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GDP, Trade Tax, and Economic Distance's Influence on Ghana's Cocoa Trade with Trading Partners

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ABSTRACT

Ghana prioritizes the production of raw cocoa beans while engaging in trade for other commodities. Although cocoa holds significant economic importance for Ghana, there is a notable gap in research regarding the economic factors influencing cocoa exports, especially between American, European and Asian markets. The effects of Gross Domestic Product (GDP), trade taxes, and economic distance on trade flows, market accessibility, and sustainability in these regions remain ambiguous. This study utilized panel data from 2001 to 2023, employing the gravity model through Panel Ordinary Least Squares (POLS), Generalized Least Squares (GLS), and Poisson Pseudo-Maximum Likelihood (PPML) estimation methods. The findings indicate that Ghana's cocoa trade with American, European, and Asian markets is significantly influenced by Ghana's GDP, the economies of its trading partners, international trade taxes, and economic distance between them. To enhance Ghana's cocoa trade, forming trade agreements with emerging Asian economies could reduce barriers and improve market access. Ghana should consider revising cocoa export duties to increase competitiveness and negotiating with trade partners to lower import tariffs on its cocoa products in Asian markets.

INTRODUCTION

The exchange of agricultural goods across national boundaries, governed by bilateral agreements between countries, constitutes international trade. The expansion of global commerce and integration into the world economy is crucial for generating high-productivity employment opportunities, which in turn drive growth and performance in all economies, particularly in developing nations such as Ghana, Nigeria, Côte d'Ivoire, Kenya, Ethiopia, and South Africa, among others (Eshetu, 2024; Yeboah et al., 2020). International

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trade serves as the main engine for economic growth, contributing to poverty reduction and achieving sustainable development (Bekele & Mersha, 2019; Wahab, 2023). The global marketplace for agricultural commodities enables countries to improve their societal well-being through cross-border trade (Abafita & Tadesse, 2021; Thai-Ha, 2017; Verter, 2016). International trade allows nations to have market access to goods and services that they cannot locally produce but can purchase and consume locally, and vice versa, which promotes economic development, improving the standard of living, fostering innovation, and cooperation between trading countries (Aragie et al., 2023; Bekele & Mersha, 2019; Bonuedi et al., 2020; Kastner et al., 2021). However, variations in natural and man-made resource endowments among nations, such as Ghana and European or Asian countries, result in each having distinct advantages in producing specific cocoa products. Ghana, for instance, specializes in raw cocoa bean production due to its comparative advantage in cocoa cultivation, while trading for other commodities from its trading partners (Aragie et al., 2023; Bekele & Mersha, 2019; Bonuedi et al., 2020; Kastner et al., 2021). In Ghana, the trade of cocoa and its derivatives is a significant contributor to export income. These exports rank as the country's third largest source of foreign exchange, following closely behind gold and crude oil (Ghana Statistical Service, 2025).

Ghana is the world's second-largest cocoa bean producer after Côte d'Ivoire and plays a vital role in global cocoa supply. Ghana accounts for 15–20% of global cocoa production, while Côte d'Ivoire leads at 40%. For 2024/2025, Ghana's cocoa production is expected to reach 700,000 metric tons (MT), recovering from the previous year's 531,000 MT (United States Department of Agriculture Foreign Agriculture Service, 2025). Ghana is a major player in the international market, known for high-quality beans sought by chocolate manufacturers worldwide. Europe is the largest cocoa bean importer, accounting for 58% of global imports in 2023. Ghana is among of the top two suppliers to the European Union, with the Netherlands, Belgium, France, Germany, and Switzerland as key destinations. The United States is also a significant market for Ghanaian cocoa, accounting for about 11.5% of Ghana's cocoa beans and products exports by volume, second only to the Netherlands which takes about 29.3% (Ghana Statistical Service, 2025). Thus, Ghana holds a substantial share of the U.S. cocoa import market, with exports valued in the low hundreds of millions of U.S. dollars annually, reflecting the importance of the U.S. as a destination for Ghana's cocoa beans and processed cocoa products. In 2023, Malaysia was among the main export destinations alongside traditional European markets and the United States. Notably, Asia's share increased by 2.1% for exports and 4.1% for imports. Asia is emerging as a promising market for Ghanaian cocoa, with Malaysia and China increasing their imports. In 2023/2024, the Netherlands imported

75,423 MT, Belgium (34,617 MT), Spain (18,700 MT), France (16,154 MT), Turkey (15,548 MT), Germany (13,357 MT of cocoa beans from Ghana, making it the largest European importers, the United States (31,575 MT), Japan (20,742 MT), Malaysia (20,411 MT) and Canada (10,425 MT) (United States Department of Agriculture Foreign Agriculture Service, 2025). Ghana also exports semi-processed products like cocoa paste, butter, and powder.

