VOLATILITY, LIQUIDITY AND STOCK MARKET RETURNS

MONDAY UHUNMWANGHO
University of Benin, Benin City, Edo State
Osazee1515@Gmail.com
OSAZEE GODWIN OMOROKUNWA
University of Benin, Benin City, Edo State
Osazee.omorokunwa@uniben.edu

Abstract

The volatility of the stock market constitute risk to investors because of the uncertainty associated with it. The behavior of volatile stock markets in the presence of liquidity is the focus of this study. A panel of sixteen (16) African countries covering the period 2013 to 2019 were selected for the investigation. The Generalised Method of Moments in first difference transformation (GMM) was engaged. The findings of this study revealed that stock market volatility positively and significantly influence market returns, while stock market liquidity significantly but inversely influence returns. The study recommend that stock market regulators should introduce more derivative investment instruments capable of minimizing market risks. Also, that liberal listing policies aimed at encouraging new firms should be implemented to stimulate trading activities and boost stock market liquidity.

Key words: Difference Generalised Method of Moments, Market Liquidity, Stock Market Returns, Volatility.

JEL Classification: F21; G12; G15

1. INTRODUCTION

The stock market plays a vital role in allocating scarce resources among competing needs and risk-sharing, thereby promoting economic activities. Economic agents may be motivated to save and entrust their funds in the stock markets only if they are assured that the securities traded in the exchanges are correctly priced. Fair prices are obtainable in an efficient market, and how rapidly security price reflects information determines the efficiency of the stock market. However, the idea that the stock market is efficient is being threatened by volatility because it bears information about future returns (Cambell, 1991); and stock market liquidity (Berstein, 1987).

Volatility denotes uncertainty about the future market returns and therefore influence investment behavior (Bhowmik & Wang, 2020). Market volatility is the extent to which the current price or market index deviates from its previous values and reflects the level of risk inherent in financial asset market. Discerning investors can use market volatility to make abnormal returns, meaning it also presents opportunities. Stock market liquidity on the other hands represents the ease of trading on financial assets at the exchange without major impact on the value of the asset. Liquid market is the delight of market regulators because it is an essential ingredient for the emergence of an efficient market (Chordia, Roll & Subrahmanyam, 2008). Frontier markets like most African markets are low in liquidity but loaded with a variety of investment risks (Chem, 2019). Notwithstanding that Sharpe (1964) relate stock returns to market systemic risk, the impact of volatility in less liquid African Stock Markets remain an area of investigation. Therefore, the main objective of this study is to determine how stock price react to systemic risk (volatility) and liquidity in African Stock markets.

2. REVIEW OF LITERATURE

2.1 THEORETICAL REVIEW

Capital asset Pricing model (CAPM) advanced by Sharpe (1964) associated asset returns to market related risk. The core idea of CAPM is that, in a capital market of competitive equilibrium, non-systematic risks can be eliminated through diversification, therefore, the only factor which make impact on the expected return is the systematic risk- the beta of the security. CAPM did not take into consideration the liquidity of the market which may have capacity to absorb shocks or at least minimize uncertainty at the exchange. Acharya and Pedersen (2005) liquidity adjusted CAPM captured asset return as a function of several liquidity risks such as trading cost (illiquidity), the covariance between the market and asset returns and so on. Their model focused more on asset liquidity risk at the expense of aggregate stock market volatility and liquidity in this study. Liquidity-augmented models have been determined to perform better empirically than the traditional models of asset pricing (Amihud & Mendelsen, 1986; Hasbrouck & Seppi, 2001; Sadka, 2003)). The reason is that, liquidity models can capture bigger part of risk by relaxing the restrictive assumptions of the traditional models, hence the need to incorporate liquidity factor into capital asset pricing model to determine stock market returns in Africa. The influence of liquidity on stock returns in a volatile market still remains largely untapped research area, hence the need to combine systematic risk factor (market volatility in this study) with stock market liquidity to address stock market returns.

