of this study, several recommendations are proposed to enhance the performance of Indonesia's textile and textile products (TTP) exports in the global market.

First, given the positive and significant influence of GDP per capita in destination countries, the Indonesian government and exporters should prioritize market expansion toward high-income economies. These markets offer greater purchasing power and demand for high-quality textile products. Strategic trade missions, bilateral agreements, and targeted promotional campaigns should be directed toward countries with stable economic growth and rising consumer demand, particularly in North America, Europe, and East Asia.

Second, the positive impact of the real exchange rate on export volume underscores the importance of maintaining a competitive and stable exchange rate. Monetary authorities should adopt exchange rate policies that support export competitiveness while minimizing volatility. Exporters, in turn, should develop pricing strategies that leverage favorable exchange rate movements to gain market share abroad.

Third, the positive relationship between population growth in destination countries and export volume suggests that Indonesia should also target emerging markets with expanding populations, such as South Asia, Africa, and parts of Latin America. These regions represent growing consumer bases with increasing demand for affordable and diverse textile products. Exporters should tailor product offerings to suit the demographic and cultural preferences of these markets.

Fourth, the negative and significant effect of geographical distance highlights the need for improved trade logistics and infrastructure. The government should invest in port modernization, streamline customs procedures, and enhance multimodal transport networks to reduce shipping times and costs. Additionally, regional trade hubs and free trade zones could be leveraged to facilitate more efficient distribution to distant markets.

Fifth, the unexpected negative impact of the trade openness index suggests that liberalization alone is insufficient to boost exports. Policymakers must ensure that trade openness is accompanied by industrial upgrading, innovation, and capacity building. The TTP industry should be supported through incentives for technology adoption, quality certification, and workforce development to enhance its competitiveness in open markets.

Finally, future research is encouraged to explore additional variables such as tariff and non-tariff barriers, foreign direct investment, and global value chain participation. A broader set of indicators may provide a more comprehensive understanding of the dynamics affecting Indonesia's TTP export performance.

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