The total cocoa trade between Ghana and its trading partners from 2001 to 2023. Ghana's highest total trade volumes were with the Netherlands (USD 463.01 million), followed closely by the United States (USD 462.50 million), Belgium (USD 454.97 million), France (USD 453.23 million), Switzerland (USD 449.50 million), Japan (USD 442.97 million), and Malaysia (USD 436.63 million). These data indicate that during the specified period, most cocoa trade transactions occurred between Ghana and four main countries: the Netherlands, the United States, Belgium, and France, surpassing trade volumes with other nations.

As a leading cocoa producer and exporter, Ghana relies heavily on this commodity for economic stability, generating export revenue, creating jobs, and supporting rural communities (Ghana Cocoa Board, 2023b, 2023a). A significant portion of Ghana's trade is from cocoa exports, with the American, European Union (EU) and Asian markets as primary importers. While America and Europe have traditionally been Ghana's main cocoa export destination, Asian countries like Japan, Malaysia, China, India, and Indonesia are seeing a rapid increase in demand (Tsowou & Gayi, 2019). However, Ghana's cocoa trade potential is affected by economic factors, including its GDP and that of its trading partners, influencing production capacity and market demand and population size, which increases labor supply for cocoa production and processing. Although a larger population in Ghana might increase the labor force for cocoa production, it could also lead to higher domestic consumption, thereby decreasing the surplus available for export. This scenario can create a negative correlation between population size and exports. Similarly, for tradingpartners, an increase in population does not necessarily translate to higher imports; structural changes or shifts in consumer preferences might counteract the expected positive impact, resulting in a negative impact on cocoa imports. Trade taxes (exports and imports), tariffs, and other duties imposed by importing countries such as the United States of America, Belgium, France, the Netherlands, and Switzerland hinder competitiveness. Barriers to global cocoa trade also arise from differences in economic structures, trade policies, geographical distance, and logistical efficiency in the cocoa markets (Nisa et al., 2023; Wijaya, 2020). Ghana encounters obstacles in exporting cocoa to major economies like the US and Europe due to a lack of variety in high-value cocoa products, such as processed chocolates, which reduces their appeal in premium markets. Furthermore,

limited trade agreements with Asian countries hinder access to growing consumer markets. While Ghana's closeness to Europe results in lower transportation costs compared to Asian producers, inefficiencies in infrastructure, including port delays and high logistics expenses, negate this advantage, particularly for distant markets like the US and Asia. Although Ghana's cocoa trade with the US and Europe is well-documented, Asia's emerging role as a market remains understudied. Comparative research on how GDP, trade policies, and economic barriers differ between these regions is lacking. The relative impact of trade taxes and economic distance on Ghana's cocoa trade tothese markets is not fully understood. While trade taxes (exports and imports) affect international trade competitiveness, there is no comprehensive study quantifying their exact impact. Similarly, although economic distance influences trade, there is limited empirical evidence on its specific effects on Ghana's bilateral cocoa trade with the primary trading partners of the US, Europe, and Asia. The extent to which trade taxes impede Ghana's cocoa trade in these markets has not been sufficiently analyzed. Despite cocoa's importance to Ghana's economy, there is a lack of research examining the economic determinants of cocoa trade, particularly among the American, European, and Asian markets. It remains unclear how GDP, trade taxes comprising export and import taxes, and economic distance collectively shape trade flows, market accessibility, and sustainability in these regions.

A research study by Nisa et al. (2023), the factors influencing the trade of cocoa beans in the global market through the Gravity Model Approach. The findings revealed that Indonesia's cocoa bean trade is impacted by several factors, including economic distance, production levels, export volume, the population of exporting countries, the area harvested, exchange rates, and membership in the AFCFTA. Abdullahi et al. (2021) identified that Nigeria's cocoa exports were significantly affected by several factors, including GDP, exchange rate policy, membership in the WTO and EU, historical colonial connections, GDP per capita, whether the country is landlocked, geographical distance, and affiliations with the AU and ECOWAS, as analyzed through a gravity model approach. Bonuedi (2013), conducted research on the factors affecting Ghana's trade flows by employing a gravity model approach. The findings indicated that elements such as Ghana's GDP, population, exchange rate, trade freedom policy, and foreign direct investments played a role in influencing these trade flows.

While previous research concentrated solely on cocoa exports, this study integrates both the export of cocoa beans and the import of cocoa products. This study expands beyond these analyses by incorporating macroeconomic determinants of trade performance, including GDP, population size, trade taxes, and economic distance. This research addresses a significant gap by analyzing the influence of GDP, trade taxes, and economic distance on

Ghana's cocoa trade with the US, Europe, and Asia. It is the first study to compare the economic determinants of cocoa trade across these three regions and offers valuable insights for policymakers, exporters, importers, and trade negotiators. This study utilizes the gravity model, a widely recognized method in international trade research, to analyze and forecastGhana's trade interactions with its primary partners. The study aims to examine the impact of key factors such as Gross Domestic Product (GDP), population size, taxes on international trade, and economic distance on Ghana's cocoa trade with its American, European, and Asian trading partners. It seeks to provide insights into how these trade variables affect trade volumes, market accessibility, and economic benefits for Ghana's cocoa sector. The overarching research objective is to contribute to Ghana's trade expansion, competitiveness, and economic development. The study seeks to:

a). GDP growth in Ghana and itsprimary trading partners is positively associated with higher cocoa trade volume in Ghana.

b). Higher international trade taxes imposed by Ghana and its trading partners are negatively associated with the volume of Ghana's cocoa trade.

c). Greater economic distance between Ghana and its trading partners is negatively associated with the volume of Ghana's cocoa trade.