Uncertainty of stock returns otherwise known as volatility has been quantified using stock market index (Bloom, 2009). 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 stock behavior of many firms and the mood of market participants. Kaya (2018) situated

the strength of stock market index proxy 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. Saleem, Sulong and Isa (2019) adopted standard deviation of daily index and GARCH to estimate volatility. Okechukwu, Mbadike, Thaddeus, Chidiebere and Ezeji (2017) used GARCH and E-GARCH to evaluate stock returns' volatility. Cheriyan and Lazar (2019) evaluated market volatility as residuals extracted from GARCH regression. Autoregressive GARCH (AR-GARCH) has also been utilized to estimate volatility (Chinzara, 2011). Valenzuala, Zer, Frylewicz and Rheinlander (2015) quantified volatility via two scale realized volatility.

The impact of stock market volatility on returns has been empirically examined by scholars such as Saleem, Sulong and Isa (2019); Ndwiga and Muriu (2016); Dimitriou and Simos (2011); Li, Yang, Hsiao and Chang (2005); Bekaert and Wu (2000); Santis and Imrohoroglu (1994). Majority of the above studies utilized country specific data as against cross-sectional data in this study. Besides, stock market liquidity factor is absent in these studies which make them different from the ongoing study. Whereas, a liquid market may have the capacity to absorbed shocks, thus, the impact of the interactions between volatility and liquidity on stock market returns desire empirical investigation.

2.2 REVIEW OF EMPIRICAL LITERATURE

Saleem, Sulong and Isa (2019) revealed a significant negative connection between volatility and firm performance in Pakistan. Ndwiga and Muriu (2016) reported a positive and significant temporary relationship between return and volatility in Kenya. Bekaert and Wu (2000) reported the existence of risk premium in Nikkel stock market from 1st January 1985 to 20th June 1994 using M-GARCH, implying negative correlation between volatility and returns. Santis and Imrohoroglu (1994) documented that aggregate market risk is not priced. That is, investors are not compensated for market risk. The study covers 17 emerging markets for the period 1988M12 to 1994M05, using weekly data and GARCH technique. Theodossiou and Lee (1995) examine the association between volatility and expected returns in nine (9) advanced countries from January 16th 1996 till December 27th 1991, using GARCH-M procedure. The result reveals volatility clustering, but no significant relationship between return and volatility was found.

Chiang and Zhang (2018) X-ray the nexus between return and volatility (risk) in Chinese stock market for the period January 1996 to February 2016. The threshold ARCH in mean technique was activated. A positive return-volatility relationship was reported, implying that volatility determine return and is priced in aggregate market. Pamane and Vikpossi (2014) examined the effect of risk on returns of 17 listed firms in Bourse Regionale Des Valuers Mobilieres, WAEMU for the period 2000M01 to 2008M12, using CAMP model. The study refutes CAPM hypothesis of zero intercept, implying that market risk has no remarkable effect on return for the entire period investigated.

Mehrara, Falahati and Zahiri (2014) inspect the influence of risk on returns in Tehran exchange, engaging CAPM model and firm specific data from 1387 till 1392. The result exposes that undiversifiable risk factor determine stock returns significantly. Hasan, Kamil, Mustafa and Baten (2012) consider the association between risk and return in Dhaka exchange Bangladesh in CAPM framework covering January 2005 to December, 2009 (firm monthly data). The study document that investors are compensated for systematic risk rather than specific firm risk owing to not significant effect of the latter on return.

3. METHODOLOGY

This study focused on stock market volatility and liquidity determinants of stock markets returns in Africa for the period 2013 to 2019. African Securities Exchanges Association (ASEA) member countries form the domain of the study. Sixteen African Exchanges were investigated for the period 2013 to 2019. They include Botswana, Egypt, Ghana, Kenya, Malawi, Mauritius, Morocco, Namibia, Nigeria, Rwanda, South Africa, Sudan, Tanzania, Tunisia, Uganda, and Zimbabwe. Data for the study was collected from the World Bank Development Indicator (World Bank Data), African Securities Exchange Association (ASEA) database, and the Bank for International Settlement database. The period was chosen to ascertain the performance of African Stock Markets post-financial crisis (2008 to 2010), and to ascertain how stock price react to systemic risk in the presence of liquidity.

