



Effects of Exchange Rate Volatility on Economic Growth: Evidence from West Africa

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Abstract: The implications of exchange rate movement for economic growth have become a growing focus of attention in the recent policy debate and the debate concentrate on the degree of volatility in the exchange rate. Exchange rate volatility is usually a risk that will result in higher costs for risk-averse investors, who may adopt a wait-and-see policy until the uncertainty subsides, thereby leading to reduced employment opportunities and slower growth. Thus, in judging the desirability of exchange rate volatility, this paper studies the effects of exchange rate volatility on economic growth for twelve West African countries: The Gambia, Ghana, Cote d'Ivoire, Mali, Niger, Nigeria, Senegal, Togo, Benin, Burkina Faso, Guinea Bissau, and Sierra Leone. Furthermore, the almost complete neglect of the financial sector development in the growth prospect of West African countries is still rather surprising since economic intuition and theory suggest that the growth of the financial sector by means of indebtedness and credit expansion does provide an average GDP growth rate. However, the financial markets and institutions in the West African countries are narrow and shallow. Thus, these countries do not have the tools to hedge exchange rate risks. Hence, fluctuating exchange rates often generate uncertainty, which leads to a decline in economic activity. Therefore, this study also analyzes the role of financial sector development on the impact of exchange rate volatility on economic growth of the West African economies. The random-effects and the two-step difference Generalized Method of Moment GMM estimation techniques are used in this analysis. The "Ad hoc method" is employed by using the lagged term of exchange rate movements for a robustness check in the random-effects model. The results support that the depreciation of the real effective exchange rate volatility has a contractionary effect on economic growth in West African countries and this contractionary effect decreases with countries' financial sector development. Our results are also support the random effect "Ad hoc methodology" and the GMM procedure implying that they are robust to the cross-section correlation and reverse causality considerations. We also showed that depreciation of real exchange rate is again contractionary for the West African countries in the short run as well as in the long run using GMM procedures. The study recommends that the authorities in the West African countries should speed up the development of their financial sector to decrease the negative effects of exchange rate volatility thereby encouraging economic growth.

Keywords: Economic Growth, Ad Hoc Methodology, Financial Sector Development, Exchange Rate Volatility, Endogeneity, Heteroskedasticity

1. Introduction

Exchange rate changes affect the economy through multiple channels. Therefore, the impact of exchange rate changes on economic growth has become the focus of increasing attention in recent policy debates, that is, the degree of exchange rate fluctuations. A volatile exchange rate is likely, in turn, to determine economic performance [37]. Thus, in judging the desirability of exchange rate volatility in the face of significant adverse shocks (internal and external),

it is necessary to study its effect on economic growth. This topic remains one of the most hotly debated topics in development economics over the last couple of decades.

Different authors have given different explanations for the impact of exchange rate changes on the economic growth of developing countries. For example, Kandil and Mirzaie [37] submit that aggregate demand affects currency depreciation through exports, imports, and the demand for domestic currency and cost of imported intermediate goods affects aggregate supply, and all of which have implications for real output growth.

Bahmani-Oskooee and Gelan [5] mentioned that in the case of African countries that in recent years have shown a sign of hope in their growth policies to transform their economies into sustainable development, the volatility of nominal and real exchange rate problems could be a more worrying issue in achieving their objectives. [28, 57] confirmed that exchange rate changes are critical to the economic growth of developing economies.

Similarly, Bahmani-Oskooee and Gelan [5] argue that unstable exchange rates may trigger uncertainty for profit-maximizing traders. As a result, their participation in the trade sector will decrease and economic growth will weaken. Correspondingly, [11] said that short-term exchange rate fluctuations may also have a negative impact on the microeconomic level. Hence, exchange-rate fluctuation is usually a risk. Higher risks will result in higher costs for risk-averse investors, who may adopt a wait-and-see policy until the uncertainty subsides, leading to reduced employment opportunities and slower growth [9, 55, 61]).

One of the main reasons behind the increased attention on the growth effects of exchange rate fluctuations is the growth experiences of West African countries, which have been assessed to pursue economic policies of beggar thy neighbor¹ that has not yielded the desired effect because the West African's exports are generally low and have higher primary commodity content, which cannot compete in the international market. More than that, the financial markets and institutions in West Africa are narrow and shallow. Thus, these countries do not have the tools to hedge exchange rate risks. Hence, fluctuating exchange rates often generate uncertainty, which leads to a decline in economic activity.

However, the standard Mundell-Fleming model predicts that currency depreciation can be expansive through the effect of expenditure switching between domestic and foreign goods. Contrary to this traditional view, the New-structuralist school provides a number of demand-side and supply-side channels through which depreciation/devaluation will adversely affect output. For example, when a great deal of the borrowing of firms is denominated in foreign currency and aggregate demand is constrained with agents' net worth, a real depreciation worsens the balance sheets of firms, which leads to contractions in investment, employment, and output [38].

Correspondingly, in the context of a global economic slowdown and weak demand, currency devaluation may not necessarily support exports. In some cases, this policy may be counterproductive. If competitors object, take policy measures, such as devaluation (to protect exports) then, such a practice may not have desirable results, especially if the country's imports are not price elastic (the imports are essential and not dependent on prices) and instead could end up hurting the trade balance through higher import prices and resulting in inflation in such economies, which then hurt the economic growth rate.

Therefore, the premise that devaluation leads to export growth and trade balance improvement and subsequent output improvement is not consistent in the literature [13, 21, 66]. In general, the empirical evidence on exchange rate fluctuations and economic growth seems to be mixed at best, indicating that further investigation is needed to better understand this relationship (see section 2.2).

The empirical evidence provided by a group of studies shows that exchange rate fluctuations in African countries are often contractive, pointing out the fundamentals that affect economic growth [6, 26, 50, 53, 64].

On the other hand, another set of empirical evidence shows that when they combine different countries and regions in their analysis, exchange rate fluctuations promote economic growth. These studies relate the expansionary effect of the undervalued exchange rate to various channels such as the development of the tradable sector and savings and investment [46, 57, 63].

Other studies have utilized the generalized method of moment (GMM) dynamic panel data estimator and offer empirical evidence that real exchange rate volatility can have a significant impact on the long-term rate of productivity growth, but the effect depends critically on a country's level of financial development [3].

At the same time, the existing literature seems to largely ignore the situation of West African countries, open, fragile, growth, and poverty-challenging economies. As pointed out earlier, the financial sector of these economies is also small, centered on banks, and not very developed; in fact, financial development has been relatively slow and mostly insufficient [8].

Since West African countries have a relatively small share of world trade, they are price takers and are vulnerable to external shocks. In addition, since their trade sector accounts for a large part of the domestic economy, shocks to the world economy will have a great impact on these countries. For example, shocks to the terms of trade are the main factor leading to large fluctuations in the GDP of these countries. For example, from 1995 to 2017, the GDP of the considered West African countries fluctuated considerably, and all the considered countries showed negative growth (see Appendix).

A critical study on the main difference in the empirical literature (see section 2.2) shows that most of the conclusions were due to the kind of data used in the empirical analysis, the estimation technique or method, the geographical region, or the country where the study takes place and the proxy for volatility. It is also found that some researchers have studied the relationship between exchange rates and economic growth from the perspective of individual country analysis and using time series data.

In contrast, recent studies, which employed the panel-based approach, are more desirable because of obvious advantages. For example, by combining cross-sectional and time-series dimensions, a panel data analysis can control not only for temporal effects but also heterogeneity across the countries.

Panel data usually contain more degrees of freedom and less multicollinearity than cross-sectional or time-series data

¹ Beggar thy neighbor policy refers to a policy that aims at addressing a country's domestic problems at the expense of others, through devaluation/depreciation of its domestic currency, which subsequently strengthening the dollar and prop up exports.

because of a large number of observations. It has the advantage of distinguishing between fixed effects and random effects, so it improves the efficiency of econometric estimation. Furthermore, it allows the researcher to control the effect of missing variables and permits accurate predictions for individual outcomes by pooling the data rather than generating predictions of individual outcomes; thereby making it appropriate to apply panel data analysis for the West African countries in this study.

In this regard, the research questions are: Does exchange rate volatility impact economic growth in West African countries? Does the level of financial sector development influence the impact of exchange rate volatility on economic growth in the West African countries?

The research objectives have been developed based on the research questions. The first objective is to investigate the impact of exchange rate fluctuations on the economic growth of the West African countries under consideration. To this end, we applied pool ordinary least square OLS, fixed effects, and random-effects models. To check the robustness of the results and control for potential endogeneity issues, we use the “Ad hoc method” by lagging the exchange rate volatility variable, as well as the two-stage least square GMM method.

Second, previous studies have shown that financial development fosters growth. An interesting question that this research attempts to answer is whether the level of financial development will also affect the impact of exchange rate fluctuations on the growth of West African countries. The basic assumption is that when the country’s financial sector is underdeveloped, exchange rate fluctuations will have a negative impact on growth. Hence, the focus of this study will be to solve the research problem and overcome the shortcomings and limitations of previous studies.

A study of this nature is significant for West African countries because a recent publication by the [2], remarked that “West African countries mainly export primary commodities and are price takers in these markets, and import manufactured products.” Hence, the relative price of the commodity is crucial in determining the economic growth rate in these countries. Therefore, understanding the impact

of exchange rate fluctuations on economic growth has become an important issue in formulating the best exchange rate policy for West African countries.

Furthermore, the almost complete neglect of the financial sector development in the growth prospect of West African countries is still rather surprising since economic intuition and theory suggest that the growth of the financial sector by means of indebtedness and credit expansion does provide an average gross domestic product GDP growth rate. Such neglect is unfortunate because it helps to reinforce the deep-seated West African countries’ research bias against the impact of this sector on economic growth in West African countries. Thus, this study also analyzes the effect of the development of the financial sector on the impact of exchange rate fluctuations on the economic growth of West African economies in order to provide policy enlightenment.

The rest of the study is as follows; Section 2 presents the literature review in two main parts. Section 2.1 puts forward the theoretical argumentation; section 2.2 puts forward an empirical study of the impact of exchange rate fluctuations on economic growth based on cross-country and individual country data. Section 3 describes the model specifications, the definition of variables, the scope and source of the data, and the measurement of exchange rate fluctuations and methodology. Section 4 provides a summary and discussions of the results. Section 5 presents conclusions.

2. Theoretical and the Empirical Literature

2.1. The Theoretical Literature

2.1.1. Impacts of Exchange Rate Movement on Economic Growth

The Keynesian open economy model suggests that internal balance and external balance can be maintained by two types of policies: expenditure-switching and expenditure-reducing policies. The exchange rate is the main tool of the first type of policy, while monetary and fiscal policies are the tools of the second type of policy.

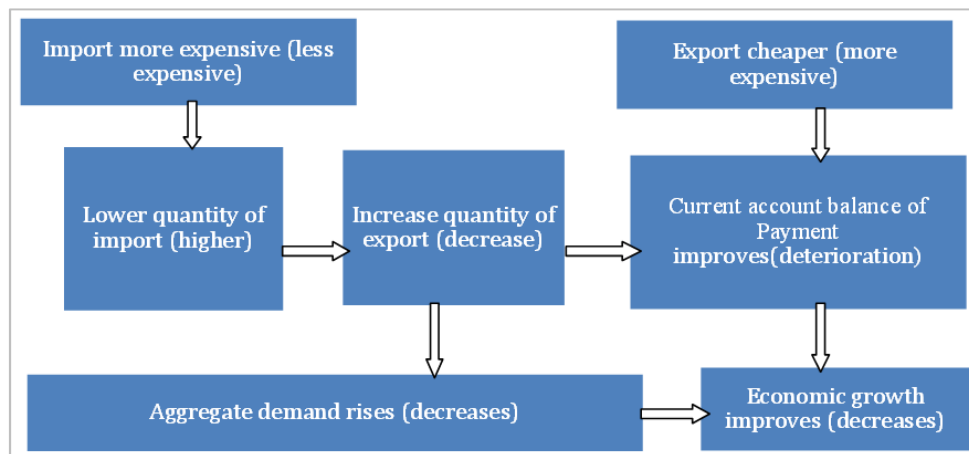


Figure 1. The Transmission mechanism of exchange rate depreciation and (appreciation) on economic growth.

The exchange rate is a key macroeconomic factor that affects international trade and the economy of each country. The development of international trade has created conditions for exchange rate fluctuations. On the one hand, exchange rate depreciation may stimulate economic activity through the initial increase in the price of foreign goods relative to domestic goods. By increasing the international competitiveness of the domestic industries, depreciation in the exchange rate diverts spending from foreign goods to domestic goods. However, the success of currency depreciation in promoting trade balance and subsequent growth largely depends on switching demand in the proper direction, as well as on the capacity of the home economy to meet the additional demand by supplying more goods [18]. Figure 1 shows the transmission mechanism of depreciation and appreciation to economic growth.

According to the standard Mundell-Fleming model [22, 49], for depreciation in the real exchange rate to increase the monetary value of exports minus imports (i.e., net exports), however, requires that the Marshall-Lerner condition applies to the specific nation's monetary value of exports minus imports. The Marshall-Lerner condition is that the sum of the absolute value of import price elasticity plus the absolute value of export price elasticity must exceed one (assuming that there is no significant change in the income of buyers in each country). If, and only if, the Marshall-Lerner condition is applicable can a reduction in the exchange rate result in a greater domestic monetary value of net exports [i.e., $X-M$]. If this is the case, then exchange rate depreciation promotes aggregate demand by encouraging exports and creating substitutions from imports to domestic goods.

When export prices decline while the exchange rate remains unchanged, major export activities become unprofitable in terms of the domestic currency. Devaluation can restore profitability without reducing foreign exchange reserves or public sector savings. Other export products whose world prices have not fallen will gain windfalls from the devaluation, which will stimulate their expansion. Changes in relative prices will also prompt exporters to find cheaper domestic substitutes for imported inputs, which will further reduce the demand for imports and strengthen the profitability of domestic production, thereby increasing output.

For example, Rodrik [58] showed that both undervalued and overvalued currencies can improve welfare by promoting structural change and industrial growth. Therefore, changes in internal trade conditions that are conducive to the industry are seen as the main development channel for structural changes. The overvalued currency imposes taxes on the export-oriented agricultural sector, but by reducing the cost of imported intermediates and capital, it serves as a subsidy to the domestic industrial sector. The net effect may be the transfer of resources from agriculture to industry.

Rodrik [57] posits that the tradable sector in developing economies is characterized by market failures and institutional weaknesses to a greater extent, which means that

the tradable sector is below its optimal size, and this creates room for policy to remove the distortion. He shows that, in an endogenous growth framework, undervaluation helps address this issue by expanding the tradable sector. Alexander [4] argued that if wages do not adjust fully to the inflationary effects of devaluation, devaluation can redistribute income from workers to producers in the form of increased profits. In turn, increased profits can encourage producers to invest more, thereby increasing production.

However, in developing countries, exchange rate depreciation may have a negative impact on economic growth [14]. Structuralism emphasizes this negative effect of devaluation. Hirschman [30] pointed out that currency depreciation caused by the initial trade deficit reduces real national income and may lead to a decline in aggregate demand. Kandil and Mirzaie [37] proposed that if the trade is balanced and the terms of trade remain unchanged, the price changes will cancel each other out. But if imports exceed exports, the net result is a decrease in domestic real income. Cooper [14] confirmed this point in a general-equilibrium model.

Depreciation may affect effective demand and supply, both domestic and foreign, the expectations of agents as well as their financial status. The latter is very important for companies and governments that borrow from foreign financial institutions. Exchange rate depreciation will burden domestic balance sheets and budgets, thereby increasing financial instability. In addition, due to depreciation, inflation may rise because domestic prices will start to rise. This event is explored in detail as follows:

2.1.2. Contractionary Devaluation Hypothesis

Krugman and Taylor [44] opined that in many developing countries devaluation may result in a short-run contraction in the level of spending and economic activity through several channels. These channels are redistribution in the private sector [16]: In the short term, devaluation will raise domestic prices, leading to a drop in real wages for all activities, which in turn leads to a drop in aggregate demand. On the other hand, the extent to which the labor force succeeds in raising its nominal wage depends on its degree of organization and relative bargaining power. Although these factors are strong in some developed countries, they are often weak in most low-income developing countries, and the recovery of real wages may take a considerable amount of time.

Assuming that nominal wages are rigid, depreciation will lead to a reduction in real wages and redistribution of income to the benefit of capital owners. Assuming that workers have a higher marginal propensity to consume than capitalists, a fall in wages will lead to a reduction in private expenditure, thereby shrinking domestic demand and output. But at the end of the adjustment process, if the labor union is strong, the nominal wage may increase. This event will increase production costs and subsequently lead to low output.

The rise in price levels caused by rising wages may increase the possibility of monetary expansion to

accommodate higher demand. The result of monetary expansion will be a jump in prices, fueling inflationary expectations and the demand for foreign currency—both as a hedge against inflation and in anticipation of a further devaluation. In addition to the negative impact, this reaction will also have an impact on the external payment position, which will further promote devaluation and a new jump in prices. This spiral of inflation and devaluation can be very harmful to economic growth, not only because it cannot correct imbalances, but also because it undermines the credibility of exchange rate devaluation as a policy tool.

Díaz-Alejandro [16] put forward another argument for contraction after devaluation. Devaluation may raise the windfall profits in export and import-competing industries. If money wages lag the price increase and if the marginal propensity to save from profits is higher than that from wages, national savings will go up and output will decrease (see [37] and [44] for confirmation).

Fiscal effect: If the ad valorem tax rate for exports is raised, the government's tax revenue will increase. In that case, the value of taxes paid by exporters (measured in domestic output units) increases after devaluation and thus reduces private disposable income, which reduces aggregate demand. In other words, if the country is a price taker in export markets so that the volume of exports is independent of the exchange rate, the value of exports in foreign currency becomes independent of the exchange rate [15]. In this case, the value of the tax paid by exporters (measured in domestic output units) increases after devaluation, thus, reducing private disposable income and expenditure. The basic assumption here is that the marginal propensity to consume in the public sector is close to zero in the short term [see 15 for details].

The impact of devaluation on output is complex. In the short term, before exports expand, domestic demand for trade will fall, which will help the balance of payments. However, due to lower real incomes, the decline in demand for home goods will be accompanied by an increase in demand for them because they are now cheaper than tradable goods. If the devaluation is large and if there is little substitution between tradable and home goods as there is in most developing countries, there will be a net reduction in demand, since the amount of money available for home goods will fall. If consumers can easily substitute domestic goods for tradable goods, the net increase in demand for them will tend to raise prices and raise wages, which will spread to tradable goods and reduce their relative price advantage.

Valuation effects: Going back to the Marshall-Lerner setting, suppose a country has an initial trade deficit. The effect of a devaluation, in that case, will mechanically create a trade deficit, if we ignore all substitution effects and measure all quantities in terms of the domestic currency (because in this case, the adverse valuation effect falls on imports, which are larger, to begin with). The resulting decline in spending on domestic goods, again, has contractionary effects [15].

Lawson-Metzler effect: The standard Keynesian consumption function means that as income increases, the average propensity to consume decreases. Under the framework of incomplete substitution, the devaluation of the RER reduces the terms of trade, thereby reducing the income of foreign goods, which may increase the total expenditure on domestic goods. This in turn has a negative impact on the current account.

Wealth effects: A nominal devaluation that increases domestic prices will reduce real currency balances and real wealth. Even if the depreciation keeps the terms of trade unchanged, the resulting negative impact on domestic spending may also lead to an improvement in the trade balance. The emphasis on the absorption effects of a higher price level has been a highlight of the monetary approach to the balance of payments [24]. In short, most of the short-term impact of exchange rate changes on output depends on the impact on the trade balance, either through the value of the trade or through the impact of domestic spending on domestic goods.

Investment decision: New investment in developing countries requires imported capital goods. On the other hand, devaluation increases the cost of imported inputs, which means that the capital cost of domestic goods will rise and new investment will fall, leading to a decline in the growth rate [38]. Foreign capital tends to flow into countries that have stable currencies. A country needs a relatively stable currency to attract foreign investors' funds. Otherwise, the prospect of exchange-rate losses inflicted by currency depreciation may deter overseas investors. There are two types of capital flows: foreign direct investment (FDI), in which foreign investors take stakes in existing companies or build new facilities in the recipient market; and foreign portfolio investment, in which foreign investors buy, sell and trade securities in the recipient market.

Winjbergen [69] also pointed out the foreign borrowing of least developed countries when analyzing the contractionary effects of devaluation. Eichengreen and Hausmann [20] submit that emerging markets cannot borrow from international markets in their own currency due to the so-called “original sin.” Hence, when firms' assets are denominated in domestic currency and liabilities are denominated in foreign currency, this currency mismatch creates balance sheet problems in the case of sharp exchange rate depreciation [23]. Hence, since a large part of its liabilities is denominated in foreign currencies, companies in developing countries may find themselves insolvent after a big depreciation. Therefore, depreciation reduces the net worth of domestic companies that have foreign currency liabilities, leading to a reduction in their investment and output [38].

2.1.3. On the Supply-side

When inputs for manufacturing are largely imported and cannot be substituted easily by domestic production, real depreciation will increase the costs of inputs [38]. Consequently, the negative impact from the higher cost of

imported inputs may dominate the production stimulus from lower relative prices for domestically traded goods, which may result in low growth [37]. However, the final effect depends on the extent to which the demand and supply curves shift due to depreciation [27].

Kandil and Mirzaie [37] conclude that the complexity of demand and supply channels may determine the results of exchange rate fluctuations as follows: In the goods market, a positive shock to the exchange rate of the domestic currency (an unexpected appreciation) will make exports more expensive and imports less expensive. Consequently, competition from foreign markets will reduce the demand for domestic products, thereby reducing domestic production.

In the currency market, the positive impact on the national currency relative to the expected value (unexpected temporary appreciation) prompts agents to reduce their national currency holdings and lower interest rates. This channel eases the contraction of aggregate demand, thereby alleviating the decline in output and prices in the face of a positive exchange rate shock. On the supply side, the positive impact of the exchange rate (unexpected appreciation) reduced the cost of imported intermediate products, increased domestic production, and lowered production costs, thereby lowering the overall price level.

The theoretical model of [37] submits that unanticipated currency fluctuations help to determine aggregate demand through exports, imports, and the demand for domestic currency, and aggregate supply through the cost of imported intermediate goods. Expected exchange rate depreciation, through the supply channel, has limited effects on output growth. Unexpected currency fluctuations seem to be more pronounced and have different effects on output growth in developing countries.

2.1.4. A New Trade Theory

A new trade theory focuses on the company's response to exchange rate changes. For example, [10] and [47] find that high-productivity exporters with lower demand elasticities respond to depreciation by increasing their mark-ups rather than export volumes. [12] show that in order to deal with depreciation, high-productivity firms increase their product range and core product prices. This will effectively dampen the Keynesian macroeconomic channel [15].

The findings from these studies suggest that firms' characteristics determine how they react to a positive profitability boost after depreciation. High-productivity firms increase their mark-ups and range of products rather than export volumes. This boost to profits, in turn, is expected to increase capital accumulation in the long run. Low-productivity firms, however, will respond by having higher entry rates and export volumes as previously unprofitable firms will now be able to enter the export market.

Demir and Razmi [15] maintain that in cases where learning externalities increase private costs, exchange rate policy can help countries acquire new sectors, which previously they did not have a comparative advantage in, and maintain them permanently. Krugman [43] presents this

argument using a Ricardian framework and shows how a temporary devaluation can help achieve permanent diversification.

In conclusion, the theoretical literature offers a variety of demand and supply-side mechanisms at micro and macro levels with sometimes positive and sometimes negative effects, conditional on the structure of the economy, the time horizon considered (short-run vs. long-run), the heterogeneities of firms, and the level of aggregation. However, the complex relationship between exchange rate changes and economic growth makes the final result inconclusive.

2.2. The Empirical Literature

As mentioned earlier, the effect of exchange rate fluctuations on economic growth has received renewed attention in recent years. However, none of the studies on the impact of exchange rate fluctuations on economic growth seem to focus on the West African countries under consideration. Few others have studied this topic in a single country linear framework analysis and employing time series data without verifying the nonlinear effect. Empirical methods and estimation techniques are also quite mixed.

Furthermore, much of the literature on the growth channel consists of mixed results. For example, some studies [3, 19, 35, 36, 56, 59, 63, 64] find a mixed effect of exchange rate movement on growth. Some studies [25, 29, 41, 42, 46, 57, 65], [46] find a positive relationship. Some studies [1, 6, 7, 26, 31, 34, 38, 50, 53, 60, 66, 67] on the other hand, find a negative effect. Some studies that have found insignificant relationships include [33, 38, 52].

Tarawalie, Sissoho, Conte, and Ahortor [64] investigate the effect of changes in the exchange rate on output growth in the West Africa Monetary Zone WAMZ economies. They designed a general equilibrium model of an open economy and used quarterly data series (1981-2010) for all countries except Ghana and Guinea. The results show that there is a negative correlation between the real exchange rates of Liberia and Sierra Leone and real GDP growth. However, the impact of exchange rates on output in The Gambia, Ghana, Guinea, and Nigeria though positive but remained weak, which may be partly due to supply-side factors as evident from their results. The paper by [66] studied the impact of exchange rate fluctuations on the economic growth of English-speaking West Africa countries. Using panel data stream from 1980 to 2017. The results obtained show that the real exchange rates of West African English-speaking countries are statistically significant and negatively correlated with GDP.

Sani, Hassan, and Azam [59] conducted an empirical study on the impact of exchange rate fluctuations from 1991 to 2014 on the output levels of five English-speaking ECOWAS countries (Nigeria, Ghana, Gambia, Sierra Leone, and Liberia). Using cointegration testing and error correction models as estimation techniques, short-term and long-term relationships between variables are obtained in each country. Generally, exchange rate fluctuations have a significant

impact on output at least for all countries considered in the study, with the exception of Liberia, which has a negative impact. On the other hand, [6] examine the fundamentals behind West Africa Economic and Monetary Union's WAEMU's recent economic growth acceleration in comparison to the group of low-income developing countries LIDCs. The regression shows that the exchange rate volatility is negative and statistically significant, which suggests that the increase in the level of exchange rate volatility reduces the possibility of growth acceleration.

Whereas, Jibrin, Jelilov, and Gayypov [36] empirically analyze the impact of exchange rate on gross domestic product and other macroeconomic aggregates in the Economic Community of West African States ECOWAS for the period 1990 to 2014. The Classic Linear Regression Model (CLRM) was used in the analysis of 10 countries, and the results showed that the exchange rates of 4 of the 9 countries have a significant relationship. These countries include Benin, Guinea-Bissau, Liberia, and Nigeria. In addition, the exchange rate is positively correlated with GDP growth, while it is negative in Ghana, Guinea-Bissau, and Sierra Leone. [26] used aggregated time series and cross-sectional data from 33 countries in sub-Saharan Africa, and their results confirmed the negative correlation between real exchange rate (RER) misalignment and economic growth. They observed that higher levels of misalignment are accompanied by higher levels of macroeconomic instability. Therefore, this means that a lower level of RER misalignment can lead to better economic performance.

Ndambendia and Alhayky [50] used panel unit root and cointegration tests to investigate the long-term relationship between effective real exchange rate fluctuations and economic growth in 15 sub-Saharan African countries from 1980 to 2004. The study used a fully modified ordinary least square OLS (FMOLS) to estimate long-term relationships. Their results show that when the ratio of domestic credit to GDP falls below the threshold of 57%, real exchange rate fluctuations will have a negative impact on economic growth. The empirical analysis of [1] investigates the role of real exchange rate RER misalignment on long-run growth in three countries of the Maghreb (Tunisia, Algeria, and Morocco) over the period 1980 to 2008. Their paper uses the fundamental equilibrium exchange rate (FEER) (from which the misalignment is derived) and the dynamic panel growth model to estimate the equilibrium RER. The results show that the coefficient for RER misalignment is negative.

Other researchers have studied this topic in a single country framework analysis, as follows: [33] analyzed the relationship between exchange rate movements and economic growth in Nigeria using annual data from 1970 to 2011. The Ordinary Least Square (OLS) technique, and the Granger causality test, revealed the existence of a positive and insignificant relationship between exchange rate and economic growth in Nigeria. Their results also show that there is no causality between exchange rate and economic growth in Nigeria.

The empirical analysis of [63] examines the impact of real

exchange rates on economic growth in South Africa using quarterly time series data for the period of 1994 to 2010. Johansen cointegration and vector error correction models are used. The results reveal that real exchange rates have a dampening long-run impact on economic growth in South Africa. The results show that currency undervaluation significantly hinders economic growth in the long-term, and significantly promotes economic growth in the short-term. On the other hand, [53] evaluate the effect of exchange rate volatility on economic growth in Nigeria from 1986 to 2014. The study determines the extent and manner to which economic growth responds to exchange rate volatility in Nigeria. Using the real effective exchange rate, using the generalized autoregressive heteroscedasticity (GARCH) model and the generalized moment method, the research results show that the changes in the real effective exchange rate are negative and significantly related to economic growth. Hence, this event shows that fluctuations are harmful to Nigeria's economic growth. The paper suggests that the government should constantly seek to maintain a stable exchange rate in Nigeria.

Ullah, Khan, and Khan, Saif-ud-Din [65] explore the relationship between exchange rate and economic growth in Pakistan for the period 1976 to 2010. Their study used the simultaneous equation model and the two- and three-stage least squares method (2SLS and 3SLS) techniques. The results show that the exchange rate has a positive effect on economic growth through the channels of export promotion incentives, enlarging the volume of investment, enhancing foreign direct investment inflows, and promoting import substitute industries. In a related study, [35] investigate the relationship between economic growth and exchange rate volatility in Pakistan for the period 1982 to 2007. Using error correction techniques and autoregressive distribution lag ARDL, the results of empirical analysis show that exchange rate fluctuations have a long-term positive correlation with economic growth. In the short term, exchange rate fluctuations have a positive and negative relationship with economic growth. Therefore, the results show that domestic economic performance is very sensitive to long-term exchange rate fluctuations.

Kogid et al. [41], using time series data from 1971 to 2009 to investigate the impact of exchange rates on Malaysia's economic growth. The results of the ARDL bounds test indicate that there is a long-term co-integration relationship between the nominal exchange rate and the real exchange rate and economic growth, and the real exchange rate has a significant positive coefficient. In addition, the results of the error correction model ECM- based ARDL show that the two exchange rates have similar causal effects on economic growth. Considering the importance of exchange rate variables, especially the real terms, the findings suggest that a systemic exchange rate via monetary policy be properly developed and implemented to promote the stability and sustainability of economic growth in Malaysia.

In the study of Hua [31], a Cobb-Douglas production function with the enhanced real exchange rate is proposed,

and the GMM system estimation method and panel data of 29 provinces in China from 1987 to 2008 are used. The results show that the real exchange rate appreciation had a negative effect on economic growth, which was more marked in coastal provinces than in inland provinces, contributing to a reduction in the difference in GDP per capita between the two provinces. Razzaque et al. [56] empirically investigate the effects of exchange rate movements on economic growth in Bangladesh. Using a suitable analytic framework to derive an empirical specification and employing cointegration techniques to determine the output response to Bangladeshi currency depreciation. The results suggest that in the long run, a depreciation of the real exchange rate is associated with a rise in aggregate output. However, a contractionary effect is observed in the short run. The results imply that the long-run expansionary effect of real depreciation may be appealing for considering exchange rate policy as a development strategy.

On the other hand, Koirala [42] empirically assesses the impact of the real effective exchange rate (REER) on the economic growth of Nepal. The study uses annual time series data for the period of 1975 to 2015. Engel Granger's residual test and error correction model are used to detect the impact of REER on Nepal's real GDP. The results of the study reveal that the real effective exchange rate has a positive impact on the real GDP of Nepal. Based on the findings, the study concludes that the transmission mechanism of REER through aggregate demand hold in the case of Nepal, and this result is compatible with the traditional approach to the exchange rate. The study recommends that Nepal must use the real exchange rate as one of the macroeconomic policies to stimulate economic growth.

Kim et al. [40] Use quarterly data from 1980 to 2003 to investigate the relationship between exports, imports, and economic growth. The results show that imports have a significant positive impact on productivity growth, but exports have not. In addition, evidence shows that the impact of imports on productivity enhancement is due to the competitive pressures created by consumer goods imports and technology transfer, and these pressures are reflected in capital goods imported from developed countries. Most of the study's results still hold using gross domestic product growth rather than productivity growth as the measure of economic growth. Evidence shows that, under certain circumstances, import liberalization can make a positive and important contribution to growth and development. Mishra [48] investigates the dynamics of the relationship between imports and economic growth in India for the period 1970–1971 to 2009–2010. Using the vector error correction estimates and Granger causality tests, the results show the existence of a two-way relationship between import growth and income growth in the long run.

Combined with the analysis of different countries, other studies on this topic have also been carried out. These include; Vieira and MacDonald [68] used time-series data from 1980 to 2004 and employed co-integration methods to study the effect of real exchange rate misalignment on long-

term growth in 90 countries. The results of the analysis suggest that a more depreciated (appreciated) real exchange rate helps (harms) long-run growth. On the other hand, the paper of Rodrik [57] shows that undervaluation of the currency stimulates economic growth, particularly for developing countries. Levy-Yeyati, Sturzenegger, and Gluzmann [46] examine whether “fear of appreciation” has a positive impact on growth performance in developing economies. Looking alternatively at two sample periods from 1974 to 2007 and 1993 to 2007, the finding shows that depreciated exchange rates led to higher growth.

Karadam [38] shows that depreciation of the real exchange rate is contractionary for developing countries while real exchange rate changes have insignificant effect on developed countries. The conclusion of the analysis is that the contraction effect on developing economies increases as the degree of debt dollarization increases.

The empirical work of Eichengreen [19] analyzes the role of the real exchange rate in the growth process, using a sample of 28 industries from 40 emerging market countries with annual data covering the period 1985 to 2003. Time-fixed effects are included throughout. The results suggest that depreciation or an increase in real exchange rate fosters the growth of industry employment, but volatility appears to have a significant negative impact on employment growth. Therefore, this means that exchange rate fluctuations will inhibit economic growth. Habib, Mileva, and Stracca [28] investigate the impact of real exchange rate movements on economic growth based on five-year average data from a panel of over 150 countries in the post-Bretton Woods period. They use external tools to deal with the possible reverse causality from growth to the real exchange rate. The research results show that real appreciation (devaluation) significantly reduces (improves) annual real GDP growth.

Karadam and Ozmen [39] empirically investigate the impact of real exchange rates on the growth of a large number of advanced and developing economies by employing non-stationary panel data estimation procedures to estimate conventional growth models augmented with global financial and monetary condition variables. The results show that the depreciation of the real exchange rate is contractive for developing economies with high external debt, but is expansionary for developed economies. Utilizing the generalized method of moment (GMM) dynamic panel data estimator for 83 countries spanning from 1960 to 2000; Aghion, Bacchetta, Ranciere, and Rogoff [3] provide empirical evidence that real exchange rate volatility can have a significant impact on the long-term rate of productivity growth, but the effect depends critically on a country's level of financial development. The results show that for countries with a low level of financial development, exchange rate fluctuations generally reduce economic growth, while for countries with a developed financial sector, there is no significant impact.

Hausmann, Pritchett, and Rodrik [29] studied growth performance by looking for a rapid acceleration of economic growth that lasted at least eight years. Using a dataset of 110

countries from 1957 to 1992, the results of the study show that the acceleration of growth is often related to the depreciation of the real exchange rate. In addition, Schnabl [60] investigated the impact of exchange rate fluctuations in a sample of 41 countries at the European Monetary Union on growth from 1994 to 2005. Using generalized least squares and generalized moment estimation techniques; the panel estimation of the entire sample reveals a significant negative impact of exchange rate fluctuations on growth. Di Nino, Eichengreen, and Sbracia [17] provide evidence of a positive correlation between undervaluation and economic growth in a panel data set spanning the period 1861 to 2011. Their results suggest that undervaluation will have a positive impact on growth by increasing the value of exports.

Vieira, Holland, Gomes Da Silva, and Bottecchia [67] used panel data sets (1970 to 2009) to assess the impact of real exchange rate fluctuations in 82 developed and emerging economies on long-term economic growth. By accurately measuring exchange rate fluctuations, the results of the two-step Generalized Moment Panel (GMM) show that large (smaller) volatile RERs have a significant negative (positive) impact on economic growth. Pablo Alfredo, Eduardo, and Federico [54] estimated the impact of currency undervaluation on different components of GDP. The result suggests that for developing countries, undervaluation does not affect the tradable sector, but does lead to greater domestic savings and investment, as well as employment. On the other hand, Janus and Riera-Crichton [34] study the impact of real effective exchange rate volatility on economic growth as well as the Euro's impact on effective real exchange rate volatility, using panel data for the period 1980 to 2011. The study shows that after a plausible endogeneity correction, real effective exchange rate volatility is negatively associated with growth in the Organization for Economic Cooperation and Development OECD countries. Therefore, this means that the stability of the real effective exchange rate may promote the growth of OECD countries.

The empirical research of Gala [25] provides new econometric evidence for the link between the real exchange rate level and development. Using panel data and the Generalized Method of Moments (GMM), the results of the study confirm that the undervaluation of the exchange rate is related to the increase in real per capita income. Barguelli Ben-Salha and Zmami [7] studied the impact of exchange rate fluctuations on economic growth. The empirical investigation is based on a sample of 45 developing and emerging countries over the period of 1985 to 2015. Using the system generalized moment estimator method, the research results show that the measurement of nominal and real exchange rate volatility based on generalized autoregressive conditional heteroscedasticity has a negative impact on economic growth.

Whereas, Njindan Iyke [51] studies the role of real currency misalignment in productivity growth for 100 middle-income countries for the period 1994 to 2010, using fixed-effects and generalized method of moment estimation techniques. The results show that if currency misalignment

occurs as an undervaluation, it will increase productivity growth, but if it occurs as an overvaluation, it will hinder productivity growth. The research results also show that the impact of real currency misalignment on productivity growth is symmetric. Nourira and Sekkat [52] investigate the relationship between undervaluation and growth for 52 developing countries from Africa, Asia, and Latin America using a panel data set from 1980 to 2005. The study employs OLS, GMM, and panel co-integration. As a result, no argument was found to support the depreciation of the real exchange rate to promote economic growth.

In general, the relationship between exchange rate changes and economic growth remains a difficult problem. Various studies done by other researchers have shown mixed effects, negative effects, positive effects, and insignificant effects. A critical study on the main difference in the literature revealed that most of the conclusions were influenced by the kind of data used in the empirical analysis, the estimation technique or methodology, the geographical region or the country in which the study is conducted, and the proxy for volatility.

It is also found that none of the studies which have studied the impact of exchange rate fluctuations on economic growth seem to focus on the West African countries under consideration. Few have carried out linear studies within the framework of single country analysis, using time series data and applying cointegration techniques without verifying the non-linear effect of exchange rate fluctuations on economic growth. Therefore, the need to use panel data for the West African economies to conduct further research on the impact of exchange rate fluctuations on economic growth as well as verify the nonlinear effect of exchange rate fluctuations on economic growth cannot be overemphasized. Thus, in this regard, the trust of this study was developed in order to overcome the shortcomings and limitations of previous studies.

3. Empirical Analysis

We first present the methodology and the variables used and then the results based on a dynamic panel of 12 West African countries over 1995-2017.

The first regression estimates the effects of the exchange rate volatility on economic growth along with the development of the financial sector, with a set of control variables, without interaction terms.

The second regression adds a variable interacting with the exchange rate volatility and the measure of financial development in order to test the prediction: the presence of a non-linear effect of exchange rate volatility on growth depending on the level of financial development.

To test these predictions, we considered standard growth regression, which is a panel data version, similar to [38, 3], in which we added measures of financial development variables. We employ the pool OLS, fixed effect, random effect, and the "Ad hoc approach," which address issues of endogeneity. In this case, if a dependent variable is potentially endogenous, it is intuitively appealing to look for

a proxy that does not suffer from the same problem. The most common approach is to lag the suspect variables by one or more periods [62]. The argument is that although current values of (e.g.,) exchange rates might be endogenous to GDP growth, it is unlikely that past values of exchange rates are subject to the same problem. The system GMM estimation, which also addresses the issues of endogeneity of explanatory variables in the model, is employed as well.