The gravity model of international trade in cocoa and its products is effectively supported by the variables of GDP, population, economic distance, and trade taxes, offering a thorough framework for examining Ghana's cocoa trade. GDP and population indicate market demand, economic distance highlights logistical and cost challenges, and trade taxes reflect policy-related trade barriers. Incorporating these variables ensuresa comprehensive and policy-relevant analysis of the factors influencing Ghana's cocoa trade with its international partners. The findings would support policymakers, cocoa producers, and exporters in developing effective trade strategies, negotiating favorable trade deals, and enhancing Ghana's standing in global cocoa markets. The study is organized into four main parts. The initial segment provides context, outlines the issues, and states the research goals. The second part details the methodological approach. The third section presents the outcomes and findings of the research. The final segment concludes the study and explores its implications for policymaking.

Literature review

A study by Eshetu (2024) examined factors influencing Ethiopian sesame and coffee exports using the gravity model and generalized moments method for 2005-2021. The research found that Ethiopia's FDI, the GDP of Ethiopia, and the GDP of partner nations positively impacted sesame export volume. Conversely, the exchange rate, trade, and Ethiopia's

population negatively affected sesame and coffee export volumes. The study noted a relationship between a weighted distance and Ethiopian sesame export volume. Abafita & Tadesse (2021) investigated global coffee trade determinants using panel data from 2001-2015, focusing on 18 major exporters and 201 trading partners. Using the gravity, OLS, and PPML methods, they identified factors influencing bilateral coffee trade flows, including exporter and importer GDP, distance, shared borders, language, colonial ties, exchange rates, arable land share, tariffs, and the global financial crisis. Azmi et al. (2024) used gravity, POLS, PPML, GLS, and Fixed Effects models to evaluate INSTC's Impact on India's trade with Eurasia. Their findings showed that the GDP of exporting and trading partners, WTO membership, landlocked status, population of both countries, distance, and INSTC affected bilateral trade flows between India and Eurasia. Khayat (2019) analyzed bilateral trade between 6 GCC countries and 8 developed nations using panel data from 2001-2012. The study, using the gravity model with random effects and ordinary least squares estimation, found that GDP per capita, the population of both exporting and importing countries, and distance influenced bilateral trade.

Adelina et al. (2020) explored determinants of Indonesian cocoa exports using panel data from 2009 to 2018 and a gravity model approach. Their research revealed that Indonesia's GDP, distance, world trade, oil, and policy impacted Indonesian cocoa export trade. Agbolosoo et al. (2024) examined factors affecting Indonesian cocoa exports using time series data from 1990 to 2022, applying FMOLS and DOLS estimation approaches. The study found that cocoa yield, production and supply, exchange rates, and world prices influenced cocoa exports. Putri et al. (2023) identified Indonesia's GDP, population of export destination countries, export volume, and economic distance as key factors determining Indonesian cocoa expor growth. Their research used panel t data from 2000 to 2020 and employed the gravity model. Abdullahi et al. (2021) reported on factors influencing Nigerian bilateral cocoa trade flows using the gravity model with Heckman selection, GLS, and PPML estimation. The study found that Nigeria's GDP, of the GDP of importing countries, GDP per capita, exchange rate, membership in WTO, EU, AU, and ECOWAS, as well as border and landlocked status affected trade flows.

Theoretical Foundations of the Gravity Model

The gravity model was originally an empirical observation, but later, several trade theories provided theoretical justification. While the gravity model does not directly emerge from classical trade theories like the Ricardian theory and the Heckscher-Ohlin (H-O) model, there are indirect links between them.

Ricardian Model (comparative advantage)