The data collected was analyzed using panel unit root test, Generalised Method of Moments (GMM) in the first difference transformation and dynamic panel model. It is usually believed that time-series data have unit roots in them. Therefore, the data were subjected to panel unit root test using Levin, Lin and Chu (2002), and Im, Pesaran and Shin (2003) as well as Fisher type test reflecting Augmented Dickey-Fuller (ADF-Fisher Chi2) and Philip Peron unit root tests (Choi, 2001). Volatility was extracted from the residual of generalised autoregressive conditional heteroscedasticity (GARCH) output and incorporated into the modeled variables in excel worksheet for further investigation in line with Hussain and Bashir (2013). The effect relationship which is the main estimation was achieved by applying GMM in the first difference transformation on dynamic panel data. 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 condition for accepting the regression outcome is that the AR(2) should not be significant at 5% level. 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.

3.1 MODEL SPECIFICATION

This study utilized the dynamic panel model to examine the impact of volatility and liquidity on returns. A dynamic panel model takes the form:

$K_{it} = \Upsilon K_{it\_1} + bZ_{it} + a_i + U_{it}$ …..……(1)

Where:
K = dependent variable,
Z = set of regressors,
Υ = the speed of adjustment,
a = individual specific effects (unknown effects), and
U = error term.

To examine the impact of stock market volatility and liquidity on returns in Africa, the following model was implemented:

$MKR = f(SMV, TOR)$ ……..……..……..(2)

The functional form of equation 2 is stated as follows:

$MKR_{it} = \Upsilon MKR_{it\_1} + b_1 SMV_{it} + b_2 TOR_{it} + U_{it}$ ……..……..……..(3)

Where:
MKR_{it} = stock market returns in market i at time t,
SMV_{it} = Volatility of the market $_i$ at time t,
TOR_{it} = stock market liquidity for market i at time t
Υ = the speed of adjustment to normal state, adopted from Arioglu and Tuan (2014),
t $_{-1}$= lag value of the variable,
U = error term, and
b_1 and b_2 = parameters to be estimated.

Stock market returns is often proxy in empirical studies using the market index. Previous Studies (Theodossiou & Lee, 1995; Baroian, 2014) captured stock market returns as the difference between the natural logarithm of the current market index and the natural logarithm of the previous stock market index. This study adopts Atoi (2014) model to evaluate returns, therefore market returns is estimated as the natural logarithm of current index minus the natural logarithm of previous index in percentage term thus:

$MKR = In(index_t) - In\left(index_{t_{-1}}\right) X\ 100$ ……..……(4)

Where:
MKR = stock market returns
$index_t$ = current market price (proxy by market index in this study)
$index_{t\_1}$= the previous market price (index), and
In = natural logarithm

Stock market volatility (SMV) was estimated in this study using autoregressive conditional heteroscedasticity (ARCH) family technique. The ARCH group is commonly used because it offers better volatility outcomes. To ascertain the existence of volatility in African Stock Market (stock market index in this study), the Generalised Autoregressive Conditional Heteroscedasticity (GARCH) model was activated. The mean equation of ARCH model (Gujarati, 2009) takes the form:

$X_t = E_{t-1}(X_t) + U_t$ ……..……..…….(5)

Where:
X_t = stock market return (Surrogate by market index) at time t in this study,
E_{t-1} = expectation which depends on information available at t-1
$U = error\ term$

The variance of equation 5 is represented thus:

$$\sigma^2 t = K_0 + \sum_{i=1}^{q} a_1 E^2 \sigma^2 t - 1 + U_t \quad \text{……(6)}$$

The general form of equation 6 with log conditional variance as autoregressive model [GARCH (1,1)] in its short form is depicted below:

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

Where:
$\log\sigma^2_t$ = the log of conditional variance which take value from $K_1E^2_{t-1}$ (previous period surprises)
E^2_{t-1} = past period error variance
σ^2_{t-1} = past period conditional variance
K_0, K_1, K_2 are parameters to be estimated, and are expected to be nonnegative, and $K_1 + K_2$ should not be up to one

3.2 ANALYSIS OF DATA AND DISCUSSION OF RESULTS

To ascertain the presence of volatility in the African Stock Market (market index in this study), the GARCH procedure was applied on the stock market index. Since the study focused on the aggregate stock market, it becomes necessary to use the market index in line with Ditimi and Ifeoluwa (2018). The GARCH (1,1) output is presented in table 1 below.

***Table 1**: GARCH Estimation of Volatility in African Stock Markets (Market Index)*

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
* = Significance at 0.05 level			

Source: Researcher's estimation (2021) with the aid of E-view 9.0

Table 1 reveals that African Stock Markets 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 a vital condition for accepting the outcome of the GARCH technique. AR (1) was added to the equation 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, and the result displayed in table 2. The result in table 2 confirms 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 by 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

Sources: Researchers' compilation using E-view 9.0

Based on the positive outcome of ARCH-LM test, and the confirmation of volatility in African Stock Markets (market index), we extract the regression residual which we called volatility and incorporate it into the stock market return modeled data set in the excel work file to enable us carry out further investigation on the impact of stock market volatility on market returns in Africa.

3.2.1 PANEL UNIT ROOT TESTS

To avoid unreliable regression outcomes and ascertain the order of integration, it was necessary to conduct unit root tests on the variables. This will help to determine whether data series are stationary. To this end, the Levin, Lin and Chu (2002); the Im, Pesaran and Shin (2003); and the Fisher-type unit root tests reflecting Augmented Dickey-Fuller (ADF-Fisher Chi2) and Philip Peron (PP) unit root tests (Choi, 2001), here-in-after refers to as LLC, IPS, ADF-Fisher, PP-Fisher unit root tests were applied on the variables at levels. The result is presented in table 3 below.

It is obvious in table 3 that all the variables are stationary at levels, meaning they are integrated of order zero 1(0). Specifically, MKR, MKV and TOR are stationary at 0.05 level judging by the probability values of LLC, IPS, ADF-Fisher Chi2, and PP-Fisher Chi2 statistics, respectively. Therefore, the data set was treated at levels.

Table 3: *Panel Unit Root Tests on Variables at Levels*

Variable	LLC	Prob.	IPS	Prob.	ADF-Fisher Chi^2 Statistic	Prob.	PP-Fisher Chi^2 Statistic	Prob.
MKR	-79.4923*	0.0000	-18.5148*	0.0000	125.429*	0.0000	176.036*	0.0000
MKV	-190.508*	0.0000	40.2942*	0.0000	192.223*	0.0000	235.74*	0.0000
MII	-6.1256*	0.0000	-1.8136*	0.0349	51.2843*	0.017	57.6584*	0.0167
TOR	-4.7973*	0.0000	-1.5302*	0.0430	51.3831*	0.0163	65.2508*	0.0005

Source: Researchers' computation with the aid of E-view 9.0

3.2.2 REGRESSION RESULTS

The results of the Generalised Method of Moments **(**GMM) in the first difference transformation estimates on the impact of stock market volatility on stock market returns in Africa are presented in table 4 below. Obviously, the goodness of fit statistic of the model captured by Sarjan T. test in table 4 reveals that there is no over-or-under restriction in the estimation technique because the J. statistic value (13.6597) with probability 0.3982 is not significant at 5 percent, and is within the range of 0.25 and 0.90 benchmark looking at the probability value. This suggests that the model is appropriately specified. Also, to confirm that there is no serial correlation in the regression results, the Arrelano and Bond (1991) autocorrelation test were applied on the regression output. The outcome of the test shