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Effects of Macroeconomic Variables on Exchange Rate in Ghana

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Abstract
This research investigates how certain important macroeconomic factors impact currency exchange rates in Ghana. The paper uses macroeconomic indicators such as exchange rates, exports, remittances, and foreign reserves to achieve the objectives of this study. Annual Time Series data gathered from 1980 – 2021 was used in the analyses. Simple OLS regression was conducted to estimate the relationship between the variables and the exchange rate. The Johansen Cointegration Test was used to establish long-run relationships. Findings from the study indicate that exports, remittances, and foreign reserves individually have a negative relationship with the exchange rate in Ghana. Implying an increase in volumes of exports, remittances, and foreign reserves positively impacts the exchange rate as it helps strengthen the local currency in international trade. The study recommends that to stabilize the exchange rate in Ghana, the government should promote export-oriented industries to boost export performance. Secondly, policymakers should recognize the potential impact of remittances on the exchange rate and implement measures to facilitate the inflow of remittances. And finally, policymakers should focus on strategies to increase foreign reserves, such as promoting foreign direct investment and diversifying export markets.
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1.0 Introduction

A country's exchange rate is crucial to its foreign trade. The exchange rate is a crucial macroeconomic statistic that is used to gauge a nation's level of global competitiveness and to determine where its economy stands on the world stage. A country's exchange rate system is strongly tied to its overall development. The exchange rate system makes payments between nations possible through a series of regulations, agreements, and organizations. A country's decision on which monetary system to use reflects its citizens' objectives about all aspects of the economy, including inflation, unemployment, interest rate levels, trade balances, and economic growth. One of each nation's primary economic goals is growth. The exchange rate policy holds significant importance within macroeconomic policy. Leveraging the exchange rate effectively can lead to achieving economic growth. A nation's exchange rate policy plays a pivotal role in striking a satisfactory equilibrium between monetary and trade policies.

Following the breakdown of the Bretton Woods system in 1973, the global economy encountered challenges such as sluggish growth, trade disputes, and currency fluctuations. Developing countries, including Ghana, faced significant difficulties in their economies and international trade relationships during this period. To address these external shocks and restore economic balance, strict fiscal and monetary policies were necessary to control spending in both the public and private sectors and prevent unsustainable current account deficits and competition from foreign trade partners. However, many developing countries deviated from this policy guideline, exacerbating the negative impacts of these external shocks on their economies. Ghana, like other developing nations, implemented reforms and policies aimed at resolving its exchange rate issues since the breakdown of the Bretton Woods system. The government collaborated with the International Monetary Fund (IMF) to structure and implement policies that addressed the country's exchange rate challenges. Both fixed and floating exchange rate regimes were adopted to tackle these issues. In the 1960s and 1970s, Ghana employed a fixed exchange rate system while occasionally intervening to address economic crises. In the 1980s, the country also introduced a floating exchange rate regime and legalized the establishment of foreign exchange bureaus to

introduce competition to the existing foreign exchange market (Asuming-Brempong, 1998).

The primary focus of this study is to assess the impact of the fundamental macroeconomic indicators on the exchange rate of the Ghanaian economy. The study will specifically analyze three main factors: exports, workers' remittances, and foreign exchange reserves

1.1 Problem Statement

The global economy is increasingly interconnected, with international trade and labor migration playing pivotal roles. The exchange rate becomes a critical economic variable in these international relations, impacting the competitiveness of nations and influencing their economic stability. However, there is a significant gap in understanding the intricate relationship between export performance, workers' remittances, foreign reserves, and exchange rates. This research seeks to address this knowledge gap by investigating the effects of exports, workers' remittances, and foreign reserves on exchange rates, shedding light on the dynamics that underlie these crucial economic variables. By doing so, this study will provide valuable insights into the factors shaping exchange rate movements in today's globalized world, taking into consideration the case of Ghana.

2. Literature Review

A comprehensive review of existing literature concerning how exchange rates impact trade balances, encompassing both domestic and international contexts was considered in two sections. The initial section delves into the theoretical elements and factors that influence exchange rates. The second section is dedicated to examining empirical studies that validate the correlation between exchange rates and trade balances.

