Macroeconomic Determinants of Air Cargo Flows in Ghana

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Abstract

Air cargo flows in a country represent air trade volume involving the exchange of goods between countries, and it is significant to the economic development of nations. However, the instability of macroeconomic variables makes air cargo trade fluctuate with its decision-making challenges. This paper examines air cargo flows by volume, origin, destination, and Ghana's macroeconomic determinants of air trade. The study collected categorized cargo volume data from Ghana Airport Company Ltd and macroeconomic data from the Bank of Ghana from 1991 to 2020. The study employed descriptive, correlation and regression to analyze data. ArcGIS mapping shows that European countries form the primary origins and destinations of cargo traffic in Ghana. The regression analysis found exchange rate (r = 0.43) and

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interest rate (r = 0.50) as the significant macroeconomic variables influencing air cargo trade in Ghana. This study highlights the need for policy decisions that promote an extensive bilateral exchange and lower interest rates for local production and export goods by air in Ghana.

Keywords: Air Cargo Trade – Exchange Rate – Interest Rate – Cargo Origin and Destination.

Resumen

Los flujos de carga aérea en un país representan el volumen de comercio aéreo que involucra el intercambio de bienes entre países, y es importante para el desarrollo económico de las naciones. Sin embargo, la inestabilidad de las variables macroeconómicas hace que el comercio de carga aérea fluctúe con sus desafíos en la toma de decisiones. Este documento examina los flujos de carga aérea por volumen, origen, destino y los determinantes macroeconómicos del comercio aéreo de Ghana. El estudio recopiló datos de volumen de carga categorizados de Ghana Airport Company Ltd y datos macroeconómicos del Banco de Ghana desde 1991 hasta 2020. El estudio empleó datos descriptivos, de correlación y de regresión para el análisis. El mapeo de ArcGIS muestra que los países europeos forman los principales orígenes y destinos del tráfico de carga en Ghana. El análisis de regresión encontró que el tipo de cambio (r = 0,43) y la tasa de interés (r = 0,50) son las variables macroeconómicas significativas que influyen en el comercio de carga aérea en Ghana. Este estudio destaca la necesidad de decisiones políticas que promuevan un amplio intercambio bilateral y tasas de interés más bajas para la producción local y los bienes de exportación por vía aérea en Ghana.

Palabras claves: Comercio de Carga Aérea – Tipo de cambio – Tasa de interés – Origen y destino de la carga.

Introduction

Air transportation is not only important and reliable, but also the fastest mode of transport between and within countries of the world. The expansion of air transport operations across the globe is a significant contributor to the increasing rate of urbanization and better income distribution (Airbus, 2011; 2014). The growth in the air cargo industry has been dramatic in recent years, which can be explained by several reasons including increasing global production of high-value goods, just-in-time manufacturing, improved inventory management, increasing dedicated air cargo airlines, and e-commerce (Yuan, Low and Tang 2010; Airbus 2021). The effect of globalization and improved supply chain systems have also been responsible for the growth of the air cargo industry (Wong, Chung and Hsu, 2016). Also, since the 1970s, the growing markets' rate of consumption has been responsible for the substantial increase in the carriage of goods by air (Brorsson, 2016). The production and distribution of goods to various geographical locations worldwide give prominence to transportation. Connecting different world locations is a significant factor in increasing air cargo traffic worldwide. Also, economic development and globalization influence the extent of a country's air cargo operations (Chen et al., 2020). Damian (2021) affirmed that the current global supply chain crisis is a significant driver of air cargo demand worldwide. As IATA (2021) stated, the worldwide cargo tonne-kilometers (CTKs) grew at 9.1% in September 2021 compared to the same month pre-COVID-19, whereas CTKs grew at 7.5% in August 2021.

It has been theoretically established that the economy drives growth in air transportation. Notwithstanding, Chingosho (2014) stated that air cargo service is a tremendous enabler of economic development. ICAO (2015) also noted that air cargo transport enables nations through efficient connections for global supply

chains. Furthermore, literature has established that, like other economic sectors, the cargo industry is also a key facilitator of economic growth. For example, Hao et al. (2020) found that air cargo networks significantly promote GDP per capita in Eastern China. Also, Button and Yuan (2013) found that air freight transport positively impacts local economic development in the USA. The benefits of air cargo transport are enormous to the economic development of nations. They include employment creation, revenue generation, regional and global trade promotion, and access to international markets with the attraction of foreign investments (Yuan, Low and Tang 2010; Chingosho, 2014). The air cargo sector of the aviation industry promotes an efficient global supply chain (Yuan, Low and Tang, 2010; Hull, 2021) which contributes to the economic growth of nations through competitive trade and production (Kasarda and Green, 2005; Hull, 2021). Laird and Johnson (2021) stated that governments and organizations' provision of transport infrastructure is key to achieve economic growth, implying that transport operations with specific reference to air cargo can promote economic growth.