The panel of country and time-period observations is

$$GDP_{it} - GDP_{it-1} = (\alpha - 1) GDP_{it-1} + \beta' VOL_{it} + \gamma' Z_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

Where GDP is nominal, VOL is exchange rate volatility, Z is a set of control variables, μ_i is an unobserved country-specific effect, and ε is an error term. The subscripts i and t represent the country and time period, respectively. The lagged gross domestic product GDP_{it-1} is used as the conditional convergence term in the standard growth equation.

In addition to the initial GDP, the control variables are inflation INF, the government's expenditure for macroeconomic stability GB, trade openness OPEN, financial sector development indicator FSDX, and a dummy variable that controls the impact of the global financial crisis DUM. These are the standard control variables. This study uses the annual variations of the real effective exchange rate, which is obtained by averaging the variance

balanced. We treat nominal GDP as the dependent variable instead of productivity growth and real GDP per capita, but our regression is estimated using a similar set of control variables used by ([38] and [3]). Starting from this benchmark, we examine the direct effect of exchange rate volatility on growth. Then, we look at the interaction between these measures and the level of financial development. More specifically, we estimate the following equation:

of twelve months of each year as a benchmark measure of exchange rate volatility VOL. The variables $GB = \{(\text{government consumption})/\text{GDP}\}$, $OPEN = \{\text{exports (X)} + \text{imports (M)} / \text{GDP}\}$, and FSDX is the index of financial sector development. This study adopts the Principal Component Analysis PCA to build the FSDX using three sets of variables characterizing a well-functioning financial system as follows. Liquid liability to GDP% (LLGDP), bank deposits to GDP% (BDGDP), and private credit by deposit money banks and other financial institutions to GDP% (PCDMBFI). With the exception of VOL, GB and OPEN, all other variables were obtained from the World Bank Data Base.

As in [38], the growth equation above can be rewritten as a dynamic panel data model as follows:

$$GDP_{it} = \alpha GDP_{it-1} - GDP_{it-1} + GDP_{it-1} + \beta' VOL_{it} + \gamma' Z_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

$$GDP_{it} = \alpha GDP_{it-1} + \beta' VOL_{it} + \gamma' Z_{it} + \mu_i + \varepsilon_{it} \quad (3)$$

LnGDP is the dependent variable of equation (3). As far as the expected signs of these estimated coefficients are concerned, in this equation, α is the constant intercept. The sign of Inflation rate (INF) is expected to relate negatively to GDP. The sign of government consumption (LnGB) is

expected to be positively correlated with GDP. The sign of trade openness (LnOPEN) is expected to relate positively to GDP. The sign of the financial sector development index variable (FSDX) is expected to be positive. And the sign of the exchange rate volatility (LnVOL) is expected to be negative.

Table 1. Summary statistics and correlations of the main variables.

	LnGDP	INF	LnGB	LnOPEN	FSDX	LnVOL
Mean	22.31	6.57	-2.12	-0.49	-0.01	1.59
Standard deviation	1.66	10.12	0.53	0.32	1.03	1.69
Skewness	0.7	2.66	-2.52	-0.28	2.14	1.87
Kurtosis	3.33	15.83	12.24	3.11	8.52	8.91
Min	19.15	-35.84	-4.7	-1.57	-1.18	-1.64
Max	27.07	72.84	-1.29	0.17	4.25	10.42
Observations	276	276	276	276	276	276
LnGDP	1.00					
INF	0.05	1.00				
LnGB	-0.32	-0.43	1.00			
LnOPEN	-0.18	-0.06	0.22	1.00		
FSDX	0.06	-0.19	0.03	0.52	1.00	
LnVOL	-0.08	0.3	-0.27	-0.32	-0.41	1.00

Table 1 provides the summary descriptive statistics for the variables with a sample of 276 observations for each. The mean of LnGDP is 22.31, the deviation of the sample means is 1.66, while the skewness is 0.70, which means that the observed values tend to have a normal distribution around the mean. And the kurtosis is 3.33, meaning lower values below the sample mean. In the case of the INF variable, the mean is

6.57, the deviation of the sample means is 10.12, while the skewness is 2.66, which means the skewness is positive. The kurtosis is 15.83, meaning a higher value above the sample means. Also, the variable LnGB shows that the mean is -2.12, the deviation of the sample means is 0.53, while the skewness is -2.52, which means the skewness is negative. And the kurtosis is 12.24, meaning higher values above the sample

mean. In the case of the LnOPEN variable, the mean is -0.49, the deviation of the sample mean is 0.32, while the skewness is -0.28, which means the skewness is negative. The kurtosis is 3.11, meaning a higher value above the sample mean. The FSDX variable shows that the mean is -0.01, the deviation of the sample mean is 1.03, while the skewness is 2.14, which means the skewness is positive. And the kurtosis is 8.52, indicating higher values above the sample mean. The variable LnVOL shows that the mean is 1.59, the deviation of the sample mean is 1.69, and the skewness is 1.87, which means the skewness is positive. And the kurtosis is 8.91, indicating higher values above the sample mean.

Taking into account the main variables we are interested in, correlation statistics show that there is a negative correlation between exchange rate volatility and LnGDP, while there is a positive correlation between financial sector

development and LnGDP.

4. Summary and Discussions of the Results

We now examine the impact of exchange rate volatility on GDP growth as well as the role of financial sector development on the impact of exchange rate volatility on GDP growth.

In order to verify whether there is a long-run stable relationship between the dependent variable and the independent variables, before estimating the model, the unit root must be tested in the panel and the cointegration relationship must be assessed. Table 2 below shows the summary result of the unit root tests conducted using [32] Panel Unit Root Test, and [45] Unit-Root Test.

Table 2. Panel unit root test [32, 45].

Variable	Level		First Difference	
	Im-Pesaran-Shin	Levin-Lin-Chu	Im-Pesaran-Shin	Levin-Lin-Chu
LnGDP	-0.69 (0.24)	-0.63 (0.26)	-7.31 (0.00)***	-7.14 (0.00)***
INF	-6.82 (0.00)***	-5.95 (0.00)***		
LnGB	-2.31 (0.01)***	-2.33 (0.01)***		
FSDX	2.19 (0.99)	0.38 (0.65)	-4.09 (0.00)***	-5.88 (0.00)***
LnOPEN	-1.88 (0.03)**	-1.21 (0.11)		-6.40 (0.00)***
LnVOL	-6.74 (0.00)***	-4.29 (0.00)***		
LnVOL*FSDX	-5.08 (0.00)***	-1.82 (0.03)**		

Note ***, ** and * denote stationarity at the 1%, 5% and 10% significance level respectively. Values in the parentheses are P-values.

The null hypothesis of the Im-Pesaran-Shin test is that “all panels contain unit roots”. The results reject the null hypothesis for all the series except for (LnGDP) and (FSDX). This implies the integration of order zero $I(0)$, for five variables, and integration of order one $I(1)$, for two variables. The null hypothesis of the Levin-Lin-Chu unit-root test is that “all panels contain unit roots”. The results of the

Levin-Lin-Chu panel unit root test show that four of the series are stationary at level. While three are stationary at the first difference. Considering the two tests, since the majority of the results favor $I(0)$, this study, therefore, considers that the variables under study are all $I(0)$. With this conclusion, the next step will be to estimate the regression equations and select the most appropriate models for the study.

Table 3. Summary of F-Test results in choosing the appropriate model.

Model	F-statistics value	Degrees of freedom (DF)	Probability	Decision	Decision
GDP	612.15	(11, 257)	0.00	Ho -rejected	Pooled model is not appropriate --Fixed effects model must be estimated.

Note: If the true model is a fixed effect, pooled OLS will yield bias estimates due to the fact that it omits the relevant country-pair-specific effects. The joint significance of the unobservable country-pair specific effects is tested by performing an F-test to choose between pool OLS and fixed effects.

Table 4. Summary of Breusch and Pagan Lagrangian Multiplier (BP-LM) test for random effects.

Model	Chi2 – Statistics	Probability	Decision	Decision
GDP	1796.32	0.00	Ho - rejected	Pooled model is not appropriate --Random effect model must be estimated.

Table 5. Summary of the Hausman Test Result in choosing between FE and RE model.

Model	Chi2 - Statistics	Probability	Decision	Decision
GDP	2.01	0.92	Ho -accepted	Random effects model is the appropriate model.

After conducting the econometric tests (F-test, BP-LM test, and Hausman test) to determine the appropriate model for this research, the random effect model appears to be suitable for the GDP model.

To ascertain the validity of the models, we conducted a variance inflation factors VIF test to measure the extent of multicollinearity among the independent variables, to ascertain whether the model is correctly specified or not, the

following tests were conducted:

Table 6. VIF test for multicollinearity.

Variable	VIF	1/VIF
FSDX	1.82	0.55
LnOPEN	1.53	0.65
LnGB	1.38	0.73
LnVOL	1.35	0.74
INF	1.35	0.74
DUM	1.19	0.84
Mean VIF	1.43	

Based on the result of the VIF test of variables for multicollinearity shown in Table 6, since none of the VIF values reached a value of 10, there is no problem of multicollinearity among the included variables in the model and therefore, we maintained all the variables for the purpose of estimation of the model.

The assumptions of the standard error component of a model are that the regression disturbances are not autocorrelated, are homoskedastic, and there is no cross-sectional dependence. Table 7 shows the diagnostic test results of the suitable model for this study to ascertain the assumption.

Table 7. Results of Autocorrelation, Heteroskedasticity and Cross-Sectional Dependence Tests.

Model	Autocorrelation (no autocorrelation)	Heteroskedasticity (Ho: homoskedasticity)	Cross-Sectional Dependence (Ho: cross-sectional dep.)
GDP model (RE)	F (1, 11) = 167.784 Prob > F = 0.00	LR chi2 (12) = 0.00 Prob> chi2 = 1.00	PSI = 16.48 Prob = 0.00

It can be seen from Table 7 that in the case of the model, the diagnostic test indicates that there is serial correlated, and the likelihood ratio test indicates that there is no heteroscedasticity (variance is a constant). The Pesaran's test of cross-sectional dependence shows the model does suffer from cross-sectional dependence. Therefore, since the time periods, T is greater than the number of groups N in the model, we, therefore, apply random-effects GLS regression with robust standard errors because it produces efficient estimates, which are free from autocorrelation and heteroscedasticity as well.

Controlling for Endogeneity

To control for potential endogeneity and further correct for heteroskedasticity, we use the "Ad hoc approach." As already pointed out, in this approach, if the dependent variable is

endogenous, it is intuitively attractive to find a proxy that does not encounter the same problem. The most common approach is to lag the suspect variables by one or more periods [62]. The argument is that although current values of (e.g.,) exchange rates might be endogenous to GDP growth, it is unlikely that past values of exchange rates are subject to the same problem.

The two-step difference GMM estimation approach is also used. In this approach, to reduce the number of instruments, we collapsed and restricted the instruments up to four lags. This is done to avoid substantial under-rejection of over-identification tests, thus, incorrectly signaling too often that the model is correctly specified when it is not. The results of the robust RE, the "Ad hoc approach" and the two-step difference GMM estimates of the model are presented as follows.

Table 8. Random Effects Estimation Results Dependent variable. Nominal GDP.

Variable	GDP Model-RE	GDP Model – RE (Ad hoc Method)
INF	-0.01** (0.00)	-0.01*** (0.00)
LnGB	0.29** (0.13)	0.28*** (0.11)
LnOPEN	-0.34 (0.23)	-0.34 (0.23)
FSDX	0.14* (0.09)	0.16** (0.08)
LnVOL	-0.09*** (0.02)	
LnVOL _{it-1}		-0.09*** (0.01)
DUM	-0.82*** (0.09)	-0.79*** (0.08)
Constant	23.42*** (0.67)	23.40*** (0.64)
Number of obs.	276	264
Number of groups	12	12
Within R ²	0.80%	80%

Note: the symbols ***, ** and * refer to levels of significance of 1%, 5% and 10% respectively. The parenthesis shows robust standard errors.

We first estimate the effects of the exchange rate volatility on economic growth along with financial sector development with a set of control variables, without the interaction term.

Since changes in economic growth can also cause exchange rate fluctuations, the research focuses on the endogeneity issue by using the lagged term of exchange rate movements

(Ad hoc Method) for robustness check. Table 8 shows the random effects estimation results for the GDP model for the West African countries. The coefficients of the real effective exchange rate volatility in the first and second columns are -0.09 and -0.09, respectively, which are highly statistically significant. Since the increase in real effective exchange rate volatility in this study indicates depreciation, these coefficients mean that the depreciation of real effective exchange rate volatility reduces GDP growth. In other words, depreciation is found to be contractionary for the West African countries under consideration.

This result is in line with the suggestions of the authors as [38] who stress a negative implication for real effective exchange rate and growth in real GDP per capita in most of the developing countries; [44], who argue that the traditional expansionary effect of depreciation does not hold for developing countries; [6] whose regression shows that the exchange rate volatility has a negative and statistically significant impact for WAEMU's economic growth; [26] who observed that higher levels of misalignment are accompanied by higher levels of macroeconomic instability in Sub-Saharan Africa countries; [50] whose result suggests that real exchange rate volatility negatively affects economic growth when the ratio of domestic credit to GDP is below the threshold value.

However, the findings in this chapter are different from ([3] and [38]). Their research found that the relationship between real effective exchange rates and real GDP growth in industrial countries is insignificant. This result is not surprising because, unlike industrial economies, West African's financial markets and institutions are narrow and shallow. These countries do not have the tools to hedge exchange rate risks. Hence, fluctuating exchange rates often create uncertainty, which reduces economic activity. On the other hand, because industrial countries have developed financial systems and institutions, volatility in the real effective exchange rate may not have any significant impact on their growth as businesses and firms can hedge their risks. The common point of these studies is the use of the standard deviation of the real effective exchange rate to measure exchange rate fluctuations. The common result of their insignificant devaluation effect may be due to their use of industrialized countries in the sample.

As for the control variables, all control variables in the model except for trade openness are statistically significant and in line with expectations. As predicted by theory, inflation and GDP are negatively correlated, and government consumption and the development of the financial sector have a positive impact on GDP. The dummy variable representing the impact of the global financial crisis shows a negative and significant impact on the GDP growth of West African countries.

Table 9 shows the results of the two-step difference GMM estimation. Sargan-Hansen's specification test and Arellano-Bond test of second-order serial correlation verify the validity of the moment condition and the absence of autocorrelation.

The results do not change when we control for endogeneity and reverse causation in both the short-term and long-term². The effect of real effective exchange rate volatility on GDP is still negative and significant for the West African countries under investigation. That is, GMM estimation results confirm the contractionary effect of depreciation in the West African economies. Among the control variables, inflation becomes insignificant with a negative sign and openness becomes significant with a negative sign when we control for the simultaneity problem. The sign of the dummy variable is still negative and significant.

Our main findings provided by random effects, "Ad hoc method," and two-step - GMM estimations are that the depreciation of real effective exchange rate is contractionary for West African countries' economic growth. This result is in line with the findings of [3] whose paper provides empirical evidence that real exchange rate fluctuations may have a significant negative impact on productivity growth in countries with relatively low levels of financial development, using GMM estimation techniques.

However, our results are contrary to the findings of [57], [46] and [25], which show that undervaluation of the exchange rate is expansionary in developing countries by using GMM estimation techniques. However, as observed by [38], in addition to using GMM estimates, what these studies have in common is that they use the Balassa-Samuelson adjusted undervaluation index as a measure of the real exchange rate. Their common results of the expansionary effect of devaluation for developing countries may be due to their use of the undervaluation index as reported by [38].

The Role of Financial Sector Development

The regression result adds a variable interacting with the exchange rate volatility and the measure of financial sector development in order to test the prediction: the presence of a non-linear effect of exchange rate volatility on growth depending on the level of financial development. The regression results in the first column of Table 10 shows that the interaction term between the fluctuation of the real effective exchange rate and the development of the financial sector is positive and significant. The positive coefficient of this result indicates that the negative impact of real effective exchange rate fluctuations on GDP growth decreases when the level of financial sector development is high. The less financially developed the economy, the greater the negative impact of exchange rate fluctuations on GDP growth. Except for openness, all other control variables are statistically significant. This result does not change when we control for endogeneity in column two, where we use the (Ad hoc method) by interacting the lagged term of exchange rate movements with financial sector development index for robustness check.

2 We also employed the "Ad hoc method" estimation which controls for endogeneity problem by using the lagged term of real effective exchange rate movements for robustness check in Table 8 column two. It again gave similar results.

Table 9. Long and short run GMM estimation result. Dependent variable. GDP.

Variable	GMM- Short Run	GMM-Long Run
INF	0.00 (0.00)	0.00 (0.00)
LnGB	0.91* (0.55)	0.85* (0.51)
LnOPEN	-0.36** (0.18)	-0.33** (0.17)
FSDX	0.59*** (0.17)	0.55*** (0.16)
LnVOL	-0.07*** (0.02)	-0.07*** (0.02)
DUM	-0.72*** (0.20)	-0.67*** (0.16)
Number of obs.	264	
Number of groups	12	
Number of Instruments	11	
Arellano-Bond test for autocorrelation order 2	0.29	
Sargan-Hansen test of the overidentifying restrictions, 2-step weighting matrix	0.65	
Sargan-Hansen test of the overidentifying restrictions, 3-step weighting matrix	0.28	

Note: the symbols ***, ** and * refer to levels of significance of 1%, 5% and 10% respectively. The parenthesis shows robust standard errors.

Table 10. Exchange Rate Volatility and GDP growth. The Role of Financial Sector Development.

Variable	GDP Model-RE	GDP Model RE (Ad hoc Method)
INF	-0.01** (0.00)	-0.01*** (0.00)
LnGB	0.24** (0.11)	0.25** (0.12)
LnOPEN	-0.33 (0.23)	-0.33 (0.21)
FSDX	0.14* (0.09)	0.16** (0.07)
LnVOL	-0.08*** (0.02)	
LnVOL _{it-1}		-0.07*** (0.02)
LnVOL*FSDX	0.05** (0.02)	
LnVOL _{it-1} *FSDX		0.05** (0.02)
DUM	-0.80*** (0.10)	-0.75*** (0.07)
Constant	23.30*** (0.61)	23.31*** (0.65)
Number of obs.	276	264
Number of groups	12	12
within R ²	0.81%	81%

Note: the symbols ***, ** and * refer to levels of significance of 1%, 5% and 10% respectively. The parenthesis shows robust standard errors.

The overall effect of the development of the financial sector in dampening the negative impact of exchange rate fluctuations on GDP growth is calculated as follows: $-0.07 + 0.05 * FSDX_{it}$.

For example, The Gambia's Financial Sector Development Index is around -0.95 in 1996. At that level of development of the financial sector, for every 1% increase in exchange rate fluctuations, its GDP will decrease by about 0.12%.

When the Gambia's financial sector development index reaches around -0.34, at the level of development of the financial sector, for every 1% increase in exchange rate fluctuations, its GDP will drop by about 0.09%. Therefore, when the financial sector development index is at a high

level, the negative impact of exchange rate fluctuations on GDP will be reduced.

For Ghana, its 1995 financial sector development index was approximately -1.02, and a 1% increase in exchange rate fluctuations resulted in a 0.12% decrease in its GDP. When Ghana's financial sector development index reached around 0.28 in 2015, at the level of development of the financial sector, a 1% increase in exchange rate fluctuations would reduce its GDP by approximately 0.06%. Therefore, the negative impact of exchange rate fluctuations on exports has been reduced at the high level of the financial sector development index.

For Cote d'Ivoire, whose Financial Sector Development

Index is around -0.15 in 2003, a 1% increase in exchange rate volatility resulted in a 0.08% reduction of its GDP. When the Financial Sector Development Index for Cote d'Ivoire reached around 0.75 in 2017, at that level of financial sector development, a 1% increase in exchange rate volatility decreased its GDP by about 0.03%. Therefore, when the financial sector development index is at a high level, the negative impact of exchange rate fluctuations on GDP will be reduced. Therefore, the estimates provided give evidence that the level of financial development plays an important role in the impact of exchange rate fluctuations on the GDP of West African countries.

5. Conclusion

To sum up the findings of this chapter, the results support that the depreciation of the real effective exchange rate

volatility has a contractionary effect on economic growth in the West African countries, and this contractionary effect decreases with countries' financial sector development. Our results are also supported by random effect "Ad hoc methodology" and the GMM procedure implying that they are robust to the cross-section correlation and reverse causality considerations. We also showed that depreciation of real exchange rate is again contractionary for the West African countries in the short run as well as in the long run using the GMM procedure. The study recommends that the authorities in the West African countries should speed up the development of their financial sector to decrease the negative effects of exchange rate volatility thereby encouraging economic growth.

Although this study has advanced the literature, researchers in the future might check disaggregated data in terms of individual country. This will remove aggregation bias associated with it.

Appendix

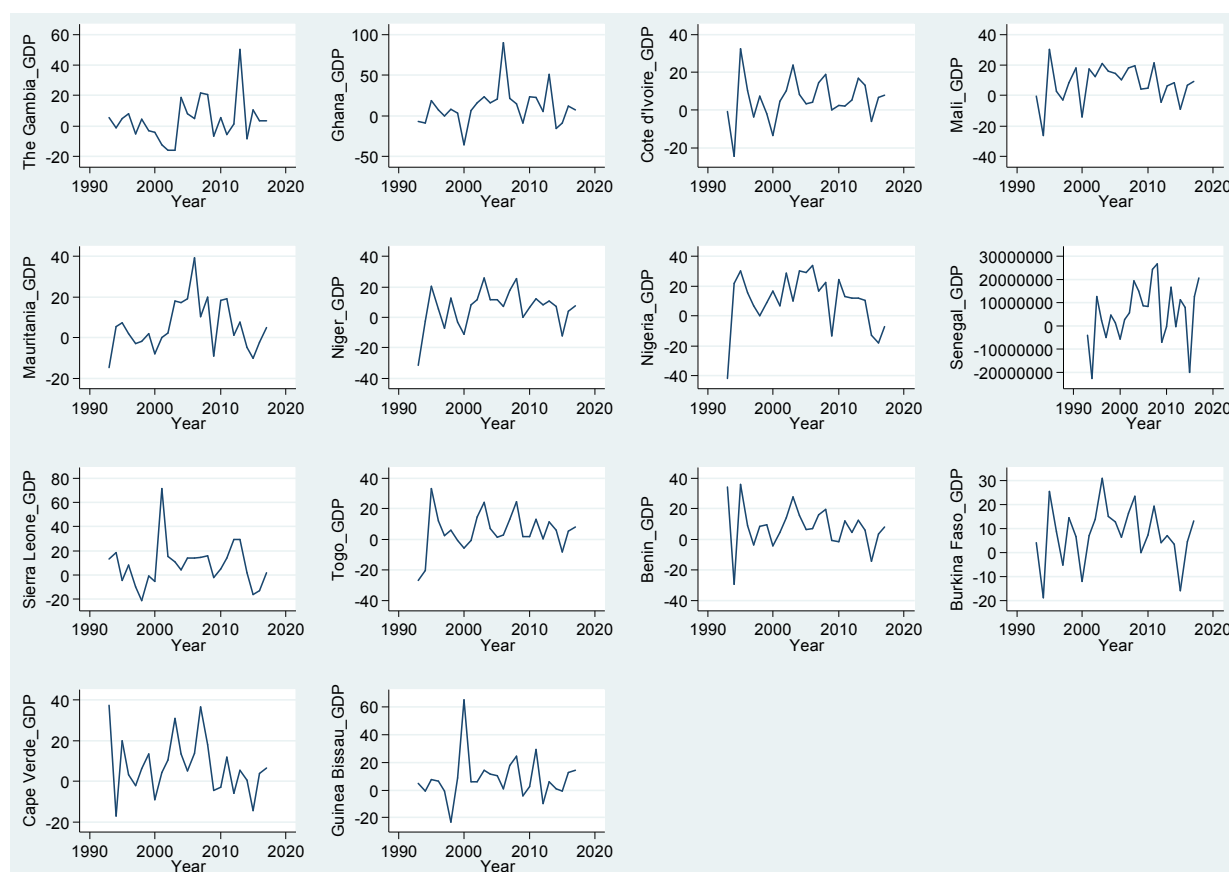


Figure 2. Country-Specific Gross Domestic Product (GDP) growth rate.

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