2.1 Mercantilism

A significant international trade theory that has held sway for about three centuries is known as mercantilism was formulated by William Petty, Thomas Mun, and Antoine de Montchrétien during the shift from feudalism to capitalism and the expansion of international trade, particularly between the 16th and 18th centuries. Mercantilism had the objective of bolstering the wealth and influence of nations by placing strong emphasis on exporting goods in exchange for precious metals such as gold and silver. This economic system found primary adoption in Western European nations including the United Kingdom, France, Spain, Netherlands, Belgium, and Portugal.

Mercantilist nations focused on exporting goods to countries under their control while implementing measures like tariffs and quotas to restrict imports. This approach, which aimed to achieve a positive trade balance, contributed to the prosperity of these nations. Exploration and colonization efforts played a significant role in advancing their goals, stimulating international trade, and leading to the accumulation of precious metals. According to mercantilism, it was believed that the world's wealth was fixed, and a nation could only increase its wealth by taking it from another nation. During this era, international trade was largely carried out by corporations and trading companies that exerted significant control over economic activities. Gold served as the primary medium of exchange for goods and services. However, this form of trade often resulted in the concentration of wealth at the expense of human development and the overall well-being of citizens within these economies.

2.2 Monetary Approach

The monetary approach emerged in the 1950s to assess the balance of payments but later shifted its focus to determining exchange rates. Key proponents of this approach included Palok (1957), Hahn (1959), Pearce (1961), Prais (1961), Mundell (1968, 1971), and Johnson (1972, 1976a). They argued that the balance of payments is fundamentally a monetary phenomenon. According to their viewpoint, since exchange rates represent the relative value of one currency in terms of another, the balance of payments can also be explained in terms of the supply and demand for money.

The monetary approach posits that the relative supply and demand of money should determine exchange rates. In other words, when the demand for money exceeds the supply, the monetary authority can address the imbalance by attracting inflows from abroad, thereby improving the trade balance. Conversely, an oversupply of money leads to outflows to other countries, worsening trade balance. Therefore, the balance of payments reflects the disequilibrium in the money market. Thus, the supply and demand of money is crucial in understanding the determination of exchange rates. In summary, the monetary approach, championed by several economists, views the balance of payments as a monetary phenomenon and emphasizes the significance of the supply and demand for money in determining exchange rates.

2.3 Empirical review

Thorbecke, (2011) in "The Effect of Exchange Rate Changes on Trade in East Asia" found that fluctuations in bilateral exchange rates have a negative impact on the export of capital and intermediate goods from developed Asian countries to their East Asian counterparts within the same region. The research employed panel data encompassing a period spanning from 1982 to 2003, comprising a total of 21 observations across 30 countries. The study recorded a significant decline in finished product exports from the developing countries of Asia to the world market while the developed Asian countries recorded some appreciations of their currencies. Thorbecke concluded that the current exchange rate regimes could disrupt the relationship between developing and developed economies in Asia if market forces drive regional currencies to appreciate.

The study focused on bilateral exchange rate changes, which means that it did not consider the broader multilateral effects or interactions between multiple currencies. Exchange rate dynamics are complex and can be influenced by various factors, including global economic conditions and monetary policies. Ignoring these broader factors may limit the understanding of the overall impact of exchange rate changes on trade.

Farhana Akhter and Nushrat Faruqu (2015), Impact of macroeconomic variables on exchange rates in Bangladesh. Analyze how macroeconomic variables have affected the exchange rate. The study considers four main independent variables, namely the volume of exports, volume of remittances received, the amount of imports and the foreign exchange reserve, while the exchange rate is the dependent variable. Correlation and regression analysis were performed to assess the relationship and the nature of that relationship. The results suggest that macroeconomic variables have a significant impact on the exchange rate. Their research revealed that the trend of increasing exports and remittances has a positive impact on the exchange rate, while the trend of increasing imports and foreign exchange reserves has a negative impact on the exchange rate.

Mduduzi Biyase (2014) examined the link between exports and economic growth in African economies in his book an export-led Growth (ELG) paradigm on Africa: A Panel Data Approach. The study used panel data from 30 African countries for the period 1990-2005. Biyase included various variables such as exports, labor, inflation, government spending and gross domestic investment in his regression and modelling. The results of the study showed that an increase in exports of 1%corresponded to economic growth of 0.056%. This result is consistent with similar studies by Krueger (1978), Tyler (1981) and Chenery (1979), which confirm the importance of exports for economic development. Based on these insights, Biyase recommended that policymakers focus on implementing policies that support and encourage export expansion as they have a positive impact on economic growth. Overall, Biyase's study underscored the important role of exports in the economic growth of African economies and suggested that policymakers must prioritize policies that encourage export-oriented strategies.

Jebouni et al. (1994), "Exchange rate policy and macroeconomic performance in Ghana". In their research, they examined the relationship between exchange rate policies and macroeconomic aggregates in Ghana. The study examined the relationship between GDP and the exchange rate and found that real depreciation had a push-up effect on GDP. The real devaluation also had a positive effect on both imports and exports. Given Ghana's import dependency, the devaluation due to the inflow of external resources is likely to lead to an increase in imports. This in turn contributed to GDP growth, with imports having a positive impact. However, the researchers noted that depending on the magnitude of the increase, the trade balance could deteriorate.

Owusu-Afriyie and Mumuni (2004) conducted a study focusing on a simple monetary model for determining the exchange rate in Ghana. They utilized co-integration analysis to empirically investigate the primary factors influencing the Cedi/Dollar exchange rate. The researchers expanded the basic model by incorporating political variables to explore any potential impact on the exchange rate. The empirical findings supported the model and highlighted the significant role of macroeconomic fundamentals in shaping the dynamics of the Cedi/Dollar rate. Additionally, they found that speculation based on the recent historical behavior of the exchange rate was also influential in predicting future movements. However, while the political variable exhibited the expected direction of influence, it did not reach conventional levels of statistical significance. Due to the dynamism of the economy, it is important to consider the temporal scope of the study. As research evolves and economic conditions change over time, the findings and conclusions of this study may become outdated or less relevant.

Antwi et al. (2014) conducted a study titled "Influential Factors of Exchange Rate Behavior in Ghana: A Co-Integration Analysis." The main objective of their research was to explore the potential determinants of exchange rates in Ghana using co-integration and error-correction modeling techniques. The findings of the study indicated that two key factors played a significant role in the upward movement of exchange rates: government expenditure and the past behavior of exchange rates. Furthermore, the study revealed the existence of long-run

relationships between exchange rates and variables such as the Consumer Price Index (CPI), nominal GDP, domestic credit, government expenditure, and imports.

Alagidede and Muazu (2016) conducted a study to analyze the causes of real exchange rate volatility and its impact on economic growth in Ghana. By employing techniques from the time series literature, they discovered that in the short run, fluctuations in output play a significant role in driving exchange rate movements in Ghana. However, in the long run, exchange rate volatility is notably influenced by factors such as government expenditure growth, money supply, terms of trade shocks, FDI flows, and domestic output changes.

This present research holds significant importance due to the following reasons. The exchange rate plays a crucial role in fostering a country's economic development. When macroeconomic variables remain stable, it contributes to exchange rate stability, which enhances the credibility of the country's economy among both domestic and foreign trade partners. Fluctuations in exchange rates can directly impact trade balance, price stability, and financial stability (Ozkan & Erden, 2015). The study's findings align with existing literature and offer novel insights into the connection between exchange rates and macroeconomic fundamentals. These insights will aid the Central Bank of Ghana, in monitoring the impact of these macroeconomic variables on the exchange rate. Moreover, policymakers will gain a deeper understanding of the relationship between macroeconomic variables and the exchange rate, enabling more effective budgeting for various sectors of the economy and ensuring its efficient performance.

3. Research Methodology

3.0 Introduction

The study methodology utilizes econometric tools and techniques. The methodology is in three sections. The initial segment addresses model specification, the second segment delves into the empirical approach, and the concluding part discusses the nature of the data and its source.

3.1 Research Design

The study is a quantitative research type that investigates the effect of macroeconomic variables on the exchange rate in Ghana's economy. The purpose is to determine the relationship between the dependent and independent variables and their implications. The variables of interest in the study are exchange rate, exports, remittance, and foreign reserves in Ghana.

3.2 Data Collection

Secondary data from the World Bank development indicators containing annual time series observations on exchange rates, exports, remittances, and foreign reserves from 2000 to 2022 was used in the analysis of this study,

3.3 Empirical Strategy

This section outlines the empirical strategy used to ensure the estimated parameters from the specified models are consistent with the chosen dataset. Several tests and techniques were employed in this process. The first step was to examine unit roots in the series, which was done using the Augmented Dickey-Fuller (ADF) Test. This test helped ensure that the results obtained were not spurious. To assess long-run equilibrium in the variables, the study utilized the Johansen Cointegration test. This test determined whether a stable relationship existed among the variables over the long term, providing insights into their interdependencies.
To approximate the long-run parameters, the Ordinary Least Squares (OLS) regression was used. This regression technique estimated the relationships between variables in the long run.

3.4 Model Specification

To investigate the impact of macroeconomic factors, namely exports, remittances, and foreign reserves, on the exchange rate, this study utilized regression analysis. Regression analysis refers to a collection of statistical techniques used to estimate the connections between a dependent variable and one or more independent variables. Since the study seeks to examine the relationship between a dependent variable (exchange rate) and three independent variables (exports, remittances and foreign reserves). Multiple linear regression model was employed in this process. Exchange rate which is the dependent variable was regressed against the selected macroeconomic variables; which are exports, remittances and foreign reserves.

Table 3.1: Description of variables

Variables	Description
EXC	Exchange rate; the rate at which the Ghana cedi is valued to foreign currencies.
EXP	Exports; the outflow of good produce locally in Ghana to other foreign countries.
RMT	Remittance, Money from relatives, friends from foreign countries.
FRS	Foreign reserves; are the amount of foreign currencies held by the central bank

The model's specified functional form is presented as follows:

EXC=F (EXP, RMT, FRS) U……………………………………………………..(1)

Equation (1) above is specified in functional form, where,

EXR= exchange rate

EXP= exports

RMT= remittance

FRS= foreign reserves

U= error term

Expanding equation (1) to make it more explicit, we obtain:

$EXR_t = \beta_0 + \beta_1 EXP + \beta_2 RMT + \beta_3 FRS + \varepsilon$……………………………………(2)

All variables as defined above, the β_i, (i=0,1,2,3) represents the parameters of estimation and ε represents the error term. The β_i represents the amount at which each of the respective independent variables affect the dependent variable. The error term (ε) is included in the model to account for unknown variation or factors that could affect the dependent variable but not included in the model.

We perform a logarithmic transformation to derive on 2 above to derive,

$lnEXC = \beta_0 + \beta_1 lnEXP + \beta_2 lnRMT + \beta_3 lnFRS + \varepsilon$…………………………. (3)

To capture the non-linear relationships among the selected variables, we employ the log-log model, also known as the log-liner model. This approach is distinct from the linear model, as it offers a different interpretation in terms of elasticities rather than marginal effects. By utilizing this model, we assume a constant elasticity across all values within the data set. As a result, the log-linear model decreases the scale of the variables, thereby lowering the probability of encountering heteroscedasticity in the model, as explained by Gujarati and Sangeetha in 2007.

3.5 Empirical Strategy

In this section, we describe the empirical approach employed to perform initial tests on the listed variables, aiming to assess whether the estimated parameters from the selected models align with the dataset. The method of choice for investigating the relationship between these variables is ordinary least squares (OLS) regression analysis. Auxiliary Regression is used to check whether there is relationship between the independent variables and finally variance inflation factor (VIF), which is used to test for the presence of multicollinearity in the model.

3.6 Unite root test

A unit root test is a statistical method used to determine whether a time series variable is non-stationary or possesses a unit root. Understanding whether a time series has a unit root is essential because it helps determine the appropriate modeling approach for the data. We assess unit roots in the series by conducting the Augmented Dickey-Fuller (ADF) Test to ensure that the results obtained are not statistically insignificant or spurious. Stationarity is a critical concept in time series analysis. A stationary time series is one whose statistical properties, such as mean, variance, and autocorrelation, remain constant over time. When a time series is stationary, it is easier to model and make accurate predictions. On the other hand, a non-stationary time series has statistical properties that change over time, making it more challenging to model and predict. One common form of non-stationarity is a unit root, which implies that the time series has a stochastic (random) trend and does not revert to a stable mean over time.

3.7 Augmented Dickey-Fuller (ADF) test.

The most popular unit root test is the Augmented Dickey-Fuller (ADF) test. The ADF test is based on the following autoregressive model:

$\Delta y_t = \rho y_{t-1} + \varepsilon_t$

where:
Δy_t is the first difference of the time series at time t.

ρ is the coefficient of the lagged value of the time series.

$\varepsilon_t$is the error term (residual) at time t.

The null hypothesis of the ADF test is that the time series has a unit root (non-stationary), which is represented as:
H0: ρ = 0
The alternative hypothesis is that the time series is stationary, indicating the absence of a unit root:
H1: ρ < 0
In other words, if the p-value obtained from the ADF test is less than a chosen significance level (commonly 0.05), then we reject the null hypothesis and conclude that the time series is stationary. If the p-value is greater than the significance level, we fail to reject the null hypothesis, indicating that the time series is non-stationary.
If the time series is found to be non-stationary (i.e., it has a unit root), one common approach is to take the first difference of the series (subtracting each value from its previous value) to make it stationary. This differencing operation removes the stochastic trend, and the resulting series is often more amenable to traditional time series analysis techniques.

3.8 Co-integration Test

Johansen (1991) introduced a method to test for co-integration among variables, which helps establish long-term linear relationships between them. The presence of co-integration allows for a systematic approach to modify cointegrated factors. When dealing with models involving more than two variables, there is a possibility of having multiple cointegrating relationships, as pointed out by Asteriou (2007). The tests for co-integration rely on eigenvalues of transformed data, representing linear combinations of the data that exhibit the highest correlation (Dwyer, 2015).

3.9 Ordinary least squares (OLS)

The simple regression model is employed to examine the connection between two variables. While it has limitations as a general tool for empirical analysis, it can still be suitable in certain empirical applications. In applied econometric analysis, the initial step involves explaining a variable y in terms of x. This raises questions about how to account for the influence of other factors on y and determine the functional relationship between y and x.
To address these concerns and capture the ceteris paribus relationship between y and x, an equation is formulated that relates y to x. By specifying this equation, we can accommodate other factors that may affect y and quantify the relationship between y and x. This allows us to analyze the impact of x on y while holding other factors constant. However, it's important to note that the ceteris paribus assumption may not perfectly reflect real-world complexity, as there could be unaccounted factors influencing y.
To account for the unknown factors affecting y, we add ε to the equation. The equation is given as follows
$y = \beta_0 + \beta_1 x + \varepsilon$……(4)
The equation presented above is known as the simple linear regression model. Within this equation, the variables have distinct roles: y is recognized as the dependent variable, while x serves as the independent variable. These terms can also be referred to as the explained variable (y) and the explanatory variable (x), respectively. The error term (ε) is used to account for disturbances in the model, representing factors beyond
x that influence y. β_0 and β_1 are the estimated parameters within the model, with $\beta_0$representing the intercept and $\beta_1$quantifying the impact of x on y.

In the case of this study, we will be dealing with three independent variables thus exports, remittance and foreign reserves and one dependent variable exchange rate.

4.0 Empirical Results and Analysis

This chapter centers on the trend analysis between the variables, time series analysis of the variables and an examination of their regression outcomes. The analysis was conducted using data spanning from 1980 to 2021, encompassing exchange rates, exports, remittances, and foreign reserves in the context of Ghana. It showcases the findings of multicollinearity test, stationarity tests, cointegration test applied to these variables, along with the outcomes of the Ordinary Least Squares (OLS) regression.

4.1 Descriptive Test Results

Table 4.1: Descriptive statistics

	EXR	EXP	RMT	FRS
Mean	1.266771	5030000000	878000000	24.12139
Median	0.630612	1760000000	37958400	22.41157
Maximum	5.805700	15700000000	4980000000	61.66173
Minimum	0.000275	528000000	500000.0	4.580828
Std. Dev.	1.730043	5.360000000	1520000000	15.91700
Skewness	1.450584	0.952311	1.470970	0.991079
Kurtosis	3.810067	2.170210	3.610075	3.102359
Observations	42	42	42	42

Source: E-views Econometric Software

The study's sample comprises 42 observations. To gauge central tendencies, we calculated the means for the Ghanaian exchange rate, exports, remittances, and foreign reserves. Specifically, the mean values for the real exchange rate, exports, remittances, and foreign reserves are approximately 1.299771, 5.03 billion, 8.78 billion, and 24.12139 Ghana cedis, respectively. It's worth noting that the standard deviations for the exchange rate and exports variables are notably higher than their respective means, indicating that data points are widely dispersed across a broad range of values. The median values, which represent the middle points of the data sets, were also calculated for the Ghanaian exchange rate, exports, remittances, and foreign reserves. They are approximately 0.630612 Ghana cedis per dollar, 1,760,000,000 Cedis, 37,958,400 Ghana Cedis, and 22.41157, respectively. It's noteworthy that the mean values for the exchange rate, exports, remittances, and foreign reserves exceed their respective median values, suggesting that the data for these variables exhibit right-skewness. Furthermore, the maximum and minimum values for each variable are not very close to their respective means, indicating some degree of fluctuation of the variables away from their means. To address outliers, mathematical transformations, such as logarithm transformation, were applied to both the exchange rate and exports variables.

4.2 Multicollinearity

This test is conducted on the variables in the model to check whether or not there is correlation between the independent variables stated.

Table 4.2: Multicollinearity test results

Correlation	EXR	EXP	RMT	FRS
EXR	1.000000			
EXP01	0.815105	1.000000		
RMT	0.899270	0.640272	1.000000	
FRS	0.388482	0.607707	0.477142	1.000000

Source: Eviews software

From the table 4.2 above, there is higher correlation between the dependent variables and the independent variables which is always normal. There should exist some degree of relationship among the independent variables (EXP, RMT and FRS) and the dependent variable (EXR). The correlation between the independent variables are used to check whether there is the presents of multicollinearity in the variables. The correlation between EXP and RMT is 0.640272, EXP and FRS is 0.607707 and RMT and FRS is 0.477142, this implies that there is low multicollinearity in the model since their correlation values lies between -0.65< correlations < 0.65.

4.3 Unit Root Test Results

Unit root tests were performed on the variables included in the models to prevent the occurrence of spurious regression results. These test outcomes are essential for discerning the short-term and long-term relationships among the variables. We employed the Augmented Dickey-Fuller (ADF) Test to assess the stationarity of the variables. It's important to note that all the variables exhibited an upward trend. To determine the stationarity of the variables, unit root tests were conducted using various specifications, including with both trend and intercept at levels and the first difference.

Table 4.3: Stationarity Test at Level

	t-Stat	P-Val
EXC	-3.23833	0.091655
EXP01	-2.3105	0.417014
RMT	-4.024542	0.215483
FRS	-1.91633	0.627945

Source: Eviews software

Table 4.4: Stationarity Test at 1st difference

	t-Stat	P-Val
EXC	-3.655069	0.008795
EXP01	-7.615955	1.01E-07
RMT	-7.298294	2.32E-07
FRS	-6.448763	2.53E-06

Source: Eviews software

From Table 4.3, the probability values of the variables are higher than 5% at level hence, we fail to reject the null hypothesis that the variables have unit root. From Table 4.4 the probability values of the variables at first difference are lower than 5%, therefore, we reject the null hypothesis of the variables having unit roots. The Augmented Dickey-Fuller Test shows that all the variables in the model have unit roots. The variables are not stationary at levels but are stationary at first difference.

4.4 Cointegration Test

Table 4.5: Trace

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.608276	75.08572	47.85613	0.0000
At most 1 *	0.470627	37.59779	29.79707	0.0052
At most 2	0.194939	12.15535	15.49471	0.1496
At most 3	0.083366	3.481882	3.841466	0.0620

Source: Eviews software

Table 4.6: Maximum Eigenvalue

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		**Max-Eigen**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	0.608276	37.48792	27.58434	0.0019
At most 1 *	0.470627	25.44245	21.13162	0.0116
At most 2	0.194939	8.673466	14.26460	0.3143
At most 3	0.083366	3.481882	3.841466	0.0620

Source: Eviews software

From Table 4.5 and Table 4.6 there exist at most 2 cointegration equations. The Trace and Maximum Eigenvalue tests have probability values lesser than 5% at none. While this statement holds true, it's important to note that the statistics for both tests exceed their respective critical values at none and at most 1. This validation of the test results serves as evidence supporting the presence of cointegration between the variables. These test outcomes strongly indicate a long-term relationship between the variables, aligning with the findings of Nyarko F. (2016) and Anning et al. (2015).

4.5 Regression results

Dependent Variable: D(EXC)
Method: Least Squares
Included observations: 41 after adjustments.

Table 4.7: regression results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.164341	0.059599	2.757427	0.0092
D(EXP)	-0.253942	0.183009	-1.387587	0.1740
D(RMT)	-0.026764	0.057064	-0.469023	0.6420
D(FRS)	-0.003539	0.005226	-0.677120	0.5028
D(EXC(-1))	0.433498	0.151827	2.855217	0.0072

Source: Eviews software

$$EXR = 0.164341 - 0.253942EXP - 0.026764RMT - 0.003539FRS$$

The table above elucidates the long run effects of factors like EXP, RMT, and FRS on EXR. Keeping all other variables constant and setting the independent variables to zero, the exchange rate of Ghana is projected to rise by approximately 0.164341, signifying a devaluation of the local currency against the US dollar by around 16.4%.

From the regression analysis above, there is a negative relationship between exports and exchange rate. Holding all variables constant, a unit increase in exports leads to -0.253942 decline in exchange rate thus, 25% decrease in the exchange rate. A negative relationship between exports and the exchange rate can also influence a country's trade balance. An increase in exports can contribute to a trade surplus (exports exceed imports). This can lead to a greater demand for the domestic currency in foreign exchange markets, potentially strengthening its value (currency appreciation). This agrees with the finding of Farhana Akhter and Nushrat Faruqu (2015), that the trend of increasing exports and remittances has a positive impact on the exchange rate.

The regression analysis show that workers' Remittance received has a negative relationship on exchange rate in Ghana. An increase in remittance by one unit leads to decrease in exchange rate by -0.026764. This is an indication that, an increase in remittances leads to an increased demand for the local currency (cedis) as recipients exchange foreign currency (dollars) for cedis. This higher demand for cedis could lead to its appreciation, resulting in a decrease in the exchange rate (dollars per cedi). This agrees with the finding of Amuedo-Dorantes and Pozo in 2002, that when these remittances take the form of gifts, they often lead to the growth of informal or parallel foreign exchange markets, subsequently causing the appreciation of the real exchange rate. This contradicts the discovery made by Jebuni et al. (1991), which suggested that an increase in capital inflow and GDP growth might exacerbate the trade deficit.

From the regression conduct above there is a negative relationship between foreign reserves and exchange rate. An increase in foreign reserves causes a reduction in exchange rate by -0.003539. An increase in the volume of foreign currency reserve in Ghana help reduce the pressure on the demand for foreign currencies (US dollars), which intern reduces the amount of cedis exchange for the dollar. Thus, an increase in foreign reserves leads to the cedi appreciation. This agrees with the finding of Amuedo-Dorantes and Pozo in 2002, that when these remittances take the form of gifts, they often lead to the growth of informal or parallel foreign exchange markets, subsequently causing the appreciation of the real exchange rate.

4.6 Regression results diagnosis

The results of the diagnostic tests show that all models are correctly specified and the parameters are correctly estimated. The tests do not fail the serial correlation and heteroscedasticity. (see Table 2 and Table 3 in Appendix). They all exhibit probability values greater than the significant level of 5%.

Table 4.8: Regression diagnosis

Diagnostic	Statistic	P-Value	conclusion
Breusch-Godfrey Serial Correlation LM Test:	Chi-Square (2): 2.496701	0.2870	No serial correlation
Heteroskedasticity Test: ARCH	Chi-Square (1): 3.395797	0.0654	No heteroscedasticity

Source: Eviews software.

5. Conclusion

This chapter provides a comprehensive overview of the research. It includes a recap of the study's main points, the conclusions derived from the research, and suggestions for policy considerations and implementation.

5.1 Summary

The regression analysis conducted in Chapter Four revealed several significant relationships between key variables and the exchange rate in Ghana. The findings indicate that there is a negative relationship between exports and the exchange rate, meaning that an increase in exports leads to a decline in the exchange rate. This suggests that as exports grow, there is a greater demand for the domestic currency, which strengthens its value. Similarly, the analysis showed a negative relationship between remittance received and the exchange rate. An increase in remittances leads to a decrease in the exchange rate, indicating that higher remittances result in an increased demand for the local currency. This higher demand can lead to currency appreciation and a decrease in the exchange rate. Furthermore, the study found a negative relationship between foreign reserves and the exchange rate. An increase in foreign reserves leads to a reduction in the exchange rate, suggesting that a higher volume of foreign currency reserves helps alleviate pressure on the demand for foreign currencies. This ultimately leads to currency appreciation.

5.2 Conclusion

In conclusion, this study has examined the relationship between key macroeconomic variables and the exchange rate in Ghana. The regression analysis revealed negative relationships between exports, remittance received, and foreign reserves with the exchange rate. These findings suggest that an increase in exports, remittances, and foreign reserves can contribute to a favorable trade balance and strengthen the local currency. The implications of these findings highlight the importance of promoting export-oriented industries, facilitating remittance inflows, and maintaining adequate foreign currency reserves. By implementing appropriate policies and strategies, policymakers can stimulate economic growth, enhance trade balance, and potentially strengthen the value of the domestic currency.

5.3 Recommendation

The findings of this study have several implications for policymakers and stakeholders in Ghana's economy. Firstly, the negative relationship between exports and the exchange rate highlights the importance of promoting and supporting export-oriented industries. By encouraging exports, policymakers can stimulate economic growth and potentially strengthen the local currency.

Secondly, the negative relationship between remittance received and the exchange rate emphasizes the significance of remittances as a source of foreign exchange. Policymakers should recognize the potential impact of remittances on the exchange rate and implement measures to facilitate the inflow of remittances, such as reducing transfer fees and providing incentives for remittance recipients to exchange foreign currency for the local currency.

Lastly, the negative relationship between foreign reserves and the exchange rate highlights the importance of maintaining adequate foreign currency reserves. Policymakers should focus on strategies to increase foreign reserves, such as promoting foreign direct investment and diversifying export markets. By doing so, they can mitigate exchange rate volatility and contribute to currency appreciation.

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APPENDIX

Table 1: OLS Estimates

Dependent Variable: D(EXC)
Method: Least Squares
Date: 09/16/23 Time: 01:21
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.164341	0.059599	2.757427	0.0092
D(EXP01)	-0.253942	0.183009	-1.387587	0.1740
D(RMT)	-0.026764	0.057064	-0.469023	0.6420
D(FRS)	-0.003539	0.005226	-0.677120	0.5028
D(EXC(-1))	0.433498	0.151827	2.855217	0.0072
R-squared	0.283079	Mean dependent var		0.248953
Adjusted R-squared	0.201145	S.D. dependent var		0.292637
S.E. of regression	0.261555	Akaike info criterion		0.272124
Sum squared resid	2.394386	Schwarz criterion		0.483234
Log likelihood	-0.442488	Hannan-Quinn criter.		0.348455
F-statistic	3.454970	Durbin-Watson stat		1.867179

Table 2: Serial correlation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.098452	Prob. F(2,33)	0.3453
Obs*R-squared	2.496701	Prob. Chi-Square(2)	0.2870

Table 3: Heteroskedasticity test

Heteroskedasticity Test: ARCH

F-statistic	3.528923	Prob. F(1,37)	0.0682
Obs*R-squared	3.395797	Prob. Chi-Square(1)	0.0654

Table 4: Cointegration test

Date: 09/16/23 Time: 01:36
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments
Trend assumption: Linear deterministic trend
Series: EXC EXP01 RMT FRS
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.608276	75.08572	47.85613	0.0000
At most 1 *	0.470627	37.59779	29.79707	0.0052
At most 2	0.194939	12.15535	15.49471	0.1496
At most 3	0.083366	3.481882	3.841466	0.0620

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.608276	37.48792	27.58434	0.0019
At most 1 *	0.470627	25.44245	21.13162	0.0116
At most 2	0.194939	8.673466	14.26460	0.3143
At most 3	0.083366	3.481882	3.841466	0.0620

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table 5: Descriptive statistics

	EXR	EXP01	RMT	FRS
Mean	1.266771	5.03E+09	8.78E+08	24.12139
Median	0.630612	1.76E+09	37958400	22.41157
Maximum	5.805700	1.57E+10	4.98E+09	61.66173
Minimum	0.000275	5.28E+08	500000.0	4.580828
Std. Dev.	1.730043	5.36E+09	1.52E+09	15.91700
Skewness	1.450584	0.952311	1.470970	0.991079
Kurtosis	3.810067	2.170210	3.610075	3.102359
Jarque-Bera	15.87772	7.553233	15.79761	6.893995
Probability	0.000357	0.022900	0.000371	0.031841
Sum	53.20437	2.11E+11	3.69E+10	1013.098
Sum Sq. Dev.	122.7150	1.18E+21	9.53E+19	10387.39
Observations	42	42	42	42