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The Role of Financial Sector Development on the Impact of Exchange Rate Volatility on Exports Trade: Evidence from West Africa

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Abstract: This article examines the role of financial sector development in determining the impact of exchange rate fluctuations on the exports of West African countries. The random-effects and the two-step difference generalized method of moment estimation technique 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 research results show that the overall impact of exchange rate fluctuations on exports depends on the level of development of the financial sector. The more financially developed an economy, the less its exports are adversely affected by exchange rate fluctuations. The results are also supported by random effect "Ad hoc methodology" by using the lagged term of exchange rate movements, implying that they are robust to heteroskedasticity and reverse causality considerations. The study suggests that the authorities of West African countries should speed up the development of their financial sector to reduce the negative impact of exchange rate fluctuations, thereby encouraging export growth.

Keywords: Exports, Ad hoc methodology, financial sector development, exchange rate volatility, endogeneity, heteroskedasticity.

1. Introduction

This paper investigates the possible nonlinearity of the impact of exchange rate volatility on export trade. Clark et al. (2004), as reported by Chit, (2008) pointed out that globalization not only leads to trade liberalization, but also to the liberalization of capital flows between countries and the related growth of cross-border financial transactions. However, as reported by Chit (2008); Clark et al. (2004) warned that in countries with underdeveloped capital markets and lack of stable economic policies, the scope and diversity of cross-border financial transactions have significantly exacerbated exchange rate fluctuations. This event, in effect, has created uncertainties in the trade sector of these economies.

However, Baron (1976) asserted that the risk of exchange rate fluctuations can be reduced through forward and futures contracts. Also, the IMF, 2004 report as mentioned by Kliatskova, (2013) suggest that the emergence of hedging mechanisms, increase in the number of multinational firms, and the creation of currency union can reduce a firm's exposure to exchange rate risks. Early theoretical models (such as Clark, 1973 and Ethier, 1973) concluded that under perfect hedging opportunities, the uncertainty of the exchange rate itself has no effect on trade volume. According to Clark et al. (2004), the development of financial hedging instruments could dampen firms' vulnerability to the risk arising from exchange rate movement.

A country's financial sector, in addition to its traditional role of financial intermediation, is important to the development of export trade, through the following: Provision of information to buyers and sellers, settling transactions, making advance payments, issuing letters of credit, and managing currency risks arising from the exchange rate volatility. However, despite little progress in the past few decades, the financial sector of West African countries is still a shallow and narrow financial system, mainly based on cities, which remains a key policy challenge. The sector is mostly commercial banking, with limited stock exchange activities (Montfort et al. 2016).

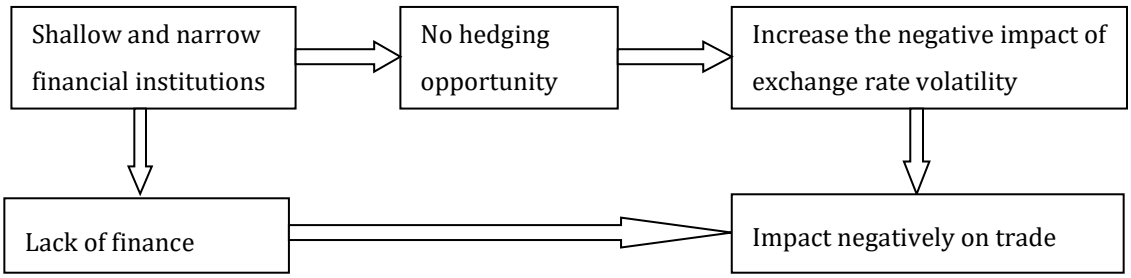
Berman and Héricourt, (2010) confirmed that financial constraints create a disconnection between firms' productivity and their export status: productivity is only a significant determinant of the export decision if the firm has enough access to external finance. Furthermore, they also show that an increase in a country's financial development dampens this disconnection, thus acting both on the number of exporters and on the exporters' selection process.

A basic role played by the development of the financial sector is to redistribute funds from agents with excess capital to agents with shortages (Rajan and Zingales, 1998). The intuition is that financial sector development reduces the transaction costs of saving and investing, as well as the overall cost of capital in an economy in general. To the extent that financial markets and institutions help firms overcome problems of moral hazard and adverse selection, it should cut the costs of external finance needed to engage in international trade. Therefore, the development of the financial sector should reduce the cost of capital and the differential cost of external financing (Rajan and Zingales, 1998).

On the other hand, the shallow financial sector can help aggravate the negative impact of exchange rate fluctuations on trade through two main mechanisms. The first possible mechanism is that a shallow financial sector can provide a less effective way to reduce the risk of exchange rate fluctuations. In addition, the shallowness of the financial sector cannot provide better financing channels for import and export companies. Hence, the affected companies cannot bear the adverse effects of exchange rate fluctuations, which may affect trade.

The study of Berman and Héricourt, (2010) also highlights that if firms are unable to get access to sufficient funds, they will face more difficulties to fund new investments, and will be even more reluctant to take the chance to engage in exports to markets characterized by highly volatile exchange rates. Therefore, the shallow financial sector can directly hinder trade by providing insufficient funds or indirectly hinder trade by providing less efficient risk transfer methods to reduce the adverse effects of exchange rate fluctuations. See Figure 1 below.

Figure 1: Direct and indirect impact of shallow and narrow financial institutions



Note: Arrows show the flow of impact

Although there are many studies investigating the impact of exchange rate volatility on trade in terms of exports, it seems there has been no attempt to analyze the role of financial sector development in managing the risk of exchange rate volatility in the West African economies. This study will investigate the role of financial sector development in the relationship between exchange rate volatility and the exports of the West African countries. This is especially important for West African economies with weak financial systems and low exports.

Therefore, the main purpose of this study is to explore whether the impact of exchange rate fluctuations is stronger when the level of financial development is low. Thus, if the impact of exchange rate fluctuations is more intense at low-level of financial development, then the West African countries should put in place policies geared towards reforming the financial sector, which will effectively lead to mitigating the exchange rate risk. This paper focuses on the relationship between exchange rate volatility and the level of financial development. Specifically, the hypothesis therefore becomes;

Ho: The negative impact of exchange rate fluctuations on exports reduces at a high level of Financial Sector Development.

H1: The negative impact of exchange rate fluctuations on exports does not reduce at a high level of Financial Sector Development.

The contribution of this study to the empirical literature is that it is the first to provide new insights into the role of financial sector development in the relationship between exchange rate volatility and exports of the countries under consideration. This will add a missing puzzle to the previous related studies.

The rest of this paper is organized as follows. Section 2 reviews the related literature that establishes the relationship between financial sector development and trade activities. Section 3 discusses the research method, model specification, definition of variables, data sources, expected signs, and construction of the financial sector development index. Section 4 gives results presentation and discussion. Section 5 draws conclusions and policy recommendations.

2. The relationship between financial sector development and export trade

A high degree of financial sector development could dampen the real economic costs of exchange rate volatility via the following mechanism. The first mechanism in which a developed financial sector could mitigate the effect of exchange rate uncertainty is that a greater degree of financial sector development could offer more effective ways of transferring risks arising from exchange rate volatility (Chit, 2008). Confirming this statement, Clark et al. (2004) submits that, the risks of exchange rate volatility could be reduced through the availability of direct and indirect hedging instruments provided by a developed financial sector

Fafchamps and Schundeln, (2012) combine data from the Moroccan census of manufacturing enterprises with information from a commune survey over the period 1998 to 2003, they tested whether a firm's expansion is affected by local financial development. Their finding suggests that local bank availability is robustly associated with faster growth for small and medium-size firms in sectors with growth opportunities, with a lower likelihood of firm exit and a higher likelihood of investment. The research further suggests that access to credit is used by pre-existing Moroccan firms to mobilize investment funds needed to engage in trade. The findings of this analysis imply that businesses /firms may do better if they set up in countries with a developed financial sector. Thus, the higher the degree of financial sector development, the higher the firm's ability to borrow, and the more likely it can survive the adverse impacts of foreign exchange rate risk on exports trade.

As noted by Kliatskova (2013), a well-developed financial sector provides firms with the opportunity to edge risks using different financial instruments. Countries with more developed financial systems are better able to give firms greater access to credit facilities, thereby helping them to withstand a period of high exchange rate volatility (Kliatskova, 2013). Thus, the greater the ability of a firm to borrow the more it can resist the adverse effect of exchange rate volatility.

Shahbaz and Mohammad, (2014) submit that exporting firms face large fixed costs, but development in the financial sector helps them to acquire these fixed costs. Bilas et al. (2017) conclude that trade volume between countries that have relatively healthier financial markets will be higher, and worsening financial conditions affect export-oriented firms more adversely than domestic-oriented ones due to higher fixed costs faced by firms dealing in exports. A more developed financial sector channel more saving to the private sector, facilitate enterprises with the use of external financing so that firms can overcome liquidity constraints. Financial sector development is a potential source of comparative advantage for a country. Economies with a higher level of financial development are more likely to have higher export shares in world trade (Shahbaz and Mohammad, 2014).

2.1: The role of financial sector development in mitigating the adverse impact of exchange rate volatility

Financial institutions mitigate risks of exchange rate fluctuations on trade through derivative contracts, such as swap, forward, and futures contracts, and their respective options in vast and rapidly growing global financial markets. Multinational companies suffered low competitiveness from exchange rate risks because their supply chains, output markets, and sources of finances are situated in different nations (Raihan, 2013). The exchange rate fluctuations subjected companies to uncertainties, this calls for new hedging policies (Sikarwar, 2014). With perfect hedging opportunities, exchange rate uncertainty alone has no negative impact on the volume of trade (Clark, 1973; and Ethier, 1973).

There are some ways to hedge against exchange rate risk. With short-term deposits, an investor can buy a forward contract or enter a futures market. In this case, the investor would arrange to sell the domestic currency in the future when converting the deposit back to dollars. On such a contract, a pre-plan for the future exchange rate is possible; therefore, the rate of return is certain as well, hence reducing the risk of exchange rate volatility. In support of this view, Baron (1976) asserts that futures contracts can cut the risk in exchange rate volatility. Thus, if firms can hedge using futures contracts, exchange rate volatility may not have any negative impact on trade volume.

The hedging of risks of fluctuating exchange rates is necessary to enhance the safety, liquidity or marketability, and fair market value of a bank's investments. Banks hedged by using foreign exchange derivatives, including currency options, currency swaps, forward, and futures contracts to lock in foreign exchanges. A bank leader hedged receivables with futures contracts to keep up or improve value at risk, ensure gains or profits, and protect against loss due to exchange rate fluctuation in the flexible or floating exchange rate regime (Raihan, 2013). A country with developed financial markets can help trade, hedging, borrow foreign currency to finance their exporting activity with the intent of avoiding the foreign exchange risk. Thus, a well-developed financial market may cut the effect of exchange rate volatility on trade.

However, Wei (1999) examines the empirical validity of the probability of hedging availability using data on over 1000 country pairs. The paper deals with the problem by specifying an endogenous regime-switching regression. The result did not show any evidence to support the hedging hypothesis validity.

2.2: The role of financial sector development in providing exporters better access to finance

Most export businesses need some sort of loan or help financing exports to get started. Exporters often need loans to ease the export of goods or services by providing the liquidity needed to accept new business, grow international sales and compete more effectively in the international marketplace.

Countries with well-developed financial institutions are better able to finance exporters. Enable export businesses to acquire financing for large-scale projects that need large amounts of capital, such as infrastructure, telecommunications, power, water, housing, airports, hotels, high-tech, financial services, and natural resource extraction industries. Also, developed financial systems and institutions enable export businesses to acquire, construct, renovate, modernize, improve or expand facilities and equipment to be used to produce goods or services involved in international trade. Production for an unusually large order or for a surge of orders may present unexpected and severe strains on working capital. Even during normal periods, countries with underdeveloped financial institutions may not be able to provide the adequate working capital needed to stimulate an exporter's growth.

Chit, (2008) submits that the lack of the ability to get access to a developed financial market to finance the entry costs may hinder the potential exporters from exporting activities. However, Chit, (2008) warns that exporting activities may not be easy to finance because of the risk associated with foreign markets and the existence of information asymmetry between potential investors and would-be exporters.

Studying the empirical relationship between exports, financial development, and economic growth in the case of Pakistan, Shahbaz and Mohammad, (2014) use the autoregressive distributed lag (ARDL) bounds testing approach to cointegration and error correction model to test the long run and short-run relationships, respectively. The direction of causality between the variables is investigated by the vector error correction

model (VECM), Granger causality test, and the robustness of causality analysis is tested by applying an innovative accounting approach (IAA). The results show that financial development spurs exports growth in Pakistan. The causality analysis reveals the feedback hypothesis that exists between financial development and exports. This study provides new insight for policymakers to sustain exports growth by stimulating development in the financial sector in Pakistan.

Rajan and Zingales, (1998) submit that if the financial sector development mitigates the cost of external finance, export firms that are typically short of funds to invest should do better in economies with well-developed financial sectors. This submission suggests that financial development liberates export firms from the constraints of generating funds internally and promotes their growth.

Nevertheless, countries with less developed financial sectors and institutions might not be able to help their export trade. For example, Chit, (2008) investigates the role of financial sector development on the trade effect of exchange rate volatility. Using the financial sector development index for the exporting country, and employing the two-stage least-squares generalization G2SLS-IV and generalized method of moment GMM-IV estimation techniques; the results give evidence that the level of financial sector development has a significant positive impact on the volume of real exports. The results of the regression further show that the interaction term of exchange rate volatility and financial sector development is positive and significant. The study concludes that the negative impact of exchange rate volatility on exports is more intense in a less financially developed economy. The intuition is that the impact of exchange rate volatility on export trade is mitigated if businesses or firms operate in a financially developed environment.

Awudu et al. (2018) look at the effect of financial development on international trade in Africa, relying on data for 46 countries over the period 1980–2015. Results from the system generalized method of moments reveal differential effects of finance on trade. In particular, the analysis indicates that private credit does not promote trade, while domestic credit positively affects trade. The analysis implies that improving the level of private (domestic) credit dampens (amplifies) exports and trade openness. The empirical analysis also finds a U-shaped relationship between private credit and trade measures, suggesting that financial sector development may be harmful (helpful) to trade for economies with a low (high) level of private credit.

On the other hand, Demirtas and Aydemir (2014) investigate the causal relationship between financial development and international trade with Toda Yamamoto, using data from 1961 to 2012 about Turkey. The result of the empirical findings suggests that there is bidirectional causality between financial development and international trade. Also, financial sector development leads to international trade indirectly through both economic growth and exchange rate. Bilas et al. (2017) check the relationship between financial development and international trade in Croatia over the period from the first quarter of 1997 and the last quarter of 2015. The autoregressive distributed lag (ARDL) bounds testing approach to cointegration is used to look at the long-run and short-run relationships. The research results show unidirectional Granger causality from financial sector development to international trade at the 10% significance level and negative long-run and positive short-run relationships between financial developments and international trade in Croatia.

Correspondingly, Drama and Yao, (2016) analyze empirically the link between financial development and international trade growth in Cote d'Ivoire using time series data covering the period of 1980 - 2014. The error correction model and cointegration method were employed to capture the short and long-run dynamics of this relationship, respectively. The result shows that the link between financial development and international trade is very weak and negative in Cote d'Ivoire. The paper concludes that authorities should promote domestic exporters by facilitating their access to private credit. Kiendrebeogo, (2012) investigates empirically whether a country's level of manufacturing trade is affected by its financial sector development. Using cross-sectional and panel specifications on a sample of 75 countries over the period 1971-2010, the findings of the empirical analysis suggest that financial development strongly and robustly exerts a positive effect on manufacturing exports, even after controlling for the effect of banking crises. Furthermore, institutional quality is found to have a favorable effect on the extent to which finance influences manufacturing trade.

Sandra and Héricourt, (2013) study how firm-level export performance is affected by Real Exchange Rate (RER) volatility and investigate whether this effect depends on existing financial constraints by using export data for more than 100,000 Chinese exporters over the 2000-2006 periods. The result shows a trade-deterring effect of RER volatility. The findings show that the value exported by firms, as well as their chance of entering

new export markets, decreases for destinations with a higher exchange rate volatility and that this effect is magnified for financially vulnerable firms. The paper concludes that financial development seems to dampen this negative impact, especially on the intensive margin of export.

Grier and Smallwood, (2007) study a sample of nine developed and nine developing countries to check the questions of how real exchange rate (RER) uncertainty impacts international trade and how those impacts vary according to the stage of development by employing the GARCH model. The result suggests that RER uncertainty has a negative and significant impact on export growth for six of the nine less developed countries in their sample, while it has an insignificant effect for the majority of the developed countries.

3. The Methodology

The role of financial sector development in mitigating the impact of exchange rate volatility on the export of 13 West African countries is examined by using a panel data set for the period from 1995 to 2017. The puzzle which is absent in the literature of the West African countries is whether financial sector development mitigates the negative impact of exchange rate fluctuations on exports.

3.1: The Model Specification and Data

The model used in this paper is augmented by variables of main interest; exchange rate volatility and financial sector development.

$$LnEXP = f\,(LnRER, LnM2, LnUSG, INFL, LnVOLA, FSDX, DUM, U) \qquad (1)$$

LnEXP is the log of the total value of exports, LnRER is the log of real exchange rate measured as {Nominal Exchange Rate (NOER)* price of foreign goods (P_f) / price of domestic goods (P_d)}, LnM2 is the log of money supply, LnUSG is the log of the gross domestic product of trading partners (U.S gross domestic product is a proxy for this variable), INFL is the inflation rate, LnVOLA is the exchange rate volatility proxy generated from the monthly real effective exchange rates. FSDX is the index of financial sector development, and DUM is the dummy that captures the effect of the financial crisis, U is the error term. An increase in the exchange rate in this chapter indicates a depreciation of the domestic currency and a decrease indicates an appreciation of the domestic currency.

Apart from the financial sector development index, the selected variables consist of nominal exchange rate NOER {Measured as the Relative price of the Local currency unit divided by the relative price of the US dollar (RPLCU/RPUSD)}, The United States Consumer Price Index (USCPI), Consumer price index (CPI) for the domestic countries. Real exchange rate RER {Calculated by (NOER* P_f/P_d)[1]}, Exports of goods and services (EXP), US gross domestic product (USG), Inflation rates (INFL) measured by GDP deflator (annual %), Exchange Rate Volatility (VOLA)[2], and Money supply (M2) measured in current US dollar[3].

3.2: Financial sector development index (FSDX)

In this section, the paper focuses on the financial sector development index. According to World Bank Report, (2016) financial sector development occurs when financial instruments, markets, and intermediaries ease the effects of information, enforcement, and transactions costs and do a correspondingly better job at providing the key functions of the financial sector in the economy.

A good measurement of financial sector development is essential to assess the development of the financial sector. It is important to note that the sample countries under consideration are developing economies; their financial markets are at the early stage of development. The majority of the exporting

[1] P_f = foreign price level (proxy as USCPI), and P_d = domestic price level (proxy as domestic CPI).

[2] Annual variation by averaging the variance of twelve months of each year (Estimations were based on the monthly real effective exchange rate data, and obtained from the bruegel.org/publication/ dataset).

[3] With the exception of RER and VOLA, all the other variables were obtained from World Bank Data Base.

businesses/firms from these economies are not listed in financial markets and the major source of finance for these businesses/firms is from banks. According to Chit (2008), this kind of financial system is a bank-based system rather than a market-based system. Beck et al. (2009) also confirm that financial deepening has taken place in banking as much as in stock and bond markets in low-income countries.

Nevertheless, as the financial sector of a country comprises a variety of financial institutions, markets, and products, to develop a comprehensive yet relatively simple framework to measure financial development in the West African economies. This study follows (Beck et al., 2000; 2009) and identifies three sets of proxy variables characterizing a well-functioning financial system as follows. Liquid liability to GDP% (LLGDP), private credit by deposit money banks and other financial institutions to GDP% (PCDMBFI), and bank deposits to GDP% (BDGDP).

Liquid Liabilities to GDP is a commonly used indicator of financial development. It equals currency plus demand and interest-bearing liabilities of banks and other financial intermediaries divided by GDP (Beck et al. 2000; 2009). This is the broadest available indicator of financial depth since it includes all banks, bank-like and nonbank financial institutions (Beck et al., 2009). These are institutions that serve as financial intermediaries, while not incurring liabilities usable as means of payment.

The second indicator is private credit by deposit money banks and other financial institutions to GDP. It is standard in the literature for measuring financial depth. Beck et al. (2009) make the case that countries with higher levels of Private Credit to GDP have been shown to grow faster and experience faster rates of poverty reduction.

And the third indicator, which also captures the liability side of the financial intermediaries' balance sheet, is the bank deposits to GDP. This indicator is limited to deposits of deposit monetary institutions (Beck et al. 2009). It can be described as; demand, time, and saving deposits in deposit money banks as a share of GDP (see Beck et al. 2000).

Chit, (2008) warned that financial sector development indicators are highly correlated. Including all of them in a model will lead to the problems of multicollinearity and over-parameterization, which may lead to biased results. To overcome this problem, Chit, (2008) uses the Principal Component Analysis PCA technique to build the financial sector development index. Hence, to avoid bias estimates in this study, we adopt the PCA approach to build the financial sector development variables using STATA 13 command options[4]. See Appendix 1 for the financial sector development variables (FSDX), which represent overall indicators of the depth of the financial sector development in the West African economies under consideration.

[4.] Principal component analysis is a statistical procedure that allows you to summarize the information contained in large data set by means of a smaller set that is more easily visualized and analyzed whilst still containing most of the information in the large set. It is a very flexible tool and allows analysis of datasets that may contain, for example, multicollinearity, missing values, categorical data, and imprecise measurements. The goal is to extract the important information from the data and to express this information as a set of summary indices.

Table 1: Summary statistics and correlations of the main variables

	LnEXP	LnVOLA	LLGDP	PCDMBFI	BDGDP	FSDX
Mean	20.9	1.51	26.79	14.59	9767.22	2.8E-
Standard deviation	1.71	1.66	16.22	11.63	168553.60	1.00
Skewness	0.47	1.89	2.06	2.12	17.20	2.12
Kurtosis	2.90	9.21	8.04	8.65	297.00	8.65
Min	17.16	-1.77	4.49	0.87	2.81	-1.18
Max	25.7	10.42	98.85	63.98	2914584	4.25
Observations	299	299	299	299	299	299
LnEXP	1.00					
LnVOLA	-0.13	1.00				
LLGDP	-0.04	-0.38	1.00			
PCDMBFI	0.16	-0.41	0.9	1.00		
BDGDP	-0.05	0.03	0.03	-0.04	1.00	
FSDX	-0.05	-0.29	0.3	0.17	-0.04	1.00

Table 1 provides the summary descriptive statistics and correlations for the variables, with a sample of 299 observations for each. The mean of LnEXP is 20.90, the deviation of the sample mean is 1.71, while the skewness is 0.47, which means that the observed values tend to have a normal distribution around the mean. And the kurtosis is 2.90, meaning lower values below the sample mean. In the case of the LnVOLA variable, the mean is 1.51, the deviation of the sample mean is 1.66, while the skewness is 1.89, which means the skewness is positive. The kurtosis is 9.21, meaning a higher value above the sample mean. Also, the variable LLGDP shows that the mean is 26.79, the deviation of the sample mean is 16.22, while the skewness is 2.06, which means the skewness is positive. And the kurtosis is 8.04, meaning lower values below the sample mean. The PCDMBFI variable shows that the mean is 14.59, the deviation of the sample mean is 11.63, while the skewness is 2.12, which means the skewness is positive. And the kurtosis is 8.65, indicating lower values below the sample mean. The BDGDP variable shows that the mean is 9767.22, the deviation of the sample mean is 168553.60, while the skewness is 17.20, which means the skewness is positive. And the kurtosis is 297.00, indicating lower values below the sample mean. Also, the variable FSDX shows that the mean is 2.8E-, the deviation of the sample mean is 1.00, while the skewness is 2.12, which means the skewness is positive. And kurtosis is 8.65, meaning high values above the sample mean.

Correlation statistics reveal that the relationship between exchange rate volatility and exports is negative, while the correlation between financial sector development and exports is also negative.

3.3: The Estimation Method

To control for potential endogeneity and heteroskedasticity, we apply the "Ad hoc approach", by lagging the exchange rate movement for a robustness check. In order to check the direct and nonlinear effect of financial sector development, the financial sector development index variable and an interaction term of the financial sector development index and exchange rate volatility are included in the model. Specifically, the regression equation to be estimated is:

$$LnEXP_{it} = \alpha_0 + \alpha_1 LnRER_{it} + \alpha_2 LnM2_{it} + \alpha_3 LnUSG_{it} + \alpha_4 INFL_{it} + \alpha_5 LnVOLA_{it} + \alpha_6 FSDX_{it} + \alpha_7 LnVOLA_{it} * FSDX_{it} + DUM + U_{it} \quad (2)$$

LnEXP is the dependent variable of the equation *(2).* As far as the expected signs of these estimated coefficients are concerned, in this equation, α_0 is the constant intercept. An increase or depreciation in the real exchange rate (LnRER), all things being equal, will make exports more competitive than before, thereby

increasing the demand for domestic exports, so that $\alpha_1>0$. The sign of money supply (LnM2) is expected to relate negatively to export, so that $\alpha_2<0$. It is assumed that exports relate positively to the gross domestic product of trading partners (LnUSG), thus, $\alpha_3>0$. The sign of inflation rate (INFL) is expected to relate negatively to exports, so $\alpha_4<0$. The sign of the exchange rate volatility (LnVOLA) is expected to be negative, so that $\alpha_5<0$. The sign of the financial sector development index variable (FSDX) is expected to be positive so that $\alpha_6>0$. The coefficient of the interaction term, α_7, is expected to be positive so that the overall impact of exchange rate volatility estimate ($\alpha_5+\alpha_7*FSDX_{it}$) is more negative at low levels of financial sector development.

4. Results presentation and discussion

As stated earlier, the interesting puzzle which this paper seeks to address is whether the negative impact of exchange rate volatility on exports reduces/increases at a high/low level of financial sector development. This puzzle will be addressed by the estimates of the overall impact of exchange rate volatility on exports.

4.1: Panel unit root tests

To verify the existence of a long-run stable relationship between the dependent and the independent variables, both testing for unit roots within the panel and assessing cointegration are necessary before estimating the models. Table 2 shows the summary result of the unit root tests conducted using Im-Pesaran-Shin, (2003) Panel Unit Root Test, and Levin-Lin-Chu, (2002) Unit-Root Test.

Table 2: Im-Pesaran-Shin (2003) and Levin-Lin-Chu (2002) panel unit root test

Variable	Level		First Difference	
	Im-Pesaran-Shin	Levin-Lin-Chu	Im-Pesaran-Shin	Levin-Lin-Chu
LnEXP	-1.29(0.09) *	-0.85(0.19)		-6.39(0.00) ***
LnRER	-1.73(0.04) **	-2.27(0.01) ***		
LnUSG	-3.96(0.00) ***	-4.99(0.00) ***		
LnM2	-2.02(0.02) **	-0.50(0.31)		-8.26(0.00) ***
INFL	-7.21(0.00) ***	-5.99(0.00) ***		
LnVOLA	-7.26(0.00) ***	-4.35(0.00) ***		
FSDX	2.37(0.99)	0.31(0.62)	-4.14(0.00) ***	-6.09(0.00) ***
LnVOLA*FSDX	-5.34(0.00) ***	-1.97(0.02) **		

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 the financial sector development index variable (FSDX). This implies the integration of order zero I (0), for seven variables, and integration of order one I (1), for one variable.

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 five of the series are stationary at a 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 ascertain the validity of the model and estimate the regression equation. 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, see the following:

Table 3: VIF test for multicollinearity

Variable	VIF	1/VIF
LnUSG	3.34	0.30
DUM	3.14	0.32
LnVOLA*FSDX	2.34	0.43
FSDX	1.96	0.51
LnVOLA	1.92	0.52
INFL	1.57	0.64
LnM2	1.54	0.65
LnRER	1.28	0.78
Mean VIF	2.14	

Based on the result of the VIF test of variables for multicollinearity shown in Table 3, since none of the VIF values reached a value of 10, there is no problem of multicollinearity among the included variables in the models and therefore, we maintained all the variables for estimation of the model.

4.2: Exchange rate impact on the exports and the role of financial sector development

Table 4 presents the estimation results of the impact of exchange rate volatility on the exports of the sample countries. The first column reports the results of the random-effects estimation. However, because of the potential problem of endogeneity, the second column reports the results of the "Ad hoc method" by using the lagged term of exchange rate movements for a robustness check in the random effect model. And also, Table 5 shows the results of the two-step difference GMM estimations.

The results provide evidence that exchange rate volatility has a significant negative impact on the exports of the economies. The result is consistent with most of the previous studies, which find a negative impact of exchange rate volatility on exports of samples of African countries as well as other regions[5].

Table 4: The robust RE estimation results, dependent variable: Exports

[5] See Omojimite and Akpokodje, (2010); Meniago and Eita, (2017); Baak, (2004); Srinivasan and Kalaivani, (2013) and Chit, (2008).

Variable	Export Model - RE	Export Model- RE (Ad hoc approach)
$LnRER_{it-1}$		-0.16
		(0.10)
LnRER	-0.30***	
	(0.10)	
LnM2	-0.16*	-0.21*
	(0.09)	(0.11)
LnUSG	1.60***	1.73***
	(0.20)	(0.20)
INFL	-0.00	-0.00
	(0.00)	(0.00)
LnVOLA	-0.04***	
	(0.01)	
$LnVOLA_{it-1}$		-0.05***
		(0.02)
DUM	-0.41***	-0.39***
	(0.12)	(0.13)
Constant	-24.95***	-29.39***
	(6.60)	(6.50)
Number of observations	299	286
Number of groups	13	13
Overall R^2	0.19%	0.19%

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

Table 5: GMM estimation results, dependent variable: Exports

Variable	Short Run GMM	Long Run GMM
LnRER	-0.53***	-0.37***
	(0.16)	(0.05)
LnM2	0.70	0.49*
	(0.53)	(0.26)
LnUSG	1.83***	1.27***
	(0.28)	(0.26)
INFL	0.00	0.00
	(0.00)	(0.00)
LnVOLA	-0.06***	-0.04***
	(0.02)	(0.01)
DUM	-0.20***	-0.14***
	(0.03)	(0.04)
No. of obs.	286	
Arellano-Bond test for AR (2)	0.67	
Sargan - Hansen 2-step weighting matrix.	0.95	
Sargan - Hansen 3-step weighting matrix.	0.84	
No. of Instruments	12	
Number of groups	13	

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

Table 6 presents the role of financial sector development in the trade effect of exchange rate volatility. As explained in the methodology section, an exporting country's financial development is measured by a Financial Sector Development Index. The first and second columns show the impact of exchange rate volatility along with financial development and a set of control variables by using the random effect model and applying the "Ad hoc approach", where we lagged the exchange rate movement by one to avoid the loss of high degrees of freedom. When we include a variable representing the level of financial sector development of the countries, the results as presented in Table 6 provide evidence in column one and column two that the level of financial sector development has a significant positive impact on the volume of exports.

In order to test the main prediction of the chapter: the non-linear effects of exchange rate volatility on exports, that is, the effect of exchange rate volatility on exports is conditional on the level of financial sector development. In Table 7, we add a variable interacting with the exchange rate volatility and the measure of financial sector development. The results of the regressions show that the interaction term of exchange rate volatility and financial sector development is positive and significant in column one as well as in column two where we apply the "Ad hoc approach", by lagging the exchange rate movement for a robustness check to account for possible endogeneity issues. The positive coefficient of this result suggests that the negative impact of exchange rate volatility on exports reduces at a high level of financial sector development.

Regarding the control variables, the coefficient of LnRER is statistically significant with a negative sign, which is inconsistent with the theoretical expectation. However, when this variable is lagged by one period, the variable becomes statistically insignificant, but the sign remains negative. The coefficient of LnM2 is statistically significant with a negative sign, which is consistent with the theoretical expectations. The coefficient of LnUSG is statistically significant with a positive sign, which is also consistent with the theoretical expectations. The inflation rate remains insignificant. And the dummy variable which captures the effects of the Global Financial crisis is significant with a negative sign.

Table 8 shows the estimation of the overall role of financial sector development in dampening the impact of exchange rate volatility on exports trade.

Table 6: Exchange Rate Volatility and Exports: The Role of Financial Sector Development

Variable	Export Model - RE	Export Model- RE (Ad hoc approach)
$LnRER_{it-1}$		-0.11
		(0.11)
LnRER	-0.25**	
	(0.12)	
LnM2	-0.20***	-0.23**
	(0.08)	(0.09)
LnUSG	1.46***	1.57***
	(0.23)	(0.22)
INFL	-0.00	-0.00
	(0.00)	(0.00)
LnVOLA	-0.04***	
	(0.01)	
$LnVOLA_{it-1}$		-0.05***
		(0.01)
FSDX	0.18**	0.16**
	(0.08)	(0.07)
DUM	-0.36***	-0.36***
	(0.12)	(0.13)
Constant	-20.69***	-24.69***
	(6.90)	(6.86)
Number of observations	299	286
Number of groups	13	13
Overall R^2	0.15%	0.16%

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

Table 7: Exchange Rate Volatility and Exports: The Role of Financial Sector Development

Variable	Export Model - RE	Export Model- RE (Ad hoc approach)
$LnRER_{it-1}$		-0.11
		(0.09)
LnRER	-0.27**	
	(0.12)	
LnM2	-0.21**	-0.23**
	(0.08)	(0.09)
LnUSG	1.39***	1.76***
	(0.21)	(0.20)
INFL	-0.00	0.00
	(0.00)	(0.00)
LnVOLA	-0.04***	
	(0.01)	
$LnVOLA_{it-1}$		-0.01
		(0.01)
$LnVOLA_{it-1}$*FSDX		0.03***
		(0.01)
FSDX	0.20**	0.13*
	(0.09)	(0.07)
LnVOLA*FSDX	0.05***	
	(0.02)	
DUM	-0.35***	-0.30**
	(0.10)	(0.12)
Constant	-18.54***	-30.66***
	(6.42)	(6.18)
Number of observations	299	273
Number of groups	13	13
Overall R^2	0.15%	0.15%

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

Table 8: Shows the overall impact of exchange rate volatility on export

Year	The Gambia	Ghana	Cote d'Ivoire	Mali	Niger	Nigeria	Senegal	Togo	Benin	Burkina Faso	Cape Verde	Guinea Bissau	Sierra Leone
1995	-0.037	-0.040	-0.003	-0.031	-0.031	-0.031	-0.018	-0.043	-0.011	-0.029	-0.031	0.003	-0.042
1996	-0.039	-0.040	-0.005	-0.024	-0.036	-0.031	-0.018	-0.044	-0.010	-0.028	-0.031	0.008	-0.042
1997	-0.038	-0.037	-0.006	-0.022	-0.037	-0.030	-0.016	-0.043	-0.011	-0.031	-0.025	0.014	-0.040
1998	-0.037	-0.034	-0.006	-0.017	-0.038	-0.028	-0.018	-0.043	-0.007	-0.032	-0.020	0.018	-0.037
1999	-0.036	-0.031	-0.009	-0.015	-0.037	-0.028	-0.018	-0.044	-0.011	-0.027	-0.022	0.028	-0.037
2000	-0.036	-0.029	-0.010	-0.013	-0.036	-0.028	-0.014	-0.044	-0.012	-0.022	-0.020	0.041	-0.036
2001	-0.036	-0.030	-0.010	-0.016	-0.035	-0.025	-0.011	-0.044	-0.013	-0.023	-0.018	0.040	-0.040
2002	-0.033	-0.031	-0.012	-0.011	-0.035	-0.027	-0.011	-0.044	-0.018	-0.023	-0.015	0.043	-0.043
2003	-0.033	-0.030	-0.014	-0.005	-0.034	-0.027	-0.010	-0.042	-0.016	-0.018	-0.014	0.046	-0.044
2004	-0.034	-0.029	-0.014	-0.003	-0.032	-0.028	-0.008	-0.040	-0.011	-0.015	-0.012	0.051	-0.045
2005	-0.035	-0.026	-0.014	-0.007	-0.031	-0.027	-0.005	-0.039	-0.007	-0.012	-0.009	0.052	-0.045
2006	-0.031	-0.023	-0.013	-0.010	-0.028	-0.027	-0.003	-0.040	-0.006	-0.009	-0.004	0.057	-0.044
2007	-0.028	-0.018	-0.010	-0.008	-0.026	-0.018	-0.004	-0.039	-0.002	-0.006	-0.005	0.062	-0.041
2008	-0.027	-0.013	-0.009	-0.008	-0.023	-0.003	-0.002	-0.036	-0.004	-0.001	-0.005	0.073	-0.038
2009	-0.026	-0.009	-0.007	-0.009	-0.019	0.004	0.001	-0.032	-0.004	0.003	-0.004	0.091	-0.035
2010	-0.025	-0.012	-0.007	-0.009	-0.018	-0.005	0.002	-0.030	0.001	0.007	-0.006	0.104	-0.033
2011	-0.020	-0.014	-0.004	-0.008	-0.016	-0.014	0.007	-0.030	0.013	0.008	-0.004	0.112	-0.028
2012	-0.022	-0.014	-0.007	-0.003	-0.015	-0.018	0.010	-0.032	0.025	0.008	0.001	0.117	-0.017
2013	-0.023	-0.011	-0.005	-0.002	-0.013	-0.018	0.015	-0.035	0.031	0.008	0.011	0.114	-0.015
2014	-0.025	-0.006	-0.001	0.001	-0.013	-0.014	0.017	-0.036	0.036	0.009	0.020	0.114	-0.016
2015	-0.024	-0.002	0.004	0.006	-0.011	-0.011	0.017	-0.034	0.039	0.009	0.029	0.110	-0.022
2016	-0.029	-0.002	0.009	0.013	-0.008	-0.010	0.019	-0.035	0.049	0.010	0.027	0.107	-0.027
2017	-0.034	-0.007	0.013	0.019	-0.008	-0.011	0.023	-0.034	0.055	0.011	0.027	0.108	-0.023

Note: The overall impact of exchange rate volatility on exports is computed as; $\alpha_5+\alpha_7 * FSDX_{it.}$

The overall role of financial sector development in dampening the impact of exchange rate volatility can be estimated from the results. For example, in Appendix 1, The Gambia's Financial Sector Development Index is around -0.95 in 1996. At that level of financial sector development, a 1% increase in exchange rate volatility reduced its exports by about 0.039%, see Table 8. In 2011, the Financial Sector Development Index for The Gambia reached around -0.34. At that level of financial sector development, a 1% increase in exchange rate volatility reduced its exports by about 0.020%. Thus, the negative impact of exchange rate volatility on exports reduced at a high level of the Financial Sector Development Index. The estimates presented in Table 8 provide evidence that the level of financial development plays an important role in the impact of exchange rate volatility on exports in the West African countries.

