THE EFFECT OF EXCHANGE RATE VOLATILITY ON ECONOMIC GROWTH

Joseph Yensu [*], Seth Kofi Nkrumah [**], Samuel Amankwah [*], Klenam Korbla Ledi [***]

* Kumasi Technical University, Kumasi, Ghana
** Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
*** *Corresponding author*, Marketing and Corporate Strategy Department, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
Contact details: Marketing and Corporate Strategy Department, Kwame Nkrumah University of Science and Technology, P.M.B, Kumasi, Ghana

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Abstract

This study aimed to investigate the connection between exchange rate volatility and economic growth in Ghana. The study applied descriptive statistical analysis, regression analysis, and correlation analysis to analyze the data spanning from the year 2000 to 2020. The study discovered that the actual exchange rate exhibits clustering volatility, which means that a period of large (small) fluctuations in the exchange rate shock is followed by large (small) fluctuations over a longer time. Negative correlations were found between exchange rate volatility and trade openness, government expenditure, money supply, foreign direct investment (FDI), output, and domestic credit to the private sector, among others. It was determined that exogenous variables such as terms of trade, domestic money supply, government expenditure, and capital flows affected exchange rate volatility over the long term, which was consistent with the findings of other studies (Rasheed, Ishaq, & Malik, 2022; Barguellil, Ben-Salha, & Zmami, 2018). The study also indicated that exchange rate volatility had a negative effect on economic growth. In all, most of the effects are felt at the end rather than in the short run. The government should encourage the diversification of industries by encouraging industrialization to boost export as a way of offsetting our huge imports. There must be a tightening of the monetary policy through raising interest rates to keep inflation at bay.

Keywords: Exchange Rate, Volatility, Economic Growth, Export, FDI

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1. INTRODUCTION

Persistent fluctuations of the exchange rate, otherwise referred to as exchange rate volatility, have been of great concern to researchers in recent times due to their impact on developing economies. Due to its impact on exports, employment growth, commerce, inflation, investment, and general economic activity and growth, exchange rate volatility fluctuation issues in both established and emerging nations have arisen in a considerable way (Latief & Lefen, 2018; Bahmani-Oskooee & Arize, 2022; Hatmanu, Cautisanu, & Ifrim, 2020; Sugiharti, Esquivias, & Setyorani, 2020). The relative merits of fixed vs floating exchange rates have been the subject of heated debate in the international money and finance community, as well as in academics, for the past four decades. Those who advocate for fixed exchange rates have often made the point that flexible exchange rate increase trade uncertainty and may in fact reduce trade volumes as it exposes greater risks because of fluctuations (Anyanwu, Adigwe, & Ananwude, 2017; Latief & Lefen, 2018). Hard exchange rate pegs improve fiscal

institutions and the improved fiscal institutions are able to propel sound budgetary management because the power of the government to print money to finance spending is removed (Dada, 2021; Bahmani-Oskooee & Arize, 2022). In addition, hard exchange rate pegs promote trade openness and economic integration (Ozata, 2020; Senadza & Diaba, 2017). Despite these advantages, however, proponents of flexible exchange rates make the argument that external risks are mitigated through sufficient systematic hedging thereby making the flow of trade unaffected. Furthermore, flexible exchange rates greatly improve fiscal discipline by making the consequences of poor fiscal policies instantly visible through fluctuations in exchange rates and price levels. When it comes to nominal support, a floating exchange rate system may not be able to provide due to the large amount of leeway it gives policymakers (Iyke & Ho, 2017; Sugiharti et al., 2020). As a small open and developing economy, Ghana is vulnerable to internal and foreign shocks that might disrupt economic growth. The nation must now plan for and implement microeconomic and macroeconomic measures to boost economic growth and address any difficulties that may occur. There are many different types of policies, including those involving the budget, the economy, and currency exchange rates. The exchange rate policy is particularly crucial since it affects domestic and foreign trade. The cedi (Ghanaian currency, GH₵) has depreciated against the currencies of its major trading partners ever since the country adopted the flexible exchange rate regime. However, there have been periods when the currency had experienced some urge over other major currencies, especially the US dollar (USD). The years between 2002 and 2007 saw the Ghanaian currency experiencing some levels of stability. In July 2007, the Bank of Ghana and monetary regulators redenominated the cedi making the US dollar exchange for 93 pesewas (1 cedi = 100 pesewas). The effect was the depreciation of the currency exchange for GH₵ 1.49 with the dollar by July 2009. There was however respite between August 2009 and March 2010 when the cedi made some gains of about 3% against the USD. The cedi has been volatile in recent years where it was exchanged at GH₵ 2.21 in 2014 at the beginning of January, but ended at GH₵ 3.20 by the end of September, a whopping 44.65% depreciation and currently stands at GH₵ 10.0 in August 2022 during the post-COVID-19 era. In addition, it should be understood that the effect of this high level of depreciation led to a rise in consumer price inflation as well as the gross domestic product (GDP) growth of Ghana. With the current changes in the exchange rate, how is this situation affecting growth, especially the GDP of Ghana?

Empirically, the issue of the relationship between exchange rate volatility and economic growth remains controversial in existing literature (Buabin, 2016; Chiloane, 2012; Mensah, Awunya-Victor, & Asare-Menako, 2013; Insah & Chiaraah, 2013; Alagidede & Ibrahim, 2017; Obeng, 2017). For instance, some studies found identified negative relationships (Musyoki, Pokhariyal, & Pundo, 2012) whereas others have identified positive relationships. The implication for a negative relationship is that the GDP growth rate is hampered by an unstable real exchange rate (*RER*) preventing risk-averse investors and players within the economy from fully participating in economic activities. When there is a good association between the exchange rate and economic growth, however, traders and investors are encouraged to take part fully of their ability. The intention is to take advantage of the regime's volatility in exchange rates. A possible outcome is faster economic growth. The effects of changes in the value of a country's currency on its exports, imports, investments, capital markets, inflation, and job growth in both developing and established countries have been demonstrated by numerous empirical studies (Ioan et al., 2020; Hatmanu et al., 2020; Dal Bianco & Loan, 2017; Alagidede & Ibrahim, 2017; Latief & Lefen, 2018; Allen, McAleer, Peiris, & Singh, 2016; Vo, Vo, & Zhang, 2019). However, there has been a scarcity of research on the impact of exchange rate volatility on economic growth in developing nations, and the few studies that have been conducted are controversial (Morina, Hysa, Ergün, Panait, & Voica, 2020). When it comes to the topic of exchange rate volatility and its effect on economic growth in Ghana, the existing literature suffers from a severe lack of empirical evidence. With that in mind, the purpose of this research is to provide an overview of how fluctuations in the value of the cedi have influenced economic expansion in Ghana.

The structure of this paper is as follows: Section 2 reviews pertinent literature related to the study. Section 3 presents the methodology employed to conduct this study. Section 4 highlights the results of the study. Sections 5 and 6 introduce the discussion and the conclusion of the study, respectively.

2. LITERATURE REVIEW

2.1. Exchange rate

The study considered nominal and real exchange rates. The nominal exchange rate is the quantity of foreign currency that one unit of domestic currency can purchase (Iyke & Ho, 2017; Allen et al., 2016). It refers to the native currency's relative value in terms of foreign currency. There are two methods that are used in the quotation of exchange rates (Wang, Wang, & Chang, 2019; Umaru, Aguda, & Davies, 2018; Rashid & Basit, 2022). These quotation methods are direct (used in America) and indirect (used in Europe). The former shows the units of the cedi per the US dollar. The latter displays the amount of foreign currency required to purchase one local currency; in this case, the number of US dollars required to purchase one Ghana cedi. There is no superiority of one against the other and, therefore, any of them can be used. There is only the need for consistency, especially in situations where the rates are being used for analysis. Ghana uses the indirect quotation. It should be noted however that there is something missing from the definition of the nominal exchange rate and its illustration. What is missing is the strength or the purchasing power of the currency. It is the real exchange rate that gives an indication of the purchasing power of the currency (Insah & Chiaraah, 2013; Umaru et al., 2018; Bahmani-Oskooee & Arize, 2022).

Real exchange, on the other hand, is concerned with what amount of goods can be purchased by the consumer, when that individual's domestic currency is expressed in another foreign currency. This is information many consumers are interested in (Chiloane, 2012; Osabuohien, Obiekwe, Urhie, & Osabohien, 2018; Barguellil, Ben-Salha, & Zmami, 2018). The real exchange rate expresses the concept of the price differential between countries employing various currencies. So, real exchange rate becomes a very important concept. It is impossible to overstate the significance of the real exchange rate in an open macroeconomic environment for both established and developing economies (Ogutu, 2014; Lin, Shi, & Ye, 2018). Changing the nominal exchange rate or the rate of inflation at home can have an impact on the actual exchange rate, which in turn changes the trade balance (Latief & Lefen, 2018; Kilicarslan, 2018). Again, the importance of the real exchange rate as viewed by the Keynesian and the monetarist is that it helps in addressing the external balance; since exchange rate policies are seen to be separate from the monetary policies (Ofori, Obeng, & Mwinlaaru, 2022; Dada, 2021). According to the Keynesian view, there is an increase in exports, an increase in employment opportunities, promotion of domestic savings, and an increase in income for the country when there is devaluation (Vo et al., 2019; Morina et al., 2020). If a country can shift its economy from producing basic commodities to manufacturing for export with the support of a competitive currency, then the exchange rate policy may be able to encourage better 'non-price characteristics' of the goods (Adusei & Gyapong, 2017; Sugiharti et al., 2020; Gala, 2008).

2.2. Exchange rate

Numerous theoretical and empirical works have demonstrated the relationship or connection between exchange rate levels and economic growth. In this study, investment and international trade are the two channels that have been used as proxies for economic growth.

2.2.1. Exchange rate volatility and investment

All the agents in the economy (Adu-Gyamfi, 2011; Kilicarslan, 2018; Hatmanu et al., 2020) manifest the effect of exchange rate volatility on growth through investment decisions. It has been established that when there are uncertainties due to fluctuations in the exchange rate investments are reduced due to the presence of adjustment costs, especially when investments are irreversible (Feng, Yang, Gong, & Chang, 2021; Ofori et al., 2022). Most investors delay their investment decisions due to the fact that real exchange rates have created a very uncertain environment. They delay so as to obtain enough information on the exchange rates, especially when the irreversible investments have the potential if exert a negative impact on the performance of the economy (Bobai, Ubangida, & Umar, 2013; Adewuyi & Akpokodje, 2013; Aysun, 2022). On the theoretical link between exchange rate and investment, it is assumed that firms sell part of their products in the domestic market, while the remainder is exported. Within this environment, firms are said to be able to influence prices due to their mark-up power. Similarly, parts of the inputs used by firms in their operations are imported. From this research, three possible outcomes have emerged: The first is that as the home currency depreciates, domestic goods become less expensive compared to imported ones because the exchange rate influences investments through domestic and export sales. The effect is that there is an increase in demand for domestic goods. Similarly, there will be an increase in exports due to cheap prices. Convenient demand scenarios lead to a slight rise in earnings for a fixed amount of capital and labour. Because of this, the company decides to pump more money into capital expenditures, which in turn leads to more hiring of people (Harchaoui, Tarkhani, & Yuen, 2005; Nsofor, Takon, & Ugwegbe, 2017; Tien, Duc, & Kieu, 2022; Mbuyi, Kakasi, Ntumba, & Mpebale, 2022; Hatmanu et al., 2020). Second, the exchange rate affects investment via the cost of imported materials. Depreciation adds to overall manufacturing costs, which reduces marginal profitability. Marginal profit is affected by the exchange rate in direct proportion to the amount of imported materials used in production (Nsofor et al., 2017). Furthermore, Harchaoui et al. (2005) demonstrate that the cost of adjusting the value of an imported investment can be affected by the exchange rate. Because of depreciation, the cost of investing goes up and so are the expenses required to adjust for the change in value. The global impact of the exchange rate on investment is not straightforward since it is contingent on which of these impacts predominates and the values of elasticities of demand.

According to Alagidede and Ibrahim's (2017) research, substantial swings in the value of a currency's exchange rate are bad for the economy. However, they argue that this is only true in the short run because growth-enhancing effects can still arise from innovation and more efficient resource allocation despite the volatility. Adu-Gyamfi (2011) used time series data from 1983 to 2010 to estimate the real exchange rate volatility and test cointegration and error correction models to find the impact of exchange rate volatility on growth over the short and long term. The results indicated that in Ghana, there was a statistically significant negative association between economic growth and exchange rate volatility in the short run but no such relationship in the end. Between 1988 and 2007, Sanginabadi and Heidari (2012) studied the impact of fluctuations in the Iranian currency on the country's economic development. The amount of Iran's economic growth was shown to correlate significantly with the actual exchange rate volatility observed in the study. Results from the autoregressive distributed lag (ARDL) model reveal that in the end, fluctuations in the value of a currency have a depressing influence on economic expansion. Research by Nsofor et al. (2017) looked into the link between currency fluctuations in Nigeria and GDP expansion. The impact of volatility and foreign direct investment (FDI) on the growth of the Nigerian economy was estimated using data on the exchange rate, GDP, government spending, external reserves, and FDI from 1981 to 2015. Government spending and the level of the external reserve were determined to have a favorable and sizeable effect on economic expansion. After twenty

years of being pegged to the US dollar, Costa Rica's currency rate was allowed to float within narrow ranges in October 2006, and the country's economic progress was studied by Laverde-Molina (2016). Estimates were made using a structural macroeconomic model to determine how changes in the nominal exchange rate and its volatility affected economic expansion from 1991 to 2014. A structural econometric model was used to simulate the results of maintaining the crawling peg regime for the remainder of the sample period. The average GDP growth rate between 2007 and 2014 would have been comparable under the crawling peg regime to that under the floating within bands regime, but inflation would have been much higher.

H1: Exchange rate volatility affects investment.

2.2.2. Exchange rate volatility and international trade

International trade is influenced by risk and uncertainty embedded in the volatility, in the business environment (Adu-Gyamfi, 2011; Rasheed, Ishaq, & Malik, 2022). Exchange rate fluctuations may affect trade flows depending on the degree to which exporters and importers are risk-averse and on how they respond to those fluctuations. Exchange rate risk arises from fluctuations in exchange rates and can have repercussions for international trade and, by extension, the balance of payments (Sanginabadi & Heidari, 2012; Gnangnon, 2022; Giofré & Sokolenko, 2022). Higher exchange rate volatility is theoretically linked to increased volumes of cross-border commerce. They claimed that increased volatility in exchange rates would discourage international trade because it would increase transaction costs for risk-averse businesses. This is because the payment is not made until the future delivery actually takes place, even though the exchange rate is agreed upon at the time of the trade deal. The benefits of international trade can be diminished if the rate at which currencies are purchased and sold is subject to wild fluctuations. Unfortunately, not all traders have access to future markets; therefore, exchange rate risk is unhedged for most countries. There are constraints and expenses associated with using forward markets for hedging even if it were practicable. For instance, it is challenging to arrange the size and timing of all overseas transactions to take advantage of the forward markets (Gnangnon, 2022; Bahmani-Oskooee & Arize, 2020; Giofré & Sokolenko, 2022). This is because the contracts tend to be large and have a short maturity.

However, further theoretical investigations (Sanginabadi & Heidari, 2012; Tarakç, Ölmez, & Durusu-Çiftçi, 2022; Rasheed et al., 2022) showed that this prediction is dependent on restricted assumptions about the shape of the utility function. After removing the bounds, it is unclear whether the effect is positive or negative, even if the risk aversion theory is still true. Taking on more danger has a multiplicative effect on your earnings and the cost of living. Since an increase in exchange rate risk causes agents to move from riskier export operations to less risky ones, the substitution impact per se reduces export activities (Bahmani-Oskooee & Arize, 2020; Giofré & Sokolenko, 2022). However, when the expected utility of export earnings decreases due to an increase in exchange rate risk, the income effect causes a transfer of resources into the export sector. Exports will benefit from a fluctuating exchange rate if the revenue effect is larger than the substitution effect. Companies can gain from greater exchange rate volatility if they are able to hedge against its negative effects or adapt their trade volumes to the fluctuations in the currency rate. As a result, a rise in exchange rate volatility can boost the value of exporting enterprises and encourage exporting (Franke, 1991; Sercu & Vanhull, 1992; Osazevbaru, 2021; Latief & Lefen, 2018).

If a business is able to alter its output in reaction to price changes, then an increase in exchange, rate volatility can boost both output and trade volume (Tarakç et al., 2022; De Grauwe, 1994, 1988; Hooper & Kohlhagen, 1978; Gnangnon, 2022). In addition, a multinational corporation with a sizable local market base can capitalize on fluctuations in exchange rates by shifting production between domestic and international markets. Consequently, greater volatility can boost the potential gains from international commerce (Bahmani-Oskooee & Arize, 2020; Broll & Eckwert, 1999; Giofré & Sokolenko, 2022). Additionally, from a political economy perspective, exchange rate changes help rebalance the balance of payments in the event of external shocks, reducing the need for trade restrictions and capital controls to establish equilibrium, which in turn supports international trade (Feng et al., 2021; Osazevbaru, 2021; Latief & Lefen, 2018).

Rasheed et al. (2022) look at how fluctuations in the value of a country's currency affect exports and imports used a fixed effect model. Economic theory predicts that fluctuations in exchange rates may be harmful to international trade and FDI, and their findings corroborate this prediction. The conclusion is that fluctuations in the value of one currency relative to another can have a detrimental effect on international trade and foreign direct investment. Barguellil et al. (2018), who looked at the impact of currency exchange rate fluctuations, studied expansion in the economy. Empirical research was conducted on a sample of 45 developing and emerging nations from 1985 to 2015 using the difference and system generalized method of moments (GMM) estimators. The findings suggest that a measure of nominal and real exchange rate volatility based on generalized autoregressive conditional heteroscedasticity is harmful to economic growth. In addition, when governments embrace flexible exchange rate regimes and financial openness, the effect of volatility is exacerbated.

More so, assumptions concerning risk aversion, functional forms and types of traders, adjustment costs, market structure, and the presence of hedging options are all crucial to understanding the theoretical conclusions. There is no conclusive analytical way to determine the connection between fluctuations in exchange rates and trade volumes. Therefore, the empirical question is the direction and amount of the influence of exchange rate fluctuation on commerce.

H2: Exchange rate volatility affects international trade.

3. RESEARCH METHODOLOGY

Secondary annual data from the Ghanaian Ministry of Finance, the Bank of Ghana, the International Monetary Fund, and the World Bank were used to compile this study's time series. It covers the periods 2000 to 2020. The World Bank data is taken from its annual publication *African Development Indicators*, whilst the data from the International Monetary Fund (IMF) are taken from a series of its annual publication *International Financial Statistics Yearbook*. The study is based on the exchange rate figures of the Ghanaian economy with data spanning the period between 2000 and 2020. Economic growth would be measured by per capita income and GDP growth rate. Ghana's exchange rate saw its worse depreciation in the 2000s, and the period afterwards also saw constant fluctuations. The choice of this period, therefore, gives a clearer picture of how Ghana's exchange rate has behaved.

3.1. Definition of variables

Table 1 details the various variables of the study as well as their measurement.

Table 1. Variables description

No.	*Variables*	*Code*	*Definition/Measurement*
1.	Real exchange rate	*RER*	The price of one currency against another currency adjusted for differences in the price levels of domestic and foreign prices
2.	Interest rate	*INRA*	Amount of interest due per period
3.	Real gross domestic product per capita	*RGDPC*	Economic growth
4.	Trade openness	*OPE*	The amount of goods imported and exported as a percentage of GDP
5.	Government expenditure	*GovEX*	Final government consumption expenditure expressed as a percentage of GDP
6.	Money supply	*MoSu*	Proxied by broad money taken as a proportion of GDP
7.	Foreign direct investment and portfolio flows	*FDIPF*	(Net inflows), expressed as a percentage of GDP and taken to include portfolio investments
8.	Output	*OUTP*	Real GDP measured on annual basis in millions of USD
9.	Terms of trade	*TOTR*	Net barter terms of trade index, computed as the percentage ratio of the export unit value indexes to the import unit value indexes
10.	Domestic credit to the private sector	*DOCRT*	Financial resources provided by banks to the private sector
11.	Labour	*LAB*	Economically active population
12.	Gross fixed capital formation	*GFCF*	Proxy for investment rates and measured as a percentage of GDP
13.	Inflation	*INFL*	Annual percentage change in the consumer price index and used to proxy macroeconomic (in)stability
14.	Export	*EXP*	Total export value

3.2. Empirical strategy

Due to the fact that there are changes in world prices, and the fact that there is instability in international commodity rates due to fluctuation in the nominal exchange rate, the study applies the real exchange in order to obtain the effect of differences in inflation so as to get a robust measure of the price of foreign currency in real terms. The study thus uses the following formula as a measure of the real effective exchange rate (*RER*):

$$RER = NER \times P^w/CPI \tag{1}$$

where, *NER* is nominal exchange rate, P^w is foreign price indices (US price level), *CPI* is domestic consumer price index.

The implication here is that a rise in *RER* implies a depreciation of the cedi, whiles a fall in *RER* means real appreciation of the cedi.

In this study, volatility has been measured using Bollerslev's (1986) generalized autoregressive conditional heteroskedasticity (GARCH) process developed in 1986. The reason for the use of this model is that it captures past values of the exchange rate, unlike the ARCH model. The GARCH model has been derived by making the log of the real exchange rate dependent on its previous value for the mean equation. It is derived as follows:

$$InRER_t = \alpha_1 + \beta InRER_{t-1} + \mu_t \quad \mu_t|\Omega_t \sim iid\ N\ (0, h_t) \tag{2}$$

$$h_t = \gamma_0 + \delta\mu_{t-1}^2 + \varphi h_{t-1} \tag{3}$$

where, $\gamma_0 > 0$, $\delta \geq 0$ and $\varphi \geq 0$.

The study's conditional variance h_t, therefore, captures the mean (γ_0), the previous volatility information μ_{t-1}^2 (ARCH term), and the forecast error variance of the past h_{t-1} (GARCH term). The GARCH model makes it possible for the error term to have a variance that varies based on the past behaviors of the series thereby reflecting the actual volatilities, which the agents perceive. In order to determine the short- and long-run causes of real exchange rate volatility, the vector autoregressive (VAR) model, based on the framework of Johansen and Juselius (1990) integration is used to compute the real exchange rate volatility.

Starting with the VAR(q), Y_t is defined as the unrestricted vector of variables integrated of order one as follows:

$$Y_t = A_0 + A_1 Y_{t-1} + \cdots + A_q Y_{t-q} + \varepsilon_t \tag{4}$$

where, Y_t is $n \times 1$ vector; A is an $n \times n$ matrices of parameters and ε_t is an $n \times 1$ vector of constant terms. The vector error correction model (VECM) can then be formulated by estimating the above equation in its first difference form as follows:

$$\Delta Y_t = \mu + \Gamma_1 \Delta Y_{t-1} + \cdots + \Gamma_{q-1} \Delta Y_{t-q-1} + \Pi_{yt} + \varepsilon_t \tag{5}$$

where,

- Δ is the difference operator;
- $\Gamma_i = (1 - A_1 - A_2 - \cdots - A_q)$ $(i = 1, 2, \ldots q - 1)$;
- $\Pi = -(I - A_1 - A_2 - \ldots - A_q)$ is the identity matrix, while $\Pi = n \times n$.

While Γ_i captures the short-run effects, Π measures the long-run changes in Y_t. Equation (2) is remodeled into an error correction model:

$$\Delta Y_t = \mu + \sum_{i=1}^{q-1} \Gamma_i \Delta Y_{t-1} + \Pi_i X_{t-q} + \varepsilon_t \qquad (6)$$

The rank of matrix Π is specified in the Johansen approach and it is, therefore, formulated further to be $\Pi = \alpha\beta'$ where α denotes the adjustment parameters entering each equation of the VECM while β' contains information about the long-run matrix of coefficients with α and β' matrices dimensioned $n \times r$. When Π has a full rank (i.e., $r = n$), then the variables in Y_t would be stationary. However, when the rank of Π is zero (i.e., non-existence of linear combination of the variables in Y_t), then there would be no cointegration. There is however going to be a cointegrating relationship when Π has a reduced rank $0 < r < n$.

Since the second objective of this study is to determine the effect of the exchange rate on economic growth, an estimation of a baseline equation that relates to growth and exchange rate volatility is formulated. The equation is presented as:

$$\Delta y_t = \varpi_0 + \varpi_1 y_{t-1} + \varpi_2 RERV_t + \varpi_2 Z_t + \varepsilon_t \qquad (7)$$

where, y_t is economic growth at time t proxied by log of real GDP per capita; y_{t-1} is the initial growth condition; $RERV_t$ is the exchange rate volatility at time t; Z_t is a vector of control variables including gross fixed capital formation, government expenditure, labour, inflation, trade openness and indicators of financial development while ε_t is the error term.

Threshold-generalized autoregressive conditional heteroscedasticity (TGARCH) models can be used alternatively to measure the exchange rate volatility instead of the GARCH.

4. RESULT

4.1. Descriptive statistical analysis of variables

In all, the study employed 13 variables, and this section presents the results of the descriptive statistical analysis detailing the mean, standard deviation, skewness and kurtosis. Again, the Jarque-Bera (J-B) has been used to test for the normality of the data. The purpose of the descriptive analysis is to establish a pattern in the data and determine the nature of the estimations and diagnostics that may be carried out later in the analysis. The results of the descriptive statistical analysis have been presented in Table 2.

Table 2. Descriptive statistics

	Mean	*Median*	*Max*	*Min*	*Std. dev.*	*Skewness*	*Kurtosis*	*J-B*	*CV*
RER	3.79	0.46	22.65	0.00	5.86	1.79	5.28	26.43 [0.01]	1.63
OPE	63.52	66.74	118.15	7.42	32.19	-0.20	2.01	1.58 [0.44]	0.51
MoSu	23.56	23.59	35.10	12.10	7.06	0.01	1.80	2.51 [0.30]	0.32
DOCRT	7.47	7.10	17.00	1.64	4.10	0.13	1.42	3.66 [0.15]	0.71
TOTR	144.56	135.41	219.62	90.33	33.20	0.82	2.34	3.29 [0.18]	0.25
RGDPC	685.237	417.71	935.28	550.77	112.97	1.28	3.95	10.53 [0.01]	0.25
OUTP	840.0	750.5	210.0	370.9	440.6	1.08	3.44	7.25 [0.03]	0.61
GFCF	19.04	21.55	32.12	3.49	7.64	-0.53	2.08	2.35 [0.32]	0.44
FDIPF	2.68	1.71	10.12	0.06	3.67	1.18	3.02	7.68 [0.02]	1.17
EXP	27.07	26.12	49.70	3.41	14.21	0.05	1.88	1.52 [0.48]	0.52
GovEX	11.35	12.13	21.87	5.75	3.54	1.17	5.17	14.14 [0.00]	0.34
LAB	54.76	54.68	58.06	51.68	1.98	0.06	1.74	2.29 [0.32]	0.04
INFL	28.93	23.44	122.87	8.73	26.36	2.47	9.00	85.68 [0.00]	0.91
INRA	23.60	21.12	47.89	9.94	10.89	0.66	2.41	2.94 [0.23]	0.46

Note: Values contained in [ ] indicate the p-values.

According to the data shown above, the average real exchange rate was GH¢ 3.79, with a standard deviation of 5.86. The high standard deviation figure suggests a great deal of dispersion. The skewness of 1.79 indicates a rightward bias. Once again, the values of skewness and kurtosis imply that the distribution of Ghana's exchange rate is leptokurtic, indicating a non-normality of the real exchange rate. Two degrees of freedom of the J-B normality test yielded an asymptotically chi-squared distribution. Real exchange rate, real GDP, FDI, government expenditure, output, and inflation all have high J-B test values. These abnormally large J-B values point to the absence of normalcy in the series. This finding is consistent with the findings of Kwek and Koay (2006). Because of its skewness value, the money supply (*MoSu*) variable is symmetrical. The overall average was 23.56%. According to the J-B test statistic and p-value, the distribution is normal and displays little variation across the time under consideration. All variables exhibit positive skewness except for the measures of trade openness (*OPE*) and gross fixed capital formation (*GFCF*). Statistics show that the average real GDP per capita in Ghana over the research period was just USD 685.24, further confirming the country's low levels of income. Variations in household income among Ghanaians are statistically significant, as seen by the standard deviation. The dispersion of the variables is evaluated by dividing the standard deviation by the mean to get the coefficient of variation (CV). A larger CV implies a larger range of possible outcomes. Because of the disparities between the means, the larger variability allows for a comparison of the relative volatility of the series. Descriptive statistical analysis shows that the real exchange rate is the most unpredictable metric in the dataset. There was the least amount of variation in the terms of trade, although the real variables all showed some range. The exchange rate is the most volatile external variable. There was a lot more uncertainty in FDI and portfolio movements than there was in the trade balance, government spending, and GDP. Both inflation and domestic credit were the most volatile external variables. Their wide range of coefficient variations accounted for this. Both openness and export showed a lot of variation because of their direct link.

Table 3. Correlation coefficients

	RERV	*OUTP*	*MoSu*	*TOTR*	*RGDPC*	*INRA*	*FDIPF*
RERV	1.000						
	-						
OUTP	-0.493*	1.000					
	[0.000]	-					
MoSu	-0.504*	0.671*	1.000				
	[0.000]	[0.000]	-				
TOTR	0.145	0.577*	0.357	1.000			
	[0.343]	[0.000]	[0.147]	-			
RGDPC	-0.514*	0.885*	0.637*	0.513*	1.000		
	[0.001]	[0.000]	[0.000]	[0.000]	-		
INRA	-0.226*	-0.180	0.130	-0.580*	-0.176	1.000	
	[0.053]	[0.426]	[0.416]	[0.001]	[0.401]	-	
FDIPF	-0.556*	0.867*	0.497*	0.565*	0.755*	-0.142	1.000
	[0.003]	[0.000]	[0.000]	[0.001]	[0.000]	[0.331]	-

*Note: Values contained in [ ] indicate the p-values. * Significant at 5% significance level.*

A correlation analysis was conducted to ascertain the coefficient of real exchange rate volatility in connection to a range of other variables, such as real GDP per capita, money supply, terms of trade, production, interest rate, and FDI. Table 3 displays the findings of this analysis, showing a negative and statistically significant association between real exchange rate volatility and all variables except terms of trade (*TOTR*), which correlates favorably but not statistically significantly. Table 3 reveals a robust relationship between real exchange rate volatility and both money supply and output. Real GDP is positively related to output, the money supply, and the terms of trade. This positive association is to be anticipated because productivity, financial deepening, and terms of trade all play crucial roles in GDP. There is also a positive correlation between terms of trade and output as well as money supply. Whereas the correlation between outputs is significant, that of the money supply is not.

4.2. Estimation of real exchange rate volatility

The GARCH (1, 1) model will be used to make an estimate of the volatility of the exchange rate, which is an important goal of the research. The estimated results are shown here. Furthermore, the results' robustness is evaluated so that the model's accuracy can be guaranteed. Ljung-Box statistics on the standardized residuals and standardized squared residuals of the computed GARCH models reveal no evidence of serial correlation, supporting the findings. Again, the ARCH Lagrange multiplier (LM) test reveals no heteroscedasticity because of the small LM statistic (9.0741) and the large p-value (0.8899).

Table 4. Estimation of real exchange rate volatility

Variable	*Coefficient*
Mean equation	
Constant	0.1192
	(4.671)***
LRER(-1)	0.9447
	(35.42)***
Variance equation	
Constant	0.0009
	(0.351)
ARCH(1)	-0.3301
	(-0.971)
GARCH(1)	1.163***
	(3.381)
ARCH[12]	9.0741[0.8800]
ARCH[1]	0.00303 [0.9551]

*Note: *** Significant at 1% significance level.*

The conditional variable equation's result shows that the mean γ_0 equation (3) is positive but insignificant. The previous forecast error — *GARCH* (h_{t-1}) shows a positive value at 1% level of significance. The results further reveal that the previous information about the real exchange rate volatility as measured by the squared residual (μ_{t-1}^2) from the mean equation is negative and insignificant. The ARCH effect's insignificance is consistent with the LM test on the residual implying that the GARCH specification is appropriate for modelling exchange rate volatility. The summation of the coefficient on the lagged squared error (δ) and lagged conditional variance (φ) is almost unified at ($0.94 \approx 1$). This implies highly persistent volatility shocks suggesting the presence of clustering volatility (a period of large (small) changes in the exchange rate shock is followed by large (small) changes over a longer period).

4.3. Unit root tests

In order to test for stationarity in the data, a unit root test was done. According to the results, two scenarios have been presented. The first had to do with it being constant and having no trend and the other being constant with a trend. In addition, there exist non-stationary variables as revealed by the augmented Dickey-Fuller (ADF) test. After the first differencing, however, all the series attained stationarity. This stationarity holds for both

situations where there is a trend or no trend. The variables show a lot of robustness to the testing approach as indicated by the unit root property. Furthermore, each of the series is non-stationary whether including trend or not, as indicated by the results of the Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test.

Table 5. Unit root results

Variables	*ADF*		*PP*		*KPSS*	
	Constant	*Trend and constant*	*Constant*	*Trend and constant*	*Constant*	*Trend and constant*
MoSu	-1.007	-2.80	-0.91	-2.97	0.58	0.12
ΔMoSu	-5.74*	-6.33*	-5.74*	-6.33*	0.13*	0.12*
INRA	-2.15	-2.07	-2.07	-1.96	0.176	0.18
ΔINRA	-5.88*	-5.86*	-6.10*	-6.72*	0.16*	0.18*
TOTR	-1.72	-1.26	-2.19	-2.68	0.25	0.21
ΔTOTR	-5.62*	-6.18*	-6.49*	-9.07*	0.47*	0.17*
OUTP	3.06	0.08	3.20	-2.29	0.68	0.22
ΔOUTP	-4.74*	-5.44*	-3.03**	-3.48***	0.59*	0.15***
FDIPF	-0.95	-2.75	-0.90	-2.74	0.57	0.07
ΔFDIPF	-5.25*	-5.20*	-5.21*	-5.20*	0.12*	0.11*
RERV	-1.70	-2.67	-1.78	-2.40	0.73	0.09
ΔRERV	-5.16*	-5.14*	-5.27*	-5.28*	0.15*	0.12*

*Note: *, **, ***, significant at 1%, 5%, 10% significance level respectively.*

4.4. Cointegration test

Finding out what factors affect interest rate volatility over time is an important research goal. Table 6 displays the results of the cointegration test. The aforesaid results imply that at most three (3) cointegrating equations exist, providing evidence for a long-run relationship between volatility, production, FDI and portfolio investment, money supply, interest rate, and terms of trade.

Table 6. Johansen trace cointegration test

Null hypothesis	*Eigenvalue*	*Trace statistics*	*0.05 Critical value*	*Prob.***
$r = 0$	0.764	114.259	94.853	0.0017*
$r \leq 1$*	0.683	89.396	67.718	0.0061*
$r \leq 2$*	0.547	59.923	46.756	0.032**
$r \leq 3$	0.475	37.964	31.697	0.081
$r \leq 4$	0.363	14.380	17.394	0.105
$r \leq 5$	0.219	4.515	4.641	0.157

*Note: *Significant at 1% significance level. ** Significant at 5% significance level.*

4.5. Drivers of real exchange rate volatility

The study also aimed to determine the factors that contribute to the unpredictability of Ghana's actual exchange rate. The VECM was employed to identify the key factors that cause short-term changes in the actual exchange rate. The outcomes are shown in Table 7. The results also include a term representing the rate at which errors are rectified, providing insight into how quickly deviations from the norm are brought back into line.

Table 7. Drivers of real exchange rate volatility

Variable	*Coefficient*	*Stand. error*	*z-statistic*	*p-value*
Constant	-0.069	0.052	-1.47	0.143
FDIPF	0.075	0.054	1.27	0.205
GovEX	0.017	0.014	1.07	0.313
OUTP	-0.026	0.002	-11.59	0.000*
MoSu	0.014	0.011	1.26	0.207
TOTR	0.009	0.010	0.65	0.516
R^2	0.223		HQIC	-14.561
χ^2 [p-value]	7.6097 [0.023]		SBIC	-13.940

*Note: * Significant at 1% significance level. *** Significant at 10% significance level.*

The following results show that the independent factors account for approximately 22% of the variance in exchange rate volatility ($R^2 = 0.223$). Model significance is represented by the p-value and χ^2 values. Each of the aforementioned variables is important at the 10% level in the scenario presented above. Trade balance, money supply, government spending, and FDI all positively affect volatility, though to a lesser extent. This suggests that in the near run, these factors are insufficient to account for fluctuations in the real exchange rate. The coefficient of output has a negative value at the 5% level of significance, indicating that exchange rate volatility rises as output falls. The coefficient of the error correction term (ECT) is negative and statistically significant, suggesting that 6.9% of the initial deviation from the long-run equilibrium is corrected each year following a short-run exchange rate shock and that it will take 14.6 years for full equilibrium to be restored to the long-run equilibrium. A normalized cointegrating equation was run to standardize the volatility in order to provide a more accurate representation of volatility. The results of the normalised cointegration equation are presented in Table 8.

Table 8. Normalised cointegrating equation

Variable	*Coefficient*	*Stand. error*	*z-statistic*	*p-value*
Constant	71.805	-	-	-
FDIPF	0.868	0.509	2.14	0.031**
GovEX	5.149	1.809	2.86	0.004*
OUTP	-11.155	2.050	-4.98	0.000*
MoSu	7.685	1.955	3.55	0.001*
TOTR	-9.181	1.752	-5.30	0.000*

*Note: ** Significant at 5% significance level. * Significant at 1% significance level.*

The results show that when productivity rises, volatility lowers and vice versa and that when productivity falls volatility rises. However, the output or instance is still negative and substantial at the 1% level. Once more, a negative and statistically significant correlation exists between terms of trade and real exchange rate volatility. This indicates that an improvement in terms of trade reduces volatility. This is not an unlikely event to occur because rising export prices tend to fall in response to an increase in a country's external purchasing power. An equally positive and statistically significant *FDIPF* value suggests that the integration of Ghana's financial market into the global financial market increases volatility over the long run. There is a positive and statistically significant value for government spending at the 1% level, indicating that there is a correlation between government spending and volatility in the exchange rate. Large government spending boosts the money supply and stimulates strong demand for non-tradable products, both of which are positively correlated with swings in the exchange rate.

4.6. The effect of exchange rate volatility on growth

In the literature, there is no definitive response to the topic of whether exchange rate volatility affects economic growth. Different investigations have produced varying findings. This component of the study tries to experimentally verify the impact of Ghana's variable exchange rate on economic growth. It should be highlighted, however, that big fluctuations in exchange rates generate a great deal of uncertainty, which impacts the investment and consumption decisions of individuals. The performance of economic growth may, therefore, be altered by investment and consumption decisions. In this part, the GMM estimation technique was utilized to determine the impact of real exchange rate fluctuation on economic growth. Table 9 displays the result of the estimation. There are three distinct specifications of the effect, as shown in the table. The overall validity was evaluated using the Hansen test for over-identification constraints. Due to the extremely low J-statistics and large p-values, it is clearly evident that the models failed to reject the null hypothesis, as indicated by the results. More than 90 percent of the variation in growth can be described by the differences in the variables, as indicated by the R-square value. The overall significance of the model is justified by the high Wald values and the low (p-values).

Table 9. Effect of real exchange rate volatility on growth: GMM estimations

Variable	*1*	*2*	*3*
Constant	-4.155 (3.302)	-4.016 (1.824)	-0.293 (1.608)
*RGDPC*t-1	0.806 (0.345)*	0.779 (0.162)*	0.914 (0.114)*
RERV	-0.009 (0.005)**	0.020 (0.033)	-0.124 (0.043)*
GovEX	0.089 (0.065)	0.080 (0.047)	0.003 (0.030)
GFCF	0.046 (0.047)	0.032 (0.026)	0.005 (0.026)
INFL	-0.026 (0.007)*	-0.033 (0.007)*	-0.084 (0.024)*
LAB	2.918 (2.251)	2.914 (1.213)**	0.345 (1.086)
OPE	0.041 (0.024)	0.044 (0.031)	0.163 (0.045)*
DOCRT	0.081 (0.031)**	0.076 (0.024)*	0.057 (0.022)*
RERV square		0.005 (0.004)	0.019 (0.006)*
Interactions/Transmission channels:			
*RERV * INFL*			-0.023 (0.008)*
*RERV * INRA*			0.007 (0.004)***
*RERV * TRADE*			0.021 (0.011)***
Wald	7341.45	5916.74	7793.07
p-value	0.000	0.000	0.000
Hansen's J-statistic [p-value]	8.628 [0.202]	9.883 [0.201]	9.421 [0.231]

Note: Dependent variable is log of real GDP per capita. Values in ( ) are robust standard errors.
, **, * Significant at 1%, 5%, 10% significance level respectively.*

Based on the results of Model 1, it can be inferred that fluctuations in the real exchange rate have a negative and considerable effect on growth. To be more precise, growth slows by 0.9% for every percentage point rise in volatility. Inflation's negative impact on growth adds to the evidence that volatility in macroeconomic indicators is harmful to development. Every percentage points that inflation rises, growth slows by 2.6%. All the models show that domestic credits have a positive coefficient and large values, indicating that they contribute to economic growth. In contrast, the findings suggest that openness to trade, labour, and capital are all relatively minor contributors to economic growth. Model 2 incorporates a quadratic term of exchange rate volatility, and the results show that volatility

and its square have a beneficial effect on growth. However, statistically speaking, they do not mean anything. When the quadratic term is taken into account, the favorable impact of labour on growth becomes much more noticeable. Model 3 analyzes the channels via which volatility affects growth. In this case, volatility has a negative effect at a 1% level of significance, but adding the quadratic element flips it to a positive effect. A U-shaped link between volatility and growth is implied.

Once the transmission channels are managed, the value of trade openness increases significantly. Furthermore, it should be mentioned that all the channel coefficients are statistically significant. Volatility and trade have a positive interaction term, suggesting that changes in the exchange rate affect growth by influencing the competitiveness of domestic export and import-competing firms. However, when there is excessive volatility, this competitiveness deteriorates, and firms' earnings tend to fall as a result. Once again, growth is impacted when inflation is reduced as a source of macroeconomic instability. When there is actual volatility in exchange rates, interest rates rise. This indicates that interest rates rise in response to depreciation, affecting capital inflows, and fall in response to appreciation.

5. DISCUSSION

In the last half-century, Ghana's economy and government have gone through a variety of growth spurts, dips, and upheavals. Regular price and income controls have been a hallmark of economic policies that were not founded on market principles during this time. Very low productivity, extremely high and fluctuating prices, an inflated currency, and high-interest rates have all plagued Ghana's economy. This terrible and unfavorable investment climate has led to very slow growth. The instability of exchange rates has been cited as a factor that is retarding growth. This research set out to find out how fluctuations in the cedi affect the growth of the country's economy. The particular goals were to analyze the impact of exchange rate volatility on growth, study and estimate the real exchange rate volatility, determine the drivers of volatility, and establish whether the link among the variables is long- or short-run. To examine the information collected from 2000 to 2020, the researchers used descriptive statistics, regression analysis, and correlation analysis. Specifically, the study indicated that significant (small) changes in the exchange rate shock tend to be followed by similarly large (small) changes over a longer period of time, indicating that the actual exchange rate is of clustering volatility in nature. It was found that trade openness, government spending, money supply, FDI, output, domestic lending to the private sector, etc. all correlate negatively with exchange rate volatility. Long-term exchange rate volatility was found to be affected by exogenous variables such as the terms of trade, domestic money supply, government expenditure, and capital flows. Research also shows that fluctuations in exchange rates have a dampening effect on economic expansion. The overall impact is more felt in the long run than in the short term. Investment choices by all actors in the economy reveal the impact of exchange rate volatility on growth (Adu-Gyamfi, 2011; Kilicarslan, 2018; Hatmanu et al., 2020). It is well known that investment decreases due to adjustment costs when there are uncertainties due to variations in the currency rate, especially when investments are irreversible (Feng et al., 2021; Ofori et al., 2022). Because of the high level of uncertainty brought on by fluctuating real exchange rates, most investors are holding off on making any investment decisions. They wait to collect adequate data on the exchange rates, which is especially important when the long-term investments could have a detrimental effect on the economy's growth and development (Bobai et al., 2013; Adewuyi & Akpokodje, 2013; Aysun, 2022; Mbuyi et al., 2022; Hatmanu et al., 2020). Furthermore, the risk and uncertainty inherent in the volatile business environment affect international trade (Adu-Gyamfi, 2011; Rasheed et al., 2022). Exchange rate fluctuations may affect trade flows depending on the degree to which exporters and importers are risk-averse and on how they respond to those fluctuations. Exchange rate risk arises from fluctuations in exchange rates and can have repercussions for international trade and, by extension, the balance of payments (Sanginabadi & Heidari, 2012; Gnangnon, 2022; Giofré & Sokolenko, 2022). The correlation between fluctuating currency exchange rates and business deals across borders. They claimed that increased volatility in exchange rates would discourage international trade because it would increase transaction costs for risk-averse businesses. This is because the payment is not made until the future delivery actually takes place, even though the exchange rate is agreed upon at the time of the trade deal. Unpredictable fluctuations in exchange rates limit the benefits of international trade by making future earnings less assured for both parties (Bahmani-Oskooee & Arize, 2020; Giofré & Sokolenko, 2022; Osazevbaru, 2021; Latief & Lefen, 2018).

6. CONCLUSION

This study aimed to investigate the connection between exchange rate volatility and economic growth in Ghana. The study discovered that the actual exchange rate exhibits clustering volatility, meaning that a period of large (small) fluctuations in the exchange rate shock is followed by large (small) fluctuations over a longer time. A negative association was found between exchange rate volatility and trade openness, government spending, money supply, foreign direct investment, production, and domestic private credit. It was determined that external variables such as terms of trade, domestic money supply, government expenditures, and capital flows affected long-term exchange rate volatility. The study also indicated that exchange rate volatility had a negative effect on economic growth. Due to the paucity of current research on the topic, the value of this study resides in the fact that it will contribute to the existing literature by giving evidence of the relationship between exchange rate volatility and economic growth using very recent data. Even though there have been studies in the past, the majority of them failed to adequately examine Ghana's exchange rate volatility. In addition, it is anticipated that the research findings will assist policymakers to

design cautious policies that limit the exchange rate's volatility in order to promote trade and investment, as well as capital inflows to stimulate economic growth and improve the welfare of the populace. This study's findings would be useful to practitioners in the area, such as Central Bank officials, in understanding the variables that truly drive exchange volatility, and the recommended solutions will go a long way toward assisting them in strengthening and stabilizing the exchange rate.

The paper suggests a thorough understanding of the numerous variables that enter the exchange rate policy equation so that effective measures for restoring exchange rate stability can be proposed. Since the Bank of Ghana's actions have not proven useful over the years in addressing exchange rate volatility. The Bank of Ghana must bolster its research capabilities in order to examine Ghana's macroeconomic environment so that appropriate policies may be taken. Due to the inverse relationship between exchange rate volatility and output, the Ghanaian government must foster productivity to boost output. Moreover, the government should support the diversification of sectors by promoting industrialisation in order to increase exports as a means of offsetting our massive imports. To combat inflation, the monetary policy must be tightened by increasing the interest rate. The central bank should not only focus on inflation targeting but also appear to be addressing exchange rate volatility. The central bank must strengthen its modelling and forecasting of currency rates, and it must include the impact of asset prices in its domestic monetary policy in order to enhance the foreign exchange market's transparency and functionality. Since exchange rate volatility is a significant cause of business cycles or production swings in the majority of developing nations, this study has paved a significant road for these countries. The study assists policymakers in strategizing and implementing effective measures to minimize or reduce exchange rate volatility, given that exchange rate volatility has a negative impact on domestic consumption, which ultimately lowers aggregate expenditures and dampens overall economic growth. In addition, the study's findings enable policymakers to implement policies that ensure exchange rate stability and to assess the long-term impact of exchange rate volatility on factors such as the social and political macroeconomic elements of emerging nations.

This study was limited to the influence of currency rate volatility on economic growth; future research should investigate the effects of exchange rate volatility on bilateral trade between African countries and other rising economies, such as BRICS. Additionally, additional research should investigate the relationship between exchange rate volatility, export market, and foreign direct investment in Sub-Saharan Africa. Finally, future research should investigate the relationship between exchange rate volatility and other currencies.

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