Determinants of Stock Market Volatility in Africa

Monday UHUNMWANGHO[†]

Abstract
The volatility of stock market dampens investors' confidence because of the uncertain returns associated with it, and the effect this may have on trading activities and investment worries policymakers as it may spillover to the general economy. The aim of this study is to examine the volatility of African Stock Markets and the factors influencing it in Africa. The Generalised Autoregressive Conditional Heteroscedasticity (GARCH) was used to generate the volatility, and the Generalised Method of Moments was applied on dynamic panel model to examine the factors that account for volatility in Africa. Sixteen (16) African Stock Markets were covered for the period 2013 to 2019. Data was sourced from African Securities Exchanges Association, Bank for International Settlements and World bank development Indicators databases. The study found that macroeconomic instability and financial liquidity variables determine stock market volatility in Africa. Specifically, macroeconomic instability has positive and significant effect on volatility, while stock market liquidity, diaspora remittances, growth in money supply negatively influence stock market volatility. This study recommends that the monetary authorities, particularly Central Banks should inculcate stock market volatility as part of its financial stability goal and apply financial liquidity tools like diaspora remittances, money supply, and stock market liquidity to mitigate it, while ensuring stability in the macro-economy.

Keywords: Financial Liquidities; generalized method of moment; macroeconomic instability; stock market volatility; Africa

JEL Classification Code: E44, G12, G15

[†] Department of Banking and Finance, University of Benin, +2340816998865, Email: Osazee1515@gmail.com

1. Introduction

The stock market volatility which has become evidence in global space constitute risk to investors and trigger uncertainty capable of hindering smooth market activities and returns. Indeed, fluctuations in returns dampen investors' confidence, depressed trading activities, and therefore, this is an issue of concern not only to investors but policymakers because of its effect on economy as a whole. Besides, stock market volatility threatens the claim that market absorbed all information, because stock market efficiency may be evaluated through return volatility (Uyaebo, Atoi & Usman, 2015). Therefore, it is expedient to ascertain whether African Stock markets are volatile, and if so what are the factors responsible for such volatility.

If macroeconomic indicators contain information upon which we can predict variations in financial flows and firms' valuation, there is the tendency that they can be used to capture market volatility. Corradi, Distaso and Mele (2013) declared that macroeconomic indicators account for a substantial change in aggregate market volatility. Thus, not only does stock market volatility help to predict, it can also be predicted using exogenous factors. Given that the firm value mirror economic conditions, there is every likelihood that the apprehension regarding changes in macroeconomic variables may influence stock market volatility at the aggregate level (Oseni & Nwosa, 2011). Also, regulatory agencies have been admonished to employ capital control measures to check what is termed 'hot money' coming from foreign nations (IMF, 2010), because it is capable of overheating emerging market (USA Today, 18th Nov. 2018). This portends that though, capital inflows are beneficial, it also goes with risk (IMF, 2012.). Sun (2015) declares that global fund inflows (liquidity pass-through) constitute risk to economic stability; and the volatility of returns in domestic markets is ascribed to flows of foreign funds (Stiglitz, 2004).

It can also be argued that relationship exists between market volatility and bank liquidity, since low volatility may drive investors to initiate more credits because of the excess liquidity at the disposal of banks as was witnessed in 2007 in some countries like Nigeria following the recapitalization exercise and United States in 2008. Besides, financial markets volatility on a global scale has been on the decline between the third quarter of 20 till around 2014, and this low trend was attributed to low shocks arising from macroeconomics data releases and the impact of regulations on financial sector (Financial Stability Review, November 2014). Therefore, the effect of macroeconomic instability, and financial liquidity on stock market volatility at the aggregate level desire empirical investigation.

Stock market Volatility at the aggregate level may be caused by a number of factors acting together, therefore a composite consideration of some of these factors is desirable as against using a single measure. For instance, upward movement in exchange rate drives the general price level because of its effect on the cost of production, and this instability may result in reduced funds to private sector by banks because of the perceived risk, and this may lead to variations in trading activities and ultimately fluctuations in prices at the exchange. The need arises therefore, to combine macroeconomic variables with liquidity measures to address stock market volatility in Africa. Studies have examined the nexus between variations in macroeconomic factors and stock

market (Ayopo, Isola & Olukayode, 2016; Haider, Hashmi & Ahmed, 2017; Adjasi, 2009; Abdullahi & Fakunmoju, 2019; Diebold & Yilmaz, 2008; Baroian, 2014; Wang, 2010; Hashmi & Ahmed, 2017; Oseni & Nwosa, 2011; Liljeblom & Sterius, 1997). However, the use of composite macroeconomic instability index to address stock market volatility is absent in these studies which make them different from the ongoing study. Besides, the reactions of aggregate stock market volatility-wise to macroeconomic instability and financial liquidity, using cross-sectional data framework remain an important gap in literature this study intends to fill.