The Ricardian model of comparative advantage, introduced by

economist David Ricardo in the early 1800s, is a key principle in international trade theory. This concept demonstrates how nations can gain from trade by focusing on producing goods and services in which they have a relative advantage, even if one country is more efficient at producing everything. Comparative advantage exists when a country, such as Ghana, can produce cocoa beans at a lower opportunity cost than its trading partners. This implies that even if Ghana is more productive overall, specializing in cocoa bean production can be more advantageous as it is Ghana's most efficient industry compared with those of Europe and Asia. The model assumes two countries, Ghana and Belgium, engaged in the production of raw cocoa beans and chocolates. Production relies entirely on labor, which is uniform within each country but differs in productivity between them. Markets for cocoa beans, chocolate, and labor are perfectly competitive. These cocoa products can be transported between countries without cost. All available labor is used in producing cocoa beans and chocolate. Both products exhibit constant returns to scale in production, meaning that a doubling of input results in a doubling of output. Labor can move freely between sectors within each country but not between Ghana and Belgium. The Ricardian model shows that if Ghana and Belgium specialize in cocoa-related products based on their comparative advantage, they can trade, and both end up with more cocoa-related products than they would have produced independently. The differing opportunity costs of producing cocoa beans and chocolate in Ghana and Belgium allow for mutually beneficial trade agreements. The Ricardian trade theory emphasizes the benefits of comparative advantage arising from differences in technology and productivity. Ghana's proficiency in cocoa production, relative to other countries, highlights its technological and labor productivity strengths, which contribute to its GDP. In the context of the Ricardian Theory, trade taxes on exports and imports can disrupt the benefits of comparative advantage by raising the costs of exporting goods where Ghana excels, such as cocoa. Increased taxes diminish the motivation to specialize and export. According to Ricardian Theory, greater distances lead to higher transportation and transaction costs, which can undermine the productivity advantages Ghana has in cocoa production, making exports to far-off markets less competitive.

The Heckscher-Ohlin (H-O) Model

The Heckscher-Ohlin model, conceived by Eli Heckscher and Bertil Ohlin, is a crucial theory in international trade that elucidates how nations engage in commerce based on their relative abundance of production factors. This model expands on Ricardo's comparative advantage theory by emphasizing the importance of resources such as labor and capital in shaping trade patterns. The model's core assumptions include a two-factor economy, where countries such as

Ghana possess two production factors: capital and labor, used to produce goods like cocoa beans. It also assumes a two-good economy, with cocoa beans being labor-intensive *(L)* and chocolate being capital-intensive *(K)* .Ghana is labor-abundant relative to Belgium because Ghana is endowed with more units of labor *(L)* per unit of capital *(K)* than Belgium. The assumption says that if the capital-to-labor ratio in Belgium, $\left(K/L\right)^{a}$, is greater than that in Ghana, $\left(K/L\right)^{b}$,then Belgium is capital-abundant relative to Ghana. On the other hand, factor abundance can also be evaluated by factor prices. Assume that w and r represent the wage (price of labor) and the interest rate (the price of capital). The wage *(w)* is lower in a labor-abundant country relative to a capital-abundant country, while the interest rate *(r)* is lower in a capital-abundant country relative to a labor-abundant country. Ghana is labor-abundant relative to Belgium because the wage to interest ratio in Ghana $(w/r)^{b}$, is lower than in Belgium $(w/r)^{a}$. Belgium is capital-abundant due to its higher capital-labor ratio compared to Ghana, which is labor-abundant with a lower capital -labor ratio. Both nations share identical technology and production functions for cocoa beans and chocolate. The model assumes perfect competition, with prices set by supply and demand. Capital and labor can move freely within industries in each country but not between countries. Production exhibits constant returns to scale, with no trade barriers. According to this theory, countries export goods that intensively use their abundant factors and import goods that use their scarce factor. Thus, capital-abundant Belgium should export capital-intensive chocolate to Ghana, while labor-abundant Ghana should export labor-intensive cocoa beans to Belgium. Since Ghana is labor abundant and cocoa beans are labor intensive relative to chocolate, Ghana can produce relatively more cocoa beans than Belgium, while Belgium can produce more chocolate. Consequently, Ghana's production possibilities frontier (PPF) being flatter or skewed more toward the x-axis than Belgium's.

In the context of global trade, the H-O theory emphasizes the importance of factor endowments such as land, labor, and capital in shaping production patterns. Ghana's abundant land and labor resources, primarily used for cocoa cultivation, enhance its GDP and export capabilities. According to the H-O Theory, trade taxes impact factor returns by affecting the profitability of exports. For instance, imposing export taxes on cocoa diminishes farmers' earnings (labor returns) and deters investment in capital-intensive advancements in cocoa farming. The H-O Theory also highlights that economic distance accentuates disparities in factor endowment structures and institutional quality between nations, potentially raising costs associated with compliance, logistics, and coordination. Integrating the Ricardian and Heckscher-Ohlin (H-O) theories with the Gravity Model underscores that the GDP of Ghana (as the exporter)

and its trading partners (as importers) signifies economic size and market demand. Larger GDPs suggest enhanced production and consumption abilities, which lead to higher trade volumes. Consequently, the Ricardian and H-O theories clarify why GDP is crucial in cocoa trade flows, as they represent the essential productive capacities and factor 'endowments that propel trade. When connecting Ricardian and H-O theories to the Gravity Model, trade taxes are included as trade cost variables that adversely affect bilateral trade flows. In the context of Ghana's cocoa trade, increased export taxes diminish export volumes by raising costs and reducing competitiveness, aligning with both Ricardian and H-O perspectives on how policy barriers influence trade patterns. Economic distance encompasses all costs associated with geography, infrastructure, and institutional 'differences that hinder trade flows. Although Ghana benefits from being close to Europe, inadequate infrastructure and regulatory challenges increase the effective economic distance, restricting cocoa exports to America, Europe, and Asia.