Previous econometric studies have examined the influence of various macroeconomic variables such as GDP, population, or distance, on air cargo demand (Hwang and Shiao 2011; Alexander and Merkert 2021). Hwang and Shiao (2011) concluded that a country's air cargo flows are influenced by the supply of air service and international trade factors. The global trade factors reflect what affects a country's trade volume. Furthermore, various economic, social, demographic, and operational factors affect the air cargo industry.

Alexander and Merkert (2021) stated that the relationships between a trade-driven economy and air cargo have been well established in air transport studies. It shows the importance of air trade represented by air cargo volume as influenced by ma-

croeconomic variables. Chinorackya, Kurotova, and Janoskov (2021) examined the connection between macroeconomic variables and the transport industry concerning the consequences of technologies on businesses in Slovakia. While different studies were reviewed on the relationship between air cargo and macroeconomic variables for various countries, a dearth of empirical research on air cargo and macroeconomic variables in Ghana id identified. Hence, the need to fill this knowledge gap about Ghana's air cargo trade determinants motivates this study. From here, it could be address the relationship between macroeconomic fluctuations and air cargo trade in Ghana.

As earlier established from literature, macroeconomic variables of nations characterized by fluctuations influence the cargo trade. At the same time, the changes in cargo volumes affect the macroeconomic variables of nations. The persistent nature of this situation makes decisions about air trade policy complicated. It also affects the volume of cargo by origin and destination in a country. To this end, this paper aims to examine Ghana's air cargo traffic by origin and destination to show the movement of goods between Ghana and other countries and identify the macroeconomic variable(s) that significantly influence air cargo volume in Ghana. The temporal scope of the study is 30 years, from 1991 to 2020. The study focuses on Kotoka International airport (KIA), Accra, the only airport with cargo operations in Ghana. This is because the airport is located in Accra, the capital city of Ghana, where major economic activities are concentrated.

After this introduction, the paper is structured as follows. The literature review is contained in the second section. Then, the third section presents the methodology used for the study. The fourth section analyze and discuss the results of the empirical estimations, while the fifth section handles the policy implications and conclusion.

Literature review

Analysis of cargo operations at airports

The literature about air cargo transshipment and operations, its economic relevance, and its determinants in different countries worldwide is extensive. Gong et al. (2018) identified the critical drivers for China's international trade delivered by air, and found the economy's composition to be a more important driver than the size of the economy. Lakew and Tok (2014) examined the determinants of air cargo traffic to estimate the socioeconomic determinants of air cargo volumes at airports in California, US. The study showed that manufacturing and government-related employment substantially impact outbound air cargo traffic. Merkert, Van de Voorde and Wit (2017) discussed the evolution of the air freight market by describing the heterogeneous environment in which air cargo services were performed. As a result, their research looked at the most notable global trend in air freight, focusing on the market structure and possible future strategies. Merkert and Alexander (2021) applied a gravity model to examine air trade markets in the US. They found that transport costs, modal competition, consumer spending, and cargo types also determine air cargo trade in the US.

Larrodé, Muerza and Villagrasa (2018) modelled air cargo growth factors at Zaragoza airport, Spain, with an Analytical Hierarchical Process (AHP) to examine the capacity of the airport to attract cargo and cargo airlines in a competitive market. Chao and Yu (2013) evaluated issues about air cargo competitiveness in Asian-Pacific airports. Wong, Chung, and Hsu (2016) further examined cargo market competition at the major airports in the Asia Pacific. The study conducted by Suwanwong et al. (2018) at Suvarnabhumi airport examined the connectivity of airports in Thailand using a NetCargo model to analyze the deficiency

of airports and airlines' performance. Hwang and Shiao (2011) applied a gravity model to the case of Taiwan, to analyze air cargo flows from 2004 to 2007 by examining the origination and destinations of cargo at Taiwan Taoyuan International airport.

For purposes of this study, macroeconomic variables can be defined as those factors that are both under and beyond government control and require proper coordination to sustain the economy. The factors determine the events that change the economic output, which requires fiscal policies to maintain financial stability. The changes in macroeconomic variables affect the sectoral growth of the economy. The imbalance and uncertainty in the changes in macroeconomic variables affect the air cargo trade of countries (Ederer and Reschenhofer 2018). Researchers have examined the relationship between air cargo and some macroeconomic variables in different countries outside Ghana. For example, Laird and Johnson (2021) used a macroeconomic approach to examine the effect of GDP on air transport investment. Also, Boeing (2008) found out that GDP was the main determinant of air cargo growth. Other researchers include foreign direct investment (FDI) in their analysis of the relationship between macroeconomic variables and trade. It was found that as FDI stimulates exports (Yao & Wei, 2007), it becomes a significant variable in analyzing the air cargo market (Graham, 2006), and that GDP, exports and FDI have a causal relationship (Frank & Chu, 2006). Kalayci and Yanginlar (2016), for the case of Turkey, found a long-term relationship between GDP, FDI and air transportation. Recently, Adedoyin and Balsalobre-Lorente (2020) included FDI to examine the effects of air transportation on economic growth in the US. Furthermore, Kiboi, Katuse and Mosoti (2017) employed interest rates to examine air cargo trade. Another macroeconomic variable that the literature has identified as a significant determinant of freight flow is the exchange rate (Chi, 2016). Similarly, Alici and Akar (2020) used as macroeco-

nomic determinants inflation rate, GDP, imports and exports to examine it relationship with air cargo demand, and found that inflation rates negatively affect air cargo trade. The use of exports and imports in the model implies trade balance.

The literature review has shown that different issues about air cargo operations at airports in several countries have been addressed by previous researches. However, this review shows that there is a gap referring to air cargo operations at airports in Ghana. It implies that researchers in Ghana are overlooking issues confronting air cargo supply in the country. The literature's neglect of Ghana's air cargo traffic motivates this study, by highlighting the origin and destination of air cargo in Ghana. Furthermore, the literature indicated that macroeconomic variables affect air cargo volume. Macroeconomic variables such as GDP, FDI, interest rate, exchange rate, trade balance, and inflation have been employed by researchers to analyze air cargo trade in different countries. The fact that the studies reviewed in this paper were carried out outside Ghana suggests that issues with Ghana's air cargo trade are yet to be a concern to researchers. Also, the analyzed problems about air cargo trade in other countries might not produce the same results for Ghana because of differences in the market environment, government policies, and regulations. To this end, this study attempts to fill the literature gap by using macroeconomic variables such as GDP, FDI, trade balance, interest rate, exchange rate, and inflation rate in a regression model to study their impact on Ghana's air cargo. Hence, the need to explore these macroeconomic determinants of air cargo transportation in Ghana motivates this paper. It is expected that the output of this research on the origin and destination of Ghana's air cargo flow and its macroeconomic determinants will guide policy formulation to promote the growth of cargo operations at airports in Ghana.

Methodology

In order to answer the paper's research questions, this study employed a quantitative research design to collect and analyze data. The study collected data from the Bank of Ghana (BOG) and Ghana Airport Company Limited (GACL). Specifically, macroeconomic variables collected from BOG were Gross Domestic Product (GDP), foreign direct investment (FDI), trade balance, inflation, exchange rate, and interest rates from 1991 to 2020. The overall cargo volume at Accra airport from 1991 to 2020 was collected from GACL. Also, data showing the origin and destination of cargo in Ghana were collected from GACL for 2016. The origin and destination data were limited to 2016 because it is the only year under review with available disaggregated data.

The data collected were analyzed using descriptive analysis involving line graph and GIS mapping, inferential statistics involving correlation and regression analysis. The descriptive analysis involving GIS mapping was used to analyze the origin and destination of cargo by volume at the airport. The line graph presents the trend of Ghana's overall air cargo volume. At the same time, correlation and regression analyses were used to establish the relationship between the variables and identify the significant variables that influence air cargo trade in Ghana. The regression analysis demonstrates the extent of relationships between cargo volume and GDP, FDI, trade balance, inflation rate, exchange rates, and interest rates of Ghana.

The general regression model for the study takes the form of;

$$Y = \beta o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + e \quad (1)$$

where,

Y = Dependent variable
βo = Constant Term
$\beta_1 - \beta_6$ = Coefficients of X_1 - X_6
$X_1 - X_6$ = Independent variables and;
e = Error term, which is assumed to have a normal distribution with the variance.

Specifically for this study, the model takes the form;

$$CRG = \beta o + \beta_1(GDP) + \beta_2(FDI) + \beta_3(TBA) + \beta_4(INF) + \beta_5(EXC) + \beta_6(INT) + e \quad (2)$$

where;

CRG = Cargo Volume;
GDP = Real Gross Domestic Product;
FDI = Foreign Direct Investment;
TBA = Trade Balance;
INF = Inflation rates;
INT = Interest rates;
EXC = Exchange rates; and
e = Error term

The variables in this study are defined as follows in Table 1.