The rest part of this study is structured as follows. Section 2 is devoted to literature review and the theory underpinning the study. Section 3 detailed the sources of data, method of analysis, model specification and discussion of results. Section 4 focused on the conclusion, findings and recommendation of the study, while those who contributed to the success of this research were acknowledged in section 5.

2. Literature Review

Stock market movement is associated with aggregate macroeconomic conditions (Officer,1973; Shiller, 1981; Hansen & Jagannathan, 1991). If the overall stock market performance mirrored aggregate economic conditions, there is every tendency that apprehension regarding the future state of economy, particularly instability in the macroeconomic indicators may influence the volatility of the stock market (Oseni & Nwosa, 2011). Adrian and Rosenberg (2008) demonstrated that overall market volatility is priced; and associated it to macro-variables (business cycle). Engle and Rangel (2008) related the long-run market volatility to economic forces. Bollerslev, Gibson and Zhou (2011) focused on volatility risk-premium and ascribed it to macroeconomic forces. Corradi, Distaso and Mele (2013) declared that macroeconomic indicators substantially account for the change in aggregate market volatility.

Bhowmik and Wang (2020) submitted that monetary policy impacts stock market movement. Specifically, liberal monetary policy pushes the stock index upward, while contractionary policy depresses stock returns. Baroian (2014) submitted that previous market size is credited as sources of market volatility to the neglect of nominal macroeconomic fundamentals such as inflation, gross domestic product. Diebold and Yilmaz (2008) reported that a gap exists in literature amidst macroeconomic indicators and stock market volatility, despite its vital contributions to financial economics empirically.

Studies on volatility from the macroeconomic perspective exist, but research that uses the macroeconomic instability index as a composite measure to forecast stock market volatility is evolving. Engle, Ghysels and Sohn (2013) applied factor models that discriminate between short and long-run behaviour and incorporate economic variables into volatility models. The study documented that macroeconomic factor significantly impact volatility in the long-run in the US. Specifically, the volatility associated with growth and inflation determines market volatility. Kuncoro (2017) associated volatility of the stock market to government fiscal policy action.

Stock market index has been engaged to capture aggregate stock market volatility in previous investigations. Bloom (2009) advanced the use of the stock market index as a measure of uncertainty (volatility in this study). The advantage of using the volatility of the market index rest on its time-series property, which enables us to detect the trend, and the fact that it is a composite measure that captures the behaviour of many firms and the mood of market participants. Kaya (2018) situated the strength of stock market index proxies for volatility, indicating that market participants may take a wait-and-see approach during periods of economic policy uncertainty, and this may affect asset prices and market liquidity. Bonga (2019) claimed that the incidence of macroeconomic uncertainty or instability is attributed to trends in stock market index as well as the volatility of stock market returns. Saleem, Sulong and Isa (2019) adopted standard deviation of daily index and GARCH to estimate volatility. Okechukwu, Mbadike, Thaddeus, Chidiebere and Ezeji (2017) engaged GARCH and E-GARCH to evaluate stock returns' volatility. Diebold and Yilmaz (2008) assessed market volatility as the natural logarithm of the current index divided by the lag value of the index adjusted for inflation. Kuncoro (2017) measured volatility as the product of returns and standard deviation. Cheriyan and Lazar (2019) evaluated market volatility as residuals extracted from GARCH regression. Autoregressive GARCH (AR-GARCH) has also been utilised to estimate volatility (Chinzara, 2011). Valenzuala, Zer, Frylewicz and Rheinlander (2015) quantified volatility via two scale realized volatility. Kyaw and Hillier (2011) compute volatility using standard deviation.

2.1 Theoretical foundation for the Study

This study is predicated on the efficient market hypothesis pioneered by Fama (1970). An efficient market is where price fully reflects available information and is a fair price. Jensen (1978) viewed an efficient market as one in which a trader cannot make abnormal gains by taking advantage of information set. Meaning, information already made available cannot be capitalised on by investors to make unusual profit. On this backdrop, benefiting from price variation through prediction is difficult, if not impossible (Ruhami, Islam & Ahmad, 2018). The implication is that external activities, such as happenings in the macroeconomic environment cannot determine price movement at the exchange. However, it has been asserted that investors aiming at higher-than-normal returns on their investment should give serious considerations to the instability in macroeconomic factors because macroeconomic fundamentals as well as government actions affect stock market outcomes and activities (Barakat, Elgazzar & Hanafy, 2016). Kurihara (2006) confirmed that stock price reacts to several indicators including price in the foreign market, gross domestic product (GDP), exchange rate, the interest rate to mention a few.

3. Methodology

3.1 Sources of Data and Method of Analysis

The study focused on macroeconomic instability and financial liquidity determinants of stock markets volatility in Africa for the period 2013 to 2019. The period was chosen to ascertain the performance of African Stock Markets post-financial crisis (2008 to 2010). African countries who

are members of the African Securities Exchanges Association (ASEA) forms the domain of the study. Data for the study was collected from the World Bank Development Indicator (World bank data), African Securities Exchange Association (ASEA) database, and Bank for International Settlement database.

The Generalised Autoregressive Conditional Heteroscedasticity (GARCH) model was utilised to generate the volatility, and the residual volatility extracted and incorporated into modeled variables in excel work file. The effect relationship which is the main estimation was achieved using Generalised Method of Moments (GMM) in the first difference transformation and dynamic panel data model. To ensure there is no serial correlation in the results and to validate the regression output, the Arrelano and Bond (1991) autocorrelation test was applied. The J. statistic credited to Hansen (1982) was engaged to judge the over-or-under restriction in the estimation technique. The E-view 9.0 econometric software was used for the estimation because it is user-friendly and can produce the desired output and handle large data efficiently.

3.2 Model Specification

This study implements the dynamic panel model. A dynamic model is initiated when one or two value of the dependent variable is included as explanatory variable (Gujarati, 2009). Dynamic panels help to minimise the biases which may result when individual units are aggregated, and the dynamic changes in variables are accurately captured in panel data. A dynamic panel model takes the form:

$$K_{it} = \gamma K_{it-1} + \beta Z_{it} + \alpha_i + \mu_{it} \quad (1)$$

Where:

$K =$ dependent variable,

$Z = set\ of\ regressors,$

$\gamma = the\ speed\ of\ adjustment,$

$a = individual\ specific\ effects\ (unknown\ effects)$, and

$\mu = error\ term$

To examine the impact of macroeconomic instability index, financial liquidity on stock market volatility in Africa, the following model was implemented:

$$MKV = F(MII, TOR, BFL, DPR, EL, MKS) \quad (2)$$

The econometric form of equation 2 is stated as follows:

$$MKV_{it} = (1-\gamma)MKV_{it-1} + \beta_1 MII_{it} + \beta_2 TOR_{it} + \beta_3 BFL_{it} + \beta_4 DPR_{it} + \beta_5 EL_{it} + \mu_{it} \quad (3)$$

Where:

MKV_{it} = $Volatility\ of\ market_i at\ time\ t,$
MII_{it} = $Macroeconomic\ instability\ index\ for\ country_i\ at\ time\ t$
TOR_{it} = $Stock\ market\ liquidity\ in\ country_i\ at\ time\ t,$
MII_{it} = $bank\ funding\ liquidity\ for\ country_i\ at\ time\ t$
$(proxy\ by\ ratio\ of\ bank\ liquid\ reserve\ to\ total\ assets)$
DPR_{it} = $fund\ inflows\ to\ country_i\ at\ time\ t$
$(surrogate\ by\ diaspora\ personal\ remittances\ to\ GDP)$
EL_{it} = $economy\ wide\ liquidity\ of\ country_i\ at\ time\ t$
$1-\gamma$ = $speed\ of\ adjustment\ adopted\ from\ Arioglu\ and\ Tuan(2014)$
$t-1$ = $lag\ value\ of\ the\ variable,$
μ = $error\ term$
$\beta_1, \ldots, \beta_5$ = $parameters\ to\ be\ estimated$

Market size (MKs) in country i at time t (proxy by the number of listed firms was used as instrumental variable, therefore not included as explanatory variable in equation 2 above) Macroeconomic instability index (MII) was captured in line with Haghighi, Sameti and Isfahani (2012) with modification as follows:

$$MII = \left\{\frac{1}{wx}\left(\frac{\mathrm{Xt-Xmin}}{Xmax-Xmin}\right) + \frac{1}{\mathrm{wy}}\left(\frac{Yt-Ymin}{Ymax-Ymin}\right) + \frac{1}{wk}\left(\frac{Kt-Kmin}{Kmax-kmin}\right)\right\} \div N \quad (4)$$

Where:
$MII = macroeconomic\ index$
X, Y and K are the current value of exchange rate, inflation, and economic growth respectively.
$N = the\ number\ of\ indicators$
max and min are the maximum and minimum values of the respective indicators. wx, wy, wk are the weight of the respective indicators (proxy in this study by standard deviation). Standard deviation, maximum, minimum values was extracted from descriptive statistic of the individual variable.

Stock market volatility (MKV) was estimated in this study using generalised autoregressive conditional heteroscedasticity (GARCH). Volatility was extracted from the GARCH residual and incorporated into the modeled variables in excel work file for further investigation in line with Hussain and Bashir (2013). The mean equation of ARCH model (Gujarati, 2009) takes the form:

$$X_t = E_{t-1}(X_t) + \mu_t \quad (5)$$

Where:
$X_t = stock\ market\ returns(proxy\ by\ market\ indexin\ this\ study)at\ time\ t$
$E_{t-1} = expectations\ which\ depends\ on\ information\ available\ at\ t-1$
$\mu = error\ term$

The variance of equation 5 is represented in the following equation

$$б^2\mathrm{t} = K_0 + \sum_{i=1}^{q} a_1 E^2 б^2\mathrm{t} - 1 + \mu_t \quad (6)$$

The generalized form of the above model (equation 5) with log conditional variance as autoregressive model [GARCH (1,1)] in its condensed form is presented thus:

$$log б^2 t = K_0 + K_1 E^2\mathrm{t} - 1 + K_2 б^2\mathrm{t} - 1 \quad (7)$$

Where:
$log б^2 t = log\ conditional\ variance\ which\ take\ value\ from\ K_1 E^2\mathrm{t} - 1$
$E^2\mathrm{t} - 1 =$ past period error variance
$б^2\mathrm{t} - 1 =$ past period conditional variance
K_0, K_1 and K_2 are parameters to be estimated, and are expected not to be negative, with $K_1 + K_2$ less than one (1).

3.3 Results and Discussion

Since the study focused on the aggregate stock market, GARCH procedure was applied on the stock market index to verify the volatility in line with Ditimi and Ifeoluwa (2018). The output of GARCH (1,1) estimate is presented in table 1 below.

Table 1: GARCH Estimation of Volatility in African Stock Markets

Variable	Coefficient	Z-Statistic	P. Value
Log (GARCH)	509.1627	4.2683*	0.0000
AR (1)	0.7666	17.6113*	0.0000
	Variance Equation		
C	1623961	3.6918	0.0002
Residual Variance	0.1023	2.6703*	0.0076
GARCH (-1)	0.7517	15.4865*	0.0000

Researcher's estimation (2021) with the aid of E-view 9; * = Significance at 0.05 level

Table 1 reveals that African Stock Markets in the period investigated are volatile based on the positive and significant value of the mean and variance equation. Specifically, the mean is positive and significant at 1% level, while the residual variance is also positive and significant at 0.01 level.

Additionally, the sum of the coefficient of the residual and GARCH (-1) is less than one, which is one of the conditions for accepting the outcome of the GARCH technique. AR (1) was added to the equation in this study to achieve the stationarity required for time-series data. For robust check, the autoregressive conditional heteroscedasticity Lagrange multiplier (ARCH-LM) test was applied on the residuals. The result in table 2 confirms there is the absence of ARCH effect in the residuals due to the not significance of F.statistic and the observe R-square at 0.05 level, judging with the probability values. The result implies that the index residuals are normally distributed and the variance is constant over the period considered. The result also established the absence of autocorrelation in the residuals.

Table 2: ARCH-LM Test for Heteroscedasticity

F-statistic	1.196339	Prob. F (1,109)	0.2765
Obs*R-squared	1.205064	Prob. Chi-Square (1)	0.2723

Researcher's computation (2021) with the aid of E-view 9.0

Based on the positive outcome of ARCH-LM test and the confirmation of volatility in African Stock Markets (market index), the residual was extracted which is called volatility in this study and incorporate it into the stock market volatility modeled data set in the excel worksheet to enable further investigation on the factors responsible for the volatility of African Stock Markets.

The summary statistics of the main variables used in this study to examine the influence of macroeconomic instability and financial liquidity on stock market volatility in Africa is presented in table 3 below.

Table 3: Descriptive Statistic of Variables

Variable	Mean	Max.	Min.	Std. Dev.	Skewness	Kurtosis	J. Bera	Prob.
MKV	-6797.227	37014.15	-48835.22	8615.686	1.0065	16.1414	824.8384	0.0000
MII	1.3093	20.6268	-4.9442	2.8043	3.8313	24.5801	2425.426	0.0000
TOR	1.0657	21.2500	0.0000	2.5411	5.6725	41.0442	7289.334	0.0000
DPR	3.1968	10.4937	0.0045	2.9000	0.8237	2.7680	12.9162	0.0000
BLR	21.5060	93.3014	2.2593	18.1757	1.4800	5.6439	73.5145	0.0000
EL	16.5689	249.8353	-0.7941	26.2669	6.8698	58.3512	15178.55	0.0000
MKS	89.2792	395.0000	5.0000	96.0965	1.9038	5.8390	104.3351	0.0000

Source: Author's compilation (2021) with E-view 9.

Table 3 highlights the mean, standard deviation, skewness, kurtosis, and Jarque-Bera statistics. The table reveals that the mean of stock market volatility is negatively signed, an indication that the market may pose risk to investors. The riskiness of the market is further confirmed by the high standard deviation, which is far away from the mean, hence the need to examine the factors accountable for the volatility. The table further shows that there exist differences between the mean and standard deviation of MII, TOR, DPR, BLR, El, and MKS. Also, the maximum values of all

the variables are higher than their minimum values, an indication that the data distribution varies among the different countries. The result also indicates that the variables exhibit a strong positive skewness, suggesting that a high level of uncertainty prevail in the markets. A look at the result further shows that the Jarque-Bera statistic is significant at 1% level considering the probability value, which tends to indicate that the variables are not normally distributed. This implies that unit root tests should be conducted to determine whether the variables are stationary or not, in order to avoid spurious regression estimation.

To this end, it was necessary to conduct unit root tests on the variables to determine whether or not the data series are stationary. The Levin, Lin and Chu (LLC), Im, Pesaran and Shin (IPS), as well as Fisher type unit root tests reflecting Augmented Dickey-Fuller (ADF-Fisher Chi2) and Philip Peron (PP) unit root tests (Choi, 2001), were applied on the variables. The result of the tests at first difference is presented in table 4.

It is obvious in table 4 that in the variables are stationary at first difference, judging by the probability values of LLC, IPS, ADF-Fisher Chi2, and PP-Fisher Chi2 statistics respectively. Meaning they are integrated of order 1(1), and the result is reported in table 4 below.

Table 4: Panel Unit Root Tests on Variables at First Difference

Variable	Levin, lin & Chu St.	Prob.	Im, Pesaran and Shin W.St	Prob.	ADF-Fisher Chi^2 Statistic	Prob.	PP-Fisher Chi^2 Statistic	Prob.
MKV	-1650.05*	0.0000	-254.49*	0.0000	127.907*	0.0000	187.694*	0.0000
MII	-10.1497*	0.0000	-2.5234*	0.0058	59.3301*	0.0023	85.7413*	0.0000
TOR	-13.3606*	0.0000	-4.1652*	0.0000	84.5969*	0.0000	124.689*	0.0000
DPR	-11.4305*	0.0000	-2.5508*	0.0054	58.8528*	0.0026	77.4127*	0.0000
BLR	-7.7022*	0.0000	-1.7022*	0.0444	49.5906*	0.0244	65.8976*	0.0244
EL	-12.9284*	0.0000	-4.2681*	0.0000	81.0015*	0.0000	112.121*	0.0000
MKS	-7.0419*	0.0000	-1.6788*	0.0466	42.2737*	0.0230	57.0714*	0.0004

Author's computation (2021); * =Stationary at 0.05 level

Based on the results in table 4, the hypothesis that the data set has unit root is rejected at a probability value of 0.05. Meaning, the study can proceed to conduct regression on the variables because the outcome will be reliable and not spurious. However, the variables were handled at their respective level of stationarity.

Hypothetically, the volatility of the stock market is attributed to changes in macroeconomic variables (Schwert, 1989). The specific factors accountable for the volatility of African Stock Markets are determined in this section. The results of the GMM in the first difference transformation estimates is presented in Table 5. The results in table 5 shows that the model is well specified because of the none significance of the J. statistic at 0.05 using the probability value. This implies that there is no over-or-under restriction in the estimation technique. For robust check

the regression output was subjected to the Arrelano and Bond (1991) autocorrelation test. The outcome of the test is displayed in table 6, indicates that there is no autocorrelation in the regression results because the AR (1) and AR (2) are not significant at 0.05 using the probability values. The Wald test in table 7 reveals that each explanatory variable has a different effect on stock market volatility in African Stock Markets, therefore the hypothesis of no separate impact is rejected.

The outcome of the diagnostic tests shows that the regression output meets all the necessary diagnostic conditions, and therefore reliable for policy direction. Based on this impressive outcome, the study went ahead to interpret the GMM regression results as shown in table 5 below.

Table 5: Regression Output (MKV as Dependent Variable)

Variables	Coefficient	T.Statistic	Probability
MKV(-1)	-0.0015	-0.5937	0.5545
MII	2911.688	31.4037*	0.0000
TOR	-3056.322	-29.6413*	0.0000
DBLR	-0.3858	-0.1634	0.8706
DDPR	-528.7310	-6.7986*	0.0000
EL	-27.3948	-5.6870*	0.0000
J.Statistic: 9.5582			
Probability of J.Statistic: 0.4801			
Ranking of Instrument: 16			

Source: Author's estimation (2021); *: Significance at 1% and 5% level respectively

The results in table 5 indicates that the coefficient of all the variables except bank liquidity ratio are significant at 0.01 percent level. The speed of adjustment 0.9985 (1-0.0015) in absolute term, indicates that it took the market less time to come back to equilibrium after the distortion from the instability in the macroeconomic environment. Specifically, the speed of adjustment of about 99.85% is an indication that the stock market has a high capacity to absorbed shocks. The implication of the result is that whenever there are disturbances arising from asymmetric macroeconomic news, the market speedily bounced back to its normal level, taking advantage of liquidity and small size, therefore the effect does not linger for a long time.

Obviously, the coefficient of macroeconomic instability (MII) is rightly signed and significant at one (1) percent, implying that as instability in the aggregate economy intensifies, stock market volatility increases. Meaning, the risk in the external environment is transmitted to the stock market through macroeconomic data releases. This result is in line with Ditimi and Ifeoluwa (2018) who reported a positive impact of macroeconomic variables on stock market volatility in Nigeria; Baroian (2014) who found that volatility of macroeconomic variables significantly and positively accounted for the volatility of stock returns; and Officer (1973) who associated volatility of the stock market at aggregate level to macroeconomic volatility.

Also, stock market liquidity (TOR) which captures the ease of trading on financial securities is negatively and significantly related to stock market volatility in Africa. The significant effect implies that a boost in market liquidity will mitigate aggregate stock market risk in no small extent. This is understandable because the easier and less costly an investor liquidates his position, the less the investment risk. Indeed, an investor may change to a more favourable fixed income securities if he perceived that the equity market is riskier, thereby minimizing the associated risk. Therefore, effort should be made by stock market regulators like the Security and Exchange Commission to improve the liquidity of the stock markets in Africa to reduce market risk (volatility). Indeed, the risk is high in less liquid African Markets when compared to advanced markets (Rahman & Mustafa, 2017). This result is contrary to Valenzuala, et al (2018) who reported that an increase in stock liquidity raises volatility; and Ahmed (2018) who showed that stock market liquidity positively and significantly accounted for volatility.

The liquidity of the banking system (DBLR) measured as the ratio of bank liquid reserves to total assets in this study, is a tool used by the monetary authority like the Central Bank to control credits creation by banks. The result reveals that DBLR is negatively signed, meaning an increase in this regulatory tool minimises stock market volatility at the aggregate level. The weak effect may not be unconnected to the underdeveloped nature of the African financial system, particularly the capital markets.

Diaspora personal remittances (DDPR) another financial liquidity indicator in the study is used to capture the impact of global liquidity on African Stock Markets. DDPR negatively and significantly influence stock market volatility in Africa. The significant effect of DDPR on stock market volatility indicates that a rise in diaspora personal remittances is a potent factor in arresting stock market volatility in Africa. The reason is that diaspora remittances are stable sources of fund and the presence of this kind of funds in the domestic market will enhance trading activities, trading volume, risk sharing, boost the liquidity of the stock market, and ultimately depressed aggregate market risk (volatility). Indeed, inflows of funds to the domestic market whether in form of foreign portfolio investment or personal remittances boost financial liquidity such as banking liquidity and stock market liquidity; and stock market liquidity depressed stock market volatility, thereby minimizing aggregate stock market risk.

Economy-wise liquidity (EL), measured as growth in broad money supply is another proxy for financial liquidity in this study. This indicator is highly regulated by Central Banks with the aim of guaranteeing financial stability. The result in table 5 shows that El has a negative coefficient value of -27.3948 and is significant at 0.01% level. This suggests that money supply can be used as a regulatory tool to arrest stock market volatility in Africa. Indeed, money supply and diaspora personal remittances augment stock market liquidity to reduce stock market volatility. Meaning, money supply pass-through stock market liquidity to reduce aggregate stock market risk. Growth in money supply increases the purchasing power of the people, encourages savings, boosts funds availability for trading at the exchange, thereby improving trading volume and stock market

liquidity, and ultimately reduce stock market volatility. This finding tends to agree with Adjasi (2009) who found that changes in money supply depress stock price volatility.

Table 6: Arellano-Bond Test for Autocorrelation in Regression Output

Order of Test	M.Statistic	Probability
AR(1)	-1.4242	0.1544
AR(2)	-0.8652	0.3869

Source: Author's compilation (2021)

Table 7: Wald Test for the Significance of Overall Coefficient of the Model

Test Statistic	Statistic Value	Probability
F. Statistic	527.5754*	0.0000
Chi^2	1055.151*	0.0000

Source: Author's computation (2021); *: Significance at 5% level

4. Conclusion

The study examines the volatility of African stock markets and its determinants using generalised method of moments and dynamic panel model for the period 2013 to 2019 covering 16 African stock markets. Stock market volatility was verified using the generalised autoregressive conditional heteroscedasticity (GARCH) technique. The study found that combined macroeconomic instability index and financial liquidity variables determine stock market volatility in Africa. Specifically, macroeconomic instability index has positive and significant effect on volatility, while stock market liquidity, diaspora remittances, growth in money supply negatively influence stock market volatility. Therefore, I concluded that macroeconomic instability and financial liquidities are potent determinants of stock market volatility in Africa. This study recommends that the monetary authorities, particularly Central Banks should inculcate the challenges posed by stock market volatility as part of its financial stability goal and activate financial liquidity tools such as diaspora remittances, money supply and stock market liquidity to tackle it because of the potential they hold to mitigate stock market volatility.

5. Acknowledgement

Though it is impossible to mention all who contributed in one way and another to the success of this work. However, my profound gratitude goes to Professor S. O. Igbinosa and Professor A. E. Uwubanmwen for guidance, indepth review of the work, and for their scholarly counsel towards enriching and strengthening the research.

References

Adjasi, K. D. C. (2009). Macroeconomic uncertainty and conditional stock-price volatility in frontier African Markets: Evidence from Ghana. *Journal of Risk Finance, 10(4), 333-349.*

Abdullahi, I. B., & Fakunmoju, S.K. (2019). Market liquidity and stock return in the Nigerian Stock Exchange. *Binus Business Review, 10(2), 87-94.*

Adrian, T., & Rosenberg, J. (2008). Stock returns and volatility: Pricing the short-run and long-run components of market risk. *Journal of Finance, 63, 2997–3030.*

Ahmed, W. (2018). Stock market return, volatility and the role of investor sentiments: A case study on Pakistan stock exchange. *International Journal of Research and Scientific Innovation, 5(10), 7-16.*

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data. *Review of Economic Studies, 58(9), 277-297.*

Arioglu, E., & Tuan, K. (2014). Speed of adjustment: Evidence from Borsa Istanbul. *Borsa Istanbul Review, 14(2), 126-131.*

Ayopo, B.A., Isola, L.A., & Olukayode, S.R. (2016). Stock market response to economic growth and interest rate volatility: Evidence from Nigeria. *International Journal of Economics and Financial Issues, 6(1), 354-360.*

Barakat, M.R., Elgazzar, S.H., & Hanafy, K. M. (2016). Impact of macroeconomic variables on stock markets: Evidence from emerging markets. *International Journal of Economics and Finance, 8(1), 195-207.*

Baroian, E. (2014). Can macroeconomic volatility affect stock market volatility? The case of 5 Central and Eastern European countries. *Romanian Journal of Fiscal Policy, 5(2/9), 41-55.*

Bollerslev, T., Gibson, M., & Zhou, H. (2011). Dynamic estimation of volatility risk premia and investor risk aversion from option implied and realized volatilities. *Journal of Econometrics, 160, 102–118.*

Bonga, W.G. (2019). Measuring macroeconomic uncertainty in Zimbabwe. Munich Personal RePEc Archive (MPRA) Paper No. 94759, July.

Bloom, N. (2009). The Impact of Uncertainty Shocks. *Econometrica, 77, 623-685.*

Bhowmik, R., & Wang, S. (2020). stock market volatility and return analysis: A systematic literature review. *Entropy, 22 (522), 1-18.*

Cheriyan, K. N., & Lazar, D. (2019). Relationship between liquidity, volatility and trading activity: An intraday analysis of Indian stock market. *International Journal of Economics and Financial Issues, 9(1), 17-22.*

Chinzara, Z. (2011). Macroeconomic uncertainty and conditional stock market volatility in south Africa. *South African Journal of Economics, 79(1), 27-49.*

Choi, I. (2001). Unit root tests for panel data. *Journal of international Money and Finance, 20, 249-272.*

Corradi, V. Distaso, W., & Mele, A. (2013). Macroeconomic determinants of stock market volatility and volatility risk premiums. *Journal of Monetary Economics, 60(2), 203-220*

Diebold, F. X., & Yilmaz, K. (2008). Macroeconomic volatility and stock market volatility, world-wide. *National Bureau of Economic Research (NBER) Working Paper No. 14269, August.*

Ditimi, A., & Ifeoluwa, B. (2018). A time series analysis of the nexus between macroeconomic fundamentals and stock prices in Nigeria. *Studies in Business and Economics, 13(2),69-91.*

Engle, R.F., & Rangel, J.G. (2008). The spline GARCH model for low frequency volatility and its macroeconomic causes. *Review of Financial Studies, 21, 1187–1222.*

Engle, R.F., Ghysels, E., & Sohn, B. (2013), Stock market volatility and macroeconomic fundamentals. *Review of Economics and Statistics, 95(3), 776-797.*

Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *Journal of Finance, 25(2), 383-417.*

Gujarati, D.N. (2009). *Basic econometrics (5th Edition.).* McGraw-Hill Companies INC, USA.

Haghighi, K. H., Sameti, M., & Isfahani, D.R. (2012). The effect of macroeconomic instability on economic growth in Iran. *Research in Applied Economics, 4(3), 39-61.*

Hansen, L.P., & Jagannathan, R. (1991). Implications of security market data for models of dynamic economies. *Journal of Political Economy, 99, 225-262.*

Hansen, L.P. (1982). Large sample properties of generalized methods of moments estimators. *Econometrica, 50, 1029-1054.*

Hussain, M., & Bashir, U. (2013), Dynamic linkages of exchange rate and stock return volatility: Evidence from Pakistan, Idia and China. *International Review of Management and Business Research,2(2), 345-354.*

Haider, A. K.S., Hashmi, H. S., & Ahmed, I. (2017). Systematic risk factors and stock return volatility. *Applied Studies in Agribusiness and Commerce, 11(1-2), 61-70.*

Jensen, M.C. (1978). Some anomalous evidence regarding market efficiency. *Journal of Financial Economics, 6(2-3), 95-101.*

Kaya, O. (2018). Economic policy uncertainty in Europe: Detrimental to capital markets and bank lending. *European Union Monitor Global financial markets, Deutsche Bank Research, January.*

Kyaw, K., & Hillier, D. (2011). A re-examination of the relationship between volatility, liquidity and trading activity. *Pecvnia Monográfico, 33-45.*

Kuncoro, H. (2017). Fiscal policy and stock market returns volatility: The case of Indonesia. *International Journal of Economic Policy in Emerging Economies, 10(2), 153-170.*

Kurihara, U. (2006). The relationship between exchange rate and stock price during the quantitative easing policy in Japan. *International Journal of Business, 11(4), 375-386.*

Liljeblom, E., & Stenius, M. (1997). Macroeconomic volatility and stock market volatility: Empirical evidence on Finnish data. *Applied Financial Economics, 7(4), 419-426.*

Oseni, I.O., & Nwosa, I.P. (2011). Stock market volatility and macroeconomic variables volatility in Nigeria: An exponential GARCH approach. *Journal of Economics and Sustainable Development, 2(10), 28-42.*

Officer, R. R. (1973). The volatility of the market factor of New York stock exchanges. *Journal of Business, 46, 434-453.*

Okechukwu, A.I., Mbadike, S.N., Thaddeus, D.E., Chidiebere, B.A., & Ezeji, E.C. (2017). Macroeconomic Variables Volatility in the Nigerian Stock Market: An empirical analysis. *International Journal of Managerial Studies and Research (IJMSR), 5(6), 1-13.*

Rahman, M., & Mustafa, M. (2017). Financial deepening and stock market returns: Panel data analyses for selected developed and developing economies. *International Journal of Monetary Economics and Finance,10(1), 96-109.*

Ruhami, F., Islam, M.A., & Ahmad, S.T.T. (2018). Theories explaining stock price behavior: A review of the literature. International Journal of Islamic Banking and Finance Research, 2(2), 51-64.

Saleem, Q., Sulong, S., & Isa, B. H.H. (2019). Relationship between stock market volatility, stock market liquidity and financial performance of non-financial firms listed on Pakistan Stock Exchange. *International Journal of Academic Research in Business and Social Sciences, 9(7), 307-323.*

Schwert, G.W. (1989). Why does stock market volatility change over time? *The Journal of Finance, 64(5). 1115-1154.*

Shiller, R.J. (1981). Do stock prices move too much to be justified by subsequent changes in dividends? *American Economic Review, 71, 421-436.*

Stiglitz, J. (2004). Capital Market Liberalization, Globalization and the IMF. *Oxford Review of Economic Policy, 20(1), 57–71.*

Sun, T. (2015). The impact of global liquidity on financial Landscapes and Risks in the ASEAN-5 Countries. IMF Working Paper, WP/15/211, September.

Uyaebo, S.O., Atoi, V.N., & Usman, F. (2015). Nigeria stock market volatility in comparison with some countries: Application of asymmetric GARCH Models. *CBN Journal of Applied Statistics, 6(2), 133-160.*

Valenzuala, M., Zer, I., Frylewicz, P. & Rheinlander, T. (2015). Relative liquidity and future volatility. *Finance and Economics Discussion Series Divisions of Research and Statistics and Monetary Affairs, Federal Reserve Board, Washington, D.C., No.2014-045, January.*

Wang, X. (2010). The relationship between stock market volatility and macroeconomic Volatility. *International Research Journal of Finance and Economics, 49, 1-12.*