5. Conclusion

This paper examines the role of financial sector development in determining the impact of exchange rate volatility on the exports of West African countries. The findings suggest that the overall effect of exchange rate volatility on exports is conditional on the level of financial sector development. The more financially developed an economy, the less its exports are adversely affected by exchange rate volatility. Thus, the estimation result confirms the null hypothesis of the study and is consistent with the notion that financial sector development provides the mechanism for firms to mitigate the negative effects of exchange rate volatility and in so doing stimulates export growth (e.g., Chit, 2008; Shahbaz and Mohammad, 2014; Bilas et al. 2017; Kliatskova, 2013; Sandra and Héricourt, 2013).

Our results are also supported by random effect "Ad hoc methodology" by using the lagged term of exchange rate movements, implying that they are robust to the heteroskedasticity and reverse causality considerations. The study recommends that the authorities in the West African countries should speed up the

development process of their financial sector in order to mitigate the negative effects of exchange rate volatility and in so doing stimulate export growth.

Although this study has advanced the literature, there are some limitations that will be addressed in future research work. This study has examined the role of financial sector development in the impact of exchange rate volatility on exports using aggregate exports data. Research in the future might check disaggregated exports trade data in terms of sector, product, and country. This will remove another layer of aggregation, and further reduce any potential bias associated with it.

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Appendix

Appendix 1: The financial sector development (FSDX) index

Year	The Gambia	Ghana	Cote d'Ivoire	Mali	Niger	Nigeria	Senegal	Togo	Benin	Burkina Faso	Cape Verde	Guinea Bissau	Sierra Leone
1995	-0.90	-1.02	0.23	-0.69	-0.68	-0.71	-0.27	-1.10	-0.04	-0.63	-0.70	0.43	-1.07
1996	-0.95	-1.00	0.15	-0.48	-0.86	-0.71	-0.26	-1.12	0.00	-0.61	-0.70	0.60	-1.06
1997	-0.94	-0.90	0.12	-0.39	-0.91	-0.66	-0.21	-1.09	-0.05	-0.69	-0.50	0.80	-1.01
1998	-0.90	-0.82	0.13	-0.25	-0.93	-0.62	-0.27	-1.11	0.08	-0.74	-0.33	0.92	-0.90
1999	-0.88	-0.71	0.05	-0.15	-0.90	-0.58	-0.27	-1.13	-0.03	-0.57	-0.39	1.27	-0.91
2000	-0.86	-0.64	0.01	-0.09	-0.86	-0.61	-0.14	-1.14	-0.05	-0.41	-0.33	1.69	-0.86
2001	-0.85	-0.66	-0.02	-0.19	-0.84	-0.49	-0.05	-1.13	-0.09	-0.42	-0.27	1.68	-0.99
2002	-0.78	-0.70	-0.06	-0.05	-0.82	-0.57	-0.04	-1.12	-0.28	-0.42	-0.18	1.77	-1.12
2003	-0.77	-0.68	-0.15	0.16	-0.81	-0.57	-0.01	-1.07	-0.21	-0.28	-0.13	1.87	-1.15
2004	-0.81	-0.64	-0.15	0.22	-0.74	-0.59	0.06	-1.01	-0.02	-0.17	-0.06	2.02	-1.18
2005	-0.82	-0.54	-0.13	0.09	-0.70	-0.55	0.17	-0.98	0.09	-0.07	0.05	2.06	-1.17
2006	-0.70	-0.42	-0.11	0.02	-0.61	-0.57	0.25	-0.99	0.13	0.02	0.20	2.23	-1.12
2007	-0.60	-0.25	-0.01	0.05	-0.53	-0.26	0.22	-0.95	0.26	0.14	0.18	2.39	-1.04
2008	-0.57	-0.09	0.05	0.06	-0.45	0.23	0.27	-0.86	0.21	0.31	0.17	2.75	-0.93
2009	-0.52	0.02	0.08	0.02	-0.31	0.48	0.36	-0.73	0.19	0.43	0.20	3.38	-0.82
2010	-0.51	-0.07	0.10	0.04	-0.27	0.18	0.41	-0.67	0.38	0.55	0.14	3.78	-0.77
2011	-0.34	-0.13	0.21	0.07	-0.19	-0.13	0.57	-0.67	0.78	0.60	0.21	4.06	-0.59
2012	-0.40	-0.12	0.11	0.22	-0.17	-0.26	0.66	-0.74	1.16	0.61	0.36	4.25	-0.24
2013	-0.44	-0.04	0.17	0.27	-0.09	-0.26	0.82	-0.84	1.37	0.60	0.70	4.13	-0.16
2014	-0.50	0.14	0.29	0.38	-0.11	-0.15	0.91	-0.85	1.52	0.65	1.02	4.13	-0.21
2015	-0.47	0.28	0.48	0.53	-0.03	-0.05	0.89	-0.81	1.62	0.63	1.29	4.00	-0.40
2016	-0.63	0.27	0.65	0.75	0.06	0.01	0.95	-0.83	1.98	0.67	1.23	3.90	-0.57
2017	-0.79	0.12	0.75	0.96	0.06	-0.02	1.09	-0.81	2.15	0.69	1.23	3.95	-0.45