Table 1: Description of variables for the study

Variables	Definition	Unit of Measurement	Justification
Air cargo volume	The total volume of cargo types transported in and out of Ghana	TonKm	Cargoes are transported by their weights over a distance from the origin to the destination.
Gross Domestic Product (GDP)	The monetary measure of the market value of all goods and services produced in a country at a given period	Million USD	Figures have been adjusted by price as at 2010

Foreign Direct Investment	An investment in the form of a controlling ownership in a business in one country by an entity based in another country	Million USD	Ownership of business promotes production activities and enhances the transportation of goods.
Trade balance	The difference between the export and import value of a country	Million Ghana Cedi	The monetary value of export and import goods
Exchange rate	The price of one currency for conversion to another currency	Nominal exchange rate in USD/GhCedi	The measure of a currency value against another with price comparison of goods.
Inflation rate	The rate at which prices increase over time, resulting in a fall in the purchasing value of money	Consumer Price Index (CPI) measured in Percentage	Ghana Statistical Services and BOG provide CPI data to calculate inflation
Interest rate	The proportion of a loan charged as interest to borrowers is expressed in percentage.	Commercial Bank Rates measured in Percentage.	Lower interest rate from commercial banks encourages investment drive in a country.

Source: authors' elaboration.

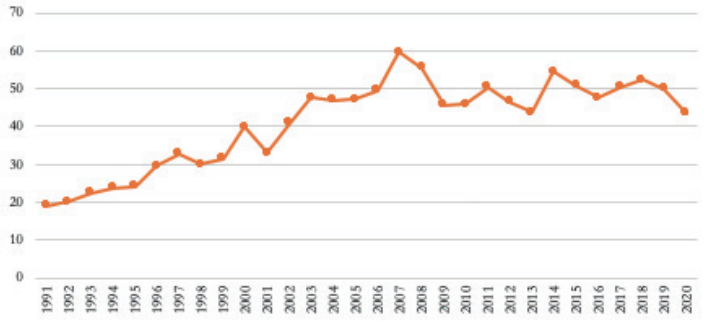
Results and Discussion

Overall trend of cargo traffic at Accra airport, Ghana

The level of air cargo operations at any airport may reflect the extent of trade and partnerships of a country. It may also

reflect the level of social and economic interactions of a country with other countries. It highlights the importance of air transportation in nations' social and economic development because it facilitates the exchange of goods and services between countries due to trade and interactions. It infers that air cargo volume is influenced by the country's trade and exchange activities. Therefore, Figure 1 presents the flow of air cargo traffic in Ghana from 1991 to 2020. The figure shows that air cargo traffic at Accra airport increased from 1.9 million Ton-Km in 1991 to 43.43 million Ton-Km in 2020.

Figure 1. Trend of cargo volume at Accra airport (million Ton-Km), Ghana 1991 – 2020.



Source: GACL Cargo Data, 2020.

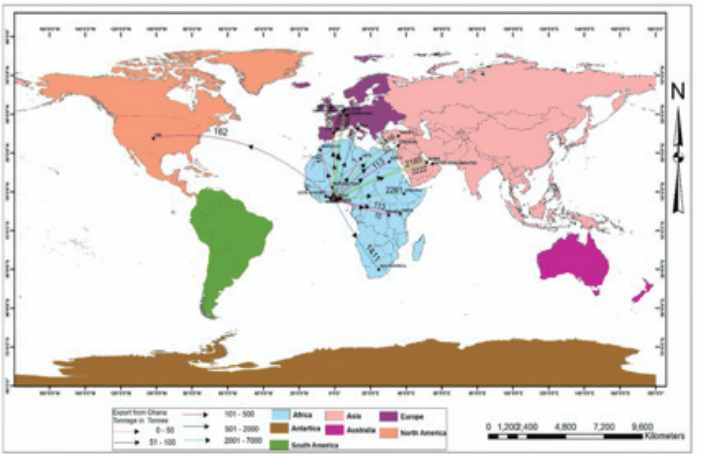
An observation of the Accra airport cargo volume trend, as presented in Figure 1, shows a gradual growth in the volume of cargo traffic until 1997. After that, the trend shows a fluctuating pattern till 2020. It is important to note that the highest volume of cargo traffic at the airport was recorded in 2007, accounting for 59.51 million Ton-Km. This may perhaps be a result of some economic factors resulting from government policies and changes in macroeconomic variables. Specifically, increasing population,

per capita income and migration in Ghana are responsible for the trend in cargo volume over the years.