METHODS

This research examines trade patterns between Ghana and key partners in Europe and Asia, including Belgium, France, Japan, Malaysia, *Netherlands, Switzerland, and the USA,* using a quantitative approach with a focus on Ghana in West Africa. These nations were chosen due to their significant dependence on the cocoa industry, which is crucial for their GDP and market exchange rates. Data were obtained from United Nations Comtrade databases, World Bank Indicators, and Distance calculator, comprising panel data from 2001 to 2023. The research utilized panel regression analysis as the primary econometric technique, implemented through STATA version 14 software.

The study employed the Random Effects Gravity Model and Poisson Pseudo Maximum Likelihood estimation within panel regression analysis. Incorporating econometric models such as Pooled Ordinary Least Squares (POLS), Generalized Least Squares (GLS), and Poisson Pseudo-Maximum Likelihood (PPML) in trade research helps assess the robustness and validity of estimated relationships under varying assumptions. POLS acts as a foundational model, assuming errors are homoscedastic without autocorrelation. GLS addresses heteroscedasticity and autocorrelation, common in panel or cross-sectional time-series data, providing more efficient estimates when its assumptions hold true. PPML is particularly useful for non-negative count or flow variables, such as trade flows or migration, and when there is heteroskedasticity or zero-inflated data. Although these models have different assumptions, POLS and GLS are linear models estimating the conditional mean of the dependent variable. GLS improves efficiency over POLS when heteroscedasticity or autocorrelation exists. While PPML is nonlinear in estimation, it focuses on the conditional mean, similar to POLS and GLS, rather than conditional

probability. If the conditional mean function is correctly specified, PPML provides consistent coefficient estimates even with heteroscedasticity, where OLS might not succeed. When all three models produce similar coefficient estimates and signs, this strongly indicates model consistency and robust findings.

In gravity model research, Fixed Effects (FE) models are commonly preferred to address unobserved, time-invariant heterogeneity. This research employed the Hausman specification test to compare the Random Effects (RE) and Fixed Effects (FE) estimators. This test assesses whether the unique errors have any correlation with the regressors. The null hypothesis posits that the RE is consistent and efficient, indicating no correlation, while the alternative hypothesis suggests that the RE is inconsistent and inefficient, implying a correlation. As the Hausman test statistics were statistically insignificant, the null hypothesis is not rejected, making RE the preferred choice due to its greater efficiency, hence, this study chooses Random Effects (RE). This lack of significance indicates that the null hypothesis cannot be rejected, making RE a more efficient option. Moreover, RE enables the inclusion of time-invariant variables such as economic distance, which are excluded in FE estimation due to perfect collinearity with country-pair dummies. Since variables like economic distance are essential to this research, their inclusion is critical. In the case of Ghana's cocoa trade, the unobserved variables between country pairs may not be strongly correlated with time-varying factors like GDP and changes in trade taxes.

The study employed the gravity model of international trade, which is a widely used empirical framework that explains trade flows between countries based on their economic size and distance. In 1962, Jan Tinbergen introduced the gravity model, drawing inspiration from Sir Isaac Newton's law of gravity to elucidate the patterns of international trade between two countries. The gravitational law states that the attraction between two objects is proportional to their mass and inversely proportional to the square of the distance between their centers. Similarly, in international trade, the gravity model posits that the trade flow between two countries is proportional to their economic mass (GDP) and inversely related to the distance between them. The basic gravity equation for bilateral cocoa trade between Ghana and its trading partners is given by:

$$Trade_{ij} = \alpha \left(\frac{GDP_i \times GDP_j}{Economic\ distance_{ij}} \right)^{\beta} \times Z_{ij} \times \varepsilon_{ij} \quad \ldots\ldots \quad 1$$

Where $Trade_{ij}$ is defined as the trade flow between country *i* (Ghana) and country *j* (Belgium, France, Japan, Malaysia, Netherlands, Switzerland, and the US), GDP_i denotes Ghana's economic growth while GDP_j denote Ghana's trading partners' economic growth. $Economic\ distance_{ij}$, represents the geographical distance between Ghana *i* and trading partner countries *j*. Z_{ij} denotes taxes on international trade, α and β denote the parameters to be

Table 1. Description of bilateral trade variables used in Gravity Model Analysis

Variable	Description & units of measurement	Source	Expected sign
$Intrade_{ij}$	Trade (exports & imports) between Ghana & trading partners (currency) in natural logarithm form	UN COMTRADE	
$Ingdp_i$	Real GDP of Ghana (Constant 2015 US$) in natural logarithm form	WDI	+
$Ingdp_j$	Real GDP of partners (Constant 2015 US$) in natural logarithm form	WDI	+
$Inpop_i$	Population of Ghana (million) in natural logarithm form	WDI	-
$Inpop_j$	Population of partners (million) in natural logarithm form	WDI	-
$Indist_{ij}$	Economic distance between the capital city of Ghana and partners' capital city (km) of both countries in natural logarithm form	Online Distance calculator	-
$Intax_i$	Taxes (exports and imports) on international trade (% of revenue) in natural logarithm form	WDI	-

Note: For information on Indistij, please visit https://www.distancecalculator.net/

estimated and ε_{ij} denotes the error term in the gravity model equation. The gravity model in bilateral trade posits that trade volume between nations is positively correlated with their economic size and negatively correlated with the geographic distance separating them. This model has been extensively employed by economists to elucidate bilateral trade patterns, demonstrating a robust correlation with interaction metrics between trading partners worldwide. Widely adopted in international trade research, the gravity model incorporates several key variables in this study. These include the natural logarithms of GDP per capita and population for both the source and destination countries, as well as the natural logarithms of the economic distance between them.

The equation is specified by:

$$Intrade_{ij} = \beta_0 + \beta_1 lngdp_i + \beta_2 lngdp_j + \beta_3 lngdp_i + \beta_4 lngdp_j + \beta_5 lnedis_{ij} + \beta_6 lntax_i + \varepsilon_{ij} \ldots\ldots\ldots 2$$

RESULTS AND DISCUSSION

The study provides insights into key economic indicators, such as GDP per capita, trading partners' GDP, population size, economic distance, and taxes on international trade that influenced Ghana's trade patterns from 2001 to 2023. Table 2 provides descriptive results of the trade variables employed in the econometric analysis.

Table 2 reveals that between 2001 and 2023, Ghana's total cocoa export and import transactions amounted to $20.54, as per the analysis. Ghana's GDP per capita averaged $24.39, reflecting the country's economic performance and standard of living. The mean GDP of Ghana's trading partners was slightly

Table 2. Descriptive statistics of Ghana's cocoa trade with trading partners

Variable	Obs	Mean	Standard Dev.	Minimum	Maximum
lntrade	154	20.54	1.40	16.45	23.45
$lngdp_i$	154	24.39	0.39	23.76	24.98
$lngdp_j$	154	27.96	1.38	25.73	30.72
$lnpop_i$	154	17.09	0.16	16.82	17.34
$lnpop_j$	154	17.45	1.25	15.79	19.63
$lnedis_{ij}$	154	10.15	0.80	9.21	11.64
$lntax_i$	154	2.71	0.33	2.29	3.55

Source: Primary Data Processed (2025)

higher at $27.96, potentially indicating greater demand for premium cocoa products. The nation's average population of 17.09 million was just below its trading partners' average of 17.45 million. Population figures influence the cocoa production workforce, local consumption, and trade demand. An average economic distance of 10.15 km suggests varied economic landscapes among Ghana's trade partners, affecting trade efficiency. The mean tax rate on international trade was 2.71%, implying substantial levies that could impede cocoa exports and diminish Ghana's competitiveness in global markets.

Pearson Correlation Matrix

Table 3 presents the Pearson correlation matrix of the Gravity model, indicating the relationships between Ghana's cocoa trade with the major partners in the US, Europe, and Asia using total trade, Ghana's GDP, trading partners' GDP, Ghana's population and that of trading partners, 'economic distance from the capital city of Ghana to trading partners' cities, and international tax on exports. The results reveal varying degrees of positive and negative correlations between these variables.

The study's results in Table 3 indicate a robust link between Ghana's economic output and population with its two-way cocoa commerce. This connection implies that Ghana's cocoa trade capacity improves as its economy expands. Increased GDP allows for more investment in cocoa cultivation, infrastructure, and processing facilities, boosting production and exports. The

Table 3. Pearson correlation matrix for Ghana's cocoa trade with trading partners

	lntrade	$lngdp_i$	$lngdp_j$	$lnpop_i$	$lnpop_j$	lnedis	$lntax_i$
lntrade	1.00						
$lngdp_i$	0.81	1.00					
$lngdp_j$	0.20	0.09	1.00				
$lnpop_i$	0.81	0.29	0.09	1.00			
$lnpop_j$	0.06	0.04	0.88	0.04	1.00		
$lnedis_{ij}$	-0.14	-0.15	0.79	-0.15	0.91	1.00	
$lntax_i$	-0.72	-0.80	-0.07	-0.80	-0.02	0.13	1.00

Source: Primary Data Processed (2025)

expanding population provides the necessary workforce for labor-intensive cocoa farming, ensuring consistent output. Trading partners' GDP and population size show a mild positive association with Ghana's cocoa trade. Nations with large populations tend to import processed cocoa goods rather than raw beans, reducingdirect trade volume. Economic distance shows a slight negative correlation with Ghana's cocoa trade, suggesting that while economic disparities create challenges, they do not completely hinder cocoa trade. In contrast, international trade taxes exhibit a strong negative correlation with Ghana's cocoa trade, indicating that higher trade taxes considerably reduce cocoa exports. These discoveries underscore crucial economic connections and trade dynamics between Ghana and its commercial partners.

Diagnostic test results

The results employ the Breusch and Pagan multiplier test, the modified Wald test for heteroscedasticity, and the Wooldridge test for autocor-relation in panel data where the test results are presented well in Table 4. The results in Table 4 show the Breusch and Pagan Lagrangian multiplier test for random effects yields a statistical value of 32.06 with a p-value of 0.0000. This p-value, below 0.05, suggests a random effect in the data. We reject the null hypothesis and determine that a random effects model is appropriate.

The modified Wald test for group -wise heteroskedasticity in the fixed regression model produces a statistical value of 58.93 with a p-value of 0.000, which is below 0.05. We reject the null hypothesis and conclude there is significant evidence of heteroskedasticity. The Wooldridge test for autocorrelation in panel data generates a statistical value of 1.198 and a p-value of 0.2861. As this p-value exceeds 0.05, we accept the null hypothesis and infer no substantial evidence of autocorrelation in the model.

Gravity results

Table 5 presents the gravity model estimates for cocoa bilateral trade using three distinct methods: Panel Ordinary Least Squares (POLS), Random-effects Generalized Least Squares (GLS), and Poisson pseudo-maximum likelihood estimation (PPML). The coefficients' signs are consistent with expectations and reach statistical significance at conventional levels. The POLS and PPML methods demonstrate

Table 4. Diagnostics test results on Ghana's bilateral cocoa trade with trading partners

Tests	Statistics	p-value
Breusch and Pagan Multiplier test for random effects	32.06	0.0000
Modified Wald test for group-wise heteroskedasticity in fixed effects regression model	58.93	0.0000
Wooldridge test for autocorrelation in panel data	1.198	0.2861

Source: Data processed (2024)

Table 5. Estimated Gravity results for Ghana's cocoa trade with trading partners

	POLS		GLS		PPML	
Variable	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
$lngdp_i$	3.192*	1.696	3.282	2.967	0.158**	0.069
$lngdp_j$	0.446***	0.091	0.450***	0.077	0.022***	0.005
$lnpop_i$	-2.895	4.273	-2.180	7.471	-0.150	0.179
$lnpop_j$	-0.056	0.153	-0.066	0.129	-0.003	0.008
lnedis	-0.577***	0.199	-0.570***	0.167	-0.028***	0.009
$lntax_i$	-0.826***	0.304	-0.263	0.377	-0.043***	0.015
Constant	-11.256	32.972	-27.205	56.745	1.566	1.437
Observations	154		154		154	
p>chi2	0.000					
R.sq	0.734		0.728		0.731	
Wald chi2	67.66***		166.55***			
Log-likelihood						
Log pseudo likelihood					-376.66	
Breusch & Pagan LM Test	32.06***					

Source: Author's computation (2025). Note: *, **, and *** are significant at 10%, 5% and 1% significance level.

greater significance compared to the GLS model, highlighting the PPML approach's robustness and enhanced statistical validity in exploring the relationship between Ghana's cocoa trade with Belgium, France, Japan, Malaysia, Netherlands, Switzerland, and the US. According to the findings presented in Table 5, Ghana's real GDP has a positive impact on cocoa trade, with statistical significance observed at the 10% level for the POLS method and at the 5% level for the PPML method. A 1% rise in Ghana's real GDP correlates with an increase in cocoa trade of 3.192% under POLS and 0.158% under PML, assuming other factors remain constant. The results suggest that an increase in Ghana's real GDP signifies higher production for domestic use and export, diversifies exports, expands the range of cocoa products for international markets, and enhances global competitiveness. As Ghana's real GDP expands, the country witnesses' improvements in infrastructure, technology, and institutional capacity, enhancing its competitiveness in the global cocoa market. This progress is bolstered by Ghana's competitive edge in cocoa exports, along with its capacity to uphold superior quality standards and effective traceability systems. A similar finding by (Abasimi & Salim, 2022; Nisa et al., 2023; Ravi Kumar et al., 2024) reported that the GDP of exporting countries positively and significantly increases bilateral trade.

Conversely, a positive and significant effect of importing countries' real GDP on cocoa bilateral trade, observed at a 1% significance level across all models, suggests a strong relationship between economic

growth and trade demand. A 1% increase in partner countries' real GDP results in an increase in bilateral cocoa trade by 0.446%, 0.450%, and 0.022%. This is attributed to the increased demand and consumption of cocoa products as trading partners' real GDP grows. The increase in real GDP of importing nations enhances their economic capacity and buying power, resulting in heightened demand for cocoa and its derivatives. The findings confirm the research outcomes of (Abasimi & Salim, 2022; Benlaria, 2024) that the GDP of importing countries significantly increased the cocoa trade.

The significant negative impact of economic distance on cocoa trade between Ghana and its partners, observed at the 1% significance level across all models, underscores the importance of transportation expenses, logistics, and market access in global commerce. For every unit increase in economic distance, cocoa trade decreases by 0.577%, 0.570%, and 0.028%, ceteris paribus. As the gap between Ghana and its trading partners widens, expenses for transporting cocoa products increase, reducing bilateral trade. As economic distance grows, shipping costs, freight charges, insurance, and handling expenses increase, making cocoa imports less competitive for distant partners. Economically distant countries may exhibit lower trade elasticity, with demand for Ghanaian cocoa decreasing more when costs rise. The research results are consistent with the findings of other researchers (Adelina et al., 2020; Azmi et al., 2024; Khmeleva et al., 2025) that economic distance reduces bilateral trade between exporting and importing countries.

The detrimental effect of international trade taxes on cocoa trade, demonstrated at a 1% significance level for both POLS and PPML estimators, indicates a robust correlation between taxation and decreased trade. A 1% rise in the international trade tax reduces cocoa trade by 0.826 % and 0.043%, with all other factors remaining constant. This suggests that international trade taxes increase the price of Ghanaian cocoa, diminishing its competitiveness against cocoa from other major producers like Cote d'Ivoire, Nigeria, and Indonesia. Consequently, importers may opt for more affordable cocoa sources, reducing demand for Ghana's cocoa exports.

CONCLUSION AND SUGGESTION

The study revealed that both Ghana's GDP and the economies of its trading partners positively affected Ghana's cocoa trade, while economic distance and international taxes had a notably negative impact on its global cocoa trade. This research concludes that Ghana's cocoa trade in American, European, and Asian markets is significantly influenced by Ghana's GDP, the economic conditions of its trading partners, international trade tariffs, and economic distance.

Based on the empirical evidence, several policy measures are recommended to enhance Ghana's cocoa trade performance. Ghana should continue to pursue strategies

that foster real GDP growth by investing in cocoa bean production, cocoa product manufacturing, and the transformation of cocoa beans into finished products. Emphasis should be placed on modernizing the cocoa value chain through technological innovations, improved productivity, and the enhancement of rural infrastructure. Encouraging the diversification of cocoa exports to include semi-processed and value-added products, alongside raw beans, is crucial. This strategy not only increases export revenues but also reduces the risk associated with price volatility in primary commodity markets. Strengthening trade ties with rapidly expanding and wealthy nations, particularly in Europe, Asia, and America, is vital. Trade diplomacy and strategies to access target markets should be utilized to tap into rising consumer demand. Investments in efficient port facilities, inland transportation networks, and digital logistics are essential to lower export costs. Regional cooperation through ECOWAS and the African Continental Free Trade Area (AfCFTA) can also help reduce effective economic distance by harmonizing standards and facilitating trade. It is important to reassess international trade tax structures to minimize their impact on exporters by negotiating for lower tariffs in destination markets, streamlining customs procedures, and providing fiscal incentives to cocoa exporters to enhance global price competitiveness. Ghana should capitalize on its comparative advantage in maintaining high-quality cocoa through traceability systems and certification programs. Strengthening quality assurance allows Ghana to secure premium prices and maintain its reputation in international markets.

Study limitations and future studies

This study is limited to examining the influence of GDP, trade tax, and economic distance on Ghana's cocoa trade with partners. Factors such as informal trade, smuggling, and underreported figures, which could skew cocoa export values, were not considered. The study measured economic distance using the distance between capitals, while ignoring cultural differences, institutional variations, or logistical costs. This measure may not capture complex trade barriers or facilitators. The gravity model assumes similar baseline relationships across partners and may overlook factors such as trade agreements, cocoa price fluctuations, or non-tariff barriers, potentially causing omitted variable bias. The study considered formal trade tax as an export tariff and did not address informal barriers like corruption, logistics delays, and infrastructure quality. It excluded factors such as foreign exchange, political stability, shared borders, language, technology, and trade agreements.

Future studies will measure economic distance, including institutional, linguistic, cultural, and political distances with geographic proximity. The study will examine how economic distance interacts with digital infrastructure affecting trade flows. Advanced

econometric methods like extended gravity model, structural gravity model, stochastic gravity model, and panel autoregressive model will analyze causality and dynamic relationships. The study will assess the effects of trade agreements and policy changes on trade taxes and barriers between Ghana and partners. The research will explore interactions between Ghana's policies and external factors. Qualitative methods will complement quantitative findings, providing insights into how economic distance and trade barriers are perceived. The study will consider foreign exchange, political stability, borders, language, technology, trade agreements, smuggling, corruption, logistics, cultural differences, institutional variations, and infrastructure quality.

Author contributions

Conceptualization, JAA; methodology, JAA software JAA; validation JAA and FS; formal analysis, and investigation JAA and FS; resources JAA, data curation, JAA, writing; JAA and FS, writing-reviewing and editing, JAA, FS, and TN, visualization; JAA and FS, supervision, TN. All authors have read and agreed to publish the manuscript.

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The dataset generated during the research is available upon request.

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The authors declare that they have no conflict of interest.

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