Origin and destination of cargo transportation at Accra airport, Ghana

The various air cargo types that flow in and out of Ghana are from other countries worldwide. The flow of air cargo in Ghana indicates the spread of the countries with which Ghana has sustained trade relationships. Figure 2 presents the destination of air cargo traffic from Ghana in 2016 with 28.20 Mn Ton. Figure 2 was developed using Flow Analysis in Arc GIS to give the destinations of air cargo from Ghana.

Figure 2: Spatial flow of air cargo from Ghana to other countries of the world. 2016



Source: Arc GIS Mapping using GACL data, 2020.

Figure 2 illustrates that air cargo traffic from Ghana was destined to 26 different world locations. Cargolux, a dedicated

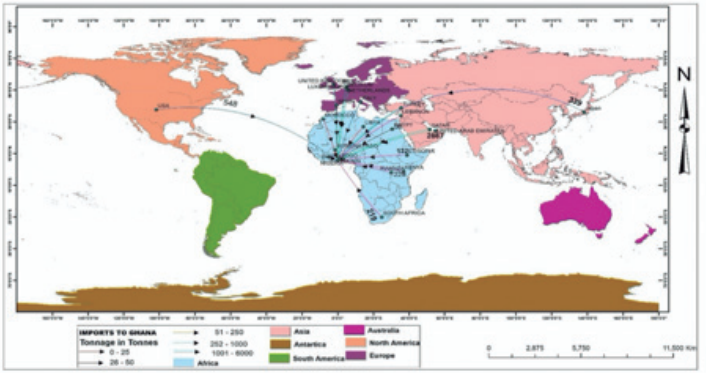
cargo airline from Luxembourg, dominates outflow cargo traffic. The first 10 locations of air cargo destinations from Ghana, as presented in Figure 2, show that 24.5% of total outflow cargo was destined for Luxembourg. The second country that receives the highest cargo volume from Ghana is Turkey, with 19.2% of the total volume, while the third is the UK, with 10.45% of the total cargo volume. It was followed by Ethiopia (8.02%), UAE (7.88%), Qatar (7.75%), the Netherlands (7.73%), Belgium (6.04%), and South Africa (5%). A significant observation from Figure 2 is that European and Asian countries dominate the destination of air cargo flow from Ghana.

Figure 2 also shows no air cargo flow from Ghana to any countries in South America and Oceania. However, it can be highlighted that the US is the only country in the American continent with flows from Ghana. At the same time, only Asian countries close to the African continent were the ones that received cargo from Ghana. It implies the importance of distance as a determinant of trade relationships between countries and possible familiarity with Ghana and its products (particularly food). Overall, Figure 2 indicates the level of air trade and interaction between Ghana and other countries.

The origin of air cargo flow to Ghana, as presented in Figure 3, shows a similar pattern to that of the outflow cargo. Every airport has inflow and outflow cargo traffic without commensurate volume and frequency. The origin of cargo traffic to Ghana, as presented in Figure 3, shows the respective countries with the volume of cargo transported by air. The total cargo traffic carried into the country in 2016 was 22.10 Mn Ton. The origin of air cargo to Ghana has the UK with 24.55%, followed by the Netherlands (15.94%), while the UAE (13.06%) ranked third in Ghana's total inflow air cargo volume. The fourth, fifth, and

sixth origins of air cargo to Ghana is Qatar (12.71%), Turkey (7.91%), and Luxembourg (7.25%), respectively.

Figure 3: Spatial flow of air cargo to Ghana from other countries of the world. 2016



Source: ArcGIS Mapping using GACL data, 2020.

Furthermore, Belgium (3.91%), other West African countries (3.24%), the USA (2.48%), and Italy (2.15%) ranked seventh, eighth, ninth, and tenth origins of air cargo to Ghana, respectively. Similar to destination patterns, European and Asian countries also dominate the origins of cargo flow to Ghana. Uniquely, there is a record of air cargo flow from Japan to Ghana. It depicts Ghana's social and economic interaction with the United Kingdom, perhaps due to a long-time relationship between colonial rule and the population of Ghanaians living in European country.

Relationships between air cargo and macroeconomic variables in Ghana

The study further analyzed the data to examine the relationships between air cargo volumes and the macroeconomic variables of Ghana using correlation and regression analysis. The

descriptive statistics of the data concerning air cargo volume and the selected macroeconomic variables are presented in Table 2.

Table 2: Descriptive statistics of Ghana's macroeconomic variables. 1991-2020.

Variables	Mean	Std. Deviation	Min	Max	N
Cargo Volume	41.14333	11.52917	19.1	59.51	30
GDP	24.33823	20.46795	4.983	67.01	30
FDI	1308.992	1332.942	58.9	3356.99	30
Trade Balance	-1486.572	1698.941	-4464.62	2507.6	30
Inflation Rate	19.13333	11.54814	8.7	58.5	30
Exchange Rate	1.61179	1.733085	.0369	5.6119	30
Interest Rate	26.5176	10.20275	9.9	47.89	30

Source: Authors' computation, 2022.

By nature, macroeconomic variables depend on one another. These relationships have varying degrees of implications for the economic development of Ghana. The pairwise correlation matrix (Table 3) of the variables under investigation reveals their relationships. It is observed that the correlation between the variables shows both positive and negative associations. This implies that any effect on one factor will produce a corresponding measure of impact on the other in the direction of the sign, either positive or negative.

Significant relationships exist between all variables pairs. The relationship between cargo volume and GDP with r = 0.6262,

indicates that Ghana's GDP significantly influences cargo volume. High GDP will enhance the increasing cargo flow with export and import of cargo by air. Conversely, a high rate of cargo traffic in any country will translate into an economic boost that will contribute to the growth of the nation's GDP. The significant relationship between cargo volume and foreign direct investment (r = 0.6462) indicates a positive effect of increasing FDI on cargo traffic. Ghana air cargo volume has a significant negative relationship with the inflation rate (r = -0.4970), implying that the inflation rate will decrease as cargo volume increases and vice versa. It is practical because Ghana's air cargo export outweighs import volume. The relationship between Ghana air cargo volume and exchange rates is significant with r = 0.5782, such that higher export volume strengthens the value of the local currency. The interest rate also has a negative relationship of r = -0.6384 with the air cargo volume of Ghana. It implies that higher interest rates on loans for businesses will lead to a decrease in air cargo volume since the majority of the companies (who are importers and exporters) will be reluctant to acquire bank loans for their businesses.

Table 3: Pairwise correlation of air cargo and macroeconomic variables in Ghana

	CRG	GDP	FDI	TBA	INF	EXC	INT
CRG	1.000						
GDP	0.6262*	1.0000					
FDI	0.6462*	0.8891*	1.0000				
TBA	-0.1612	0.2321	-0.0910	1.0000			
INF	-0.4970*	-0.5515*	-0.5274*	0.0752	1.0000		
EXC	0.5782*	0.9233*	0.7485*	0.4531*	-0.4433*	1.0000	
INT	-0.6384*	-0.4387*	-0.4629*	0.3693*	0.7319*	-0.2819	1.0000

**Significant at 5%*

Source: Authors' Computation, 2022.

The GDP's negative relationships (r = -0.5515 and -0.4387) with inflation and interest rates, respectively, indicate that increasing inflation and interest rates in a country will reduce its economic growth. The positive relationship between GDP and FDI (r = 0.8891) implies that growth in foreign direct investment significantly contributes to economic growth in Ghana. With GDP, rising interest rates (r = -0.4387) will contribute negatively to GDP growth. The rate of the Ghana Cedi exchange to a major currency like the US Dollar will have a significant effect on trade volumes. This accounts for an r = 0.4531 between trade balance and exchange rate. The negative relationship between exchange rate and inflation (r = -0.4433) also implies a growing weakening of Ghana's currency with an increasing inflation rate.

The significant positive relationship that GDP has with the exchange rate (r = 0.9233) implies that Ghana will record an increase in GDP with an increasing exchange rate with a higher volume of export cargo. However, it suffices to state that an increasing the exchange rate of GhC/USD will negatively affect other sectors of the nation's economy. The r = 0.9233 between GDP and EXC indicates multicollinearity between the variables. Consequently, GDP was removed from the variables while undertaking regression analysis, as it has a higher standard error than the exchange rate.

Table 4 attempts to present the correlation model summary resulting from the multiple linear regression analysis to determine the relationship between the Ghana air cargo volume as the dependent variable and the selected macroeconomic variables as the independent variables. The multiple correlation coefficient R2 = 0.6143, and Adjusted R2 = 0.5526 indicate a strong correlation between the dependent variable (air cargo volume) and the independent variables, which are the selected macroeconomic variables to demonstrate a strong correlation

in the relationships between the dependent and independent variables. Table 3 further shows that the selected macroeconomic variables significantly influence cargo trade in Ghana with F (4, 25) = 9.96, significant at p = 0.0001. The Adjusted R2 value showing 0.5526 indicates that 55.3% of the variance in Ghana's air cargo volume can be explained by the changes in macroeconomic variables.

Table 4: Model Summary

M.S. Number of obs				30
F(4, 25)				9.96
Prob > F				0.0001
R-squared				0.6143
Adj R-squared				0.5526
Root MSE				7.7115
Source	**SS**	**Df**	**MS**	
Model	2368.02909	4	592.007272	
Residual	148669918	25	59.4679671	
Total	3854.72827	29	132.921664	

Regress CRG FDI INF EXC INT
Source: Authors' Computation, 2022

The value of the coefficients resulting for the regression for air cargo in Ghana are presented in Table 4, which provides the estimates of the regression coefficients, standard errors of the estimates, t-tests (t) that a coefficient takes the value zero, significant level (P>t), and confidence intervals. The estimated coefficients for each explanatory variable predict the change in the dependent variable when each explanatory variable is

increased by one unit conditional upon all the other variables in the model remaining constant.

Table 5: Regression's coefficient

CRG	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
FDI	-.0000564	.0023798	-0.02	0.981	-.0049681	0.0048553
TBA	-.0020765	.0015727	-1.32	0.199	-.0053224	0.0011695
INF	.1404684	.1978073	0.71	0.484	-.2677858	0.5487227
EXC	.4379748	.2113927	2.07	0.049	.0168179	0.8742679
INT	-.5037569	.2397325	-2.10	0.046	-.9985405	-0.0089734
_cons	41.59104	7.352481	5.66	0.000	26.41627	56.76582

Source: Authors' Computation, 2022.

Table 5 shows that exchange and interest rates were significant macroeconomic variables that mainly determine the volume of Ghana's air cargo trade. The results show a regression coefficient of 0.434 and -0.504, for exchange and interest rates, respectively, both significant at $p < 0.05$. The significant levels of the remaining macroeconomic variables are at $p>0.05$. The result implies that changes in exchange rate are a relevant determinant of air trade volume in Ghana. It demonstrates the critical role of the exchange rate in international trade. It supports the study of Nicita (2013), who identified three aspects of the relationship between exchange rate and trade: exchange volatility, currency misalignment, and trade policy misalignment. Also, this study supports the finding of Mosbei et al. (2021) that exchange rate volatility significantly affects regional trade in intra east Africa. As in Kiboi, Katuse and Mosoti (2017), this study also found that the interest rate negatively affects Ghana's air cargo trade. Hence, the model from this study takes the form:

$$\text{Air cargo trade} = 41.59 + 0.43(\text{Exchange rate}) - 0.50(\text{Interest rate}) + e$$

The model implies that volatility in Ghana's exchange and interest rates profoundly influences the air trade volume. The model estimates are consistent with the economic reality in Ghana. Generally, a lower interest rate for local production and export will increase trade volume and increase the value of Ghana's currency. The result supports Asari et al. (2011) that lower interest rates will promote capital inflow and cause an increase in the value of a nation's currency.

The test of the validity of the regression analysis considers the level of multicollinearity in the model. Table 6 presents the output of the multicollinearity test with variance inflation factor (VIF) and its inverse, which indicates the tolerance level of the model. Table 6 shows that the model's multicollinearity level is of less concern since the values are less than 10 while tolerance values are all greater than 0.1.

Table 6: Test of Multicollinearity

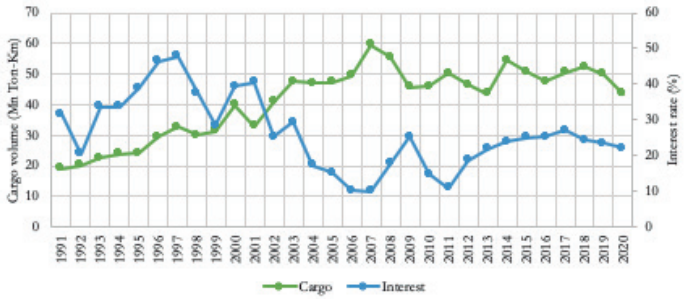
Variable	VIF	1/VIF
EXC	6.74	0.148369
FDI	5.05	0.197903
TBA	3.59	0.278927
INT	3.00	0.332871
INF	2.62	0.381641
Mean VIF	4.20	

Source: Authors' STATA Computation, 2022.

The pattern of air cargo traffic against the changes in interest rate over the years presented in Figure 4 supports that growth in air cargo traffic is in response to the changes in the interest

rates of Ghana over the years. It is evident that interest rates increased and peaked from 20.4% in 1992 to about 48% in 1997. This period witnessed a gradual increase in cargo volume. Also, air cargo recorded its highest volume of 59.51 Mn Tons -Km in 2007 when the interest rate was at its minimum value of 9.9%. It indicates that increasing interest rates will produce a decreasing volume in cargo traffic. The decrease in cargo volume from 59.51 Mn Ton-Km in 2007 to 45.7 Mn Ton-Km in 2009 may account for the increase in interest rate from 9.9% in 2007 to 25.38% in 2009. In 2011, the interest rate declined to 10.85% from 25.38% in 2009, while cargo volume increased from 45.7 Mn Ton-Km in 2009 to 50.26 Mn Ton-Km in 2011.

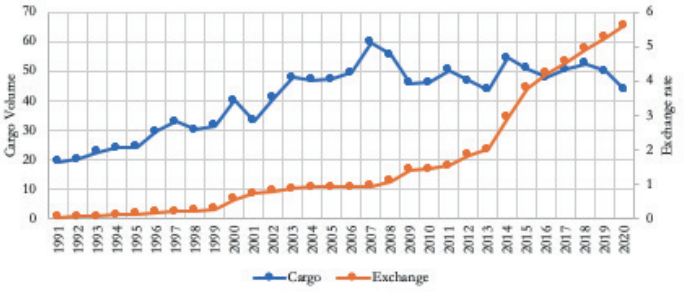
Figure 4: Trend of cargo volume vs interest rate in Ghana



Source: GACL (Cargo volume); Bank of Ghana (Interest rate).

It is observed in Figure 5 that the trend in cargo volume follows the pattern of changes in the exchange rate. The dramatic increase in the exchange rate from 2014 resulted in a decrease in cargo volume in 2014. It implies that volatility in the exchange rate significantly influences the air cargo volume in Ghana. Aside from macroeconomic variables, other exogenous factors such as the global economic recession in 2008 and the recent COVID-19 pandemic also contribute to the reducing pattern in air cargo volume.

Figure 5: Trend of cargo volume vs interest rate in Ghana



Source: GACL (Cargo volume); Bank of Ghana (Interest rate).

Conclusion and policy recommendations

The quest for the air transportation of goods for the economic development of nations will continue unabated. Therefore, it requires that an understanding of air cargo trade determinants be provided to galvanize opinions for appropriate policy decisions. This study shows that macroeconomic variables are significant determinants of air cargo trade in Ghana. However, it found that the exchange rate and interest rate significantly influence air cargo trade in Ghana. The imbalance in the macroeconomic variables causes significant fluctuations in air cargo trade. The results support Nicita (2013) and Kiboi, Katuse and Mosoti (2017), which established the effect of exchange and interest rates on trade.

The study, therefore, recommends as follows:

Expand air cargo flow by origin and destination through trade interactions with more countries:
The strategic means to improve air cargo volumes in any country, such as Ghana and other developing countries, requires enhanced trade relationships with more countries. The need for relationships is to enhance air cargo

trade with numerous countries to promote economic growth. Geographically, there is a need for Ghana to penetrate more countries, especially in the South America and Asia continents, with cargo transportation by air. Policies that promote bilateral trade agreements with countries need to be developed to increase air trade in Ghana. It should be strategic such that bilateral agreements are entered into with countries that need Ghana products for outward movement of cargo and foreign trade partners who will become major investors in the country for economic production purposes.

Promotion of local production and exportation to stabilize the exchange rate and increase currency value:
Ghana needs to develop strategic plans to expand its local production capacity for domestic consumption and export to stabilize fluctuations in exchange rates and increase the value of its currency in the global market. This will enhance Ghana's air trade volume to different countries. The government also needs to look into a policy that will create a friendlier environment for local and international businesses with an effective exchange rate policy.

Interest rates policy:
The interest rates offered to citizens for business and investment affect consumption and borrowing. A lower interest rate makes cheaper borrowing and increases spending and investment. It will promote the exchange of goods by air and excite a stagnant economy. The strategy for improving air trade in Ghana is to lower the interest rate for local production of goods, export and import practice, and consumption. This strategy will encourage airline flights into Ghana. It follows the recommendation

of Kiboi, Katuse and Mosoti (2017) that airlines should fly to countries with low-interest rates for cargo business.

Limitations and suggestions for further research:
The study is limited by subjecting selected macroeconomic variables to analyze air cargo trade in Ghana. The study did not test for causality of the significant variables because of the limited scope of sample size, which is 30 years (cargo data at GACL is available from 1991), which is not sufficient for further tests such as Johansen VECM. Future studies may include additional macroeconomic variables and expand the data points to at least 40 years to enable a test for short and long-run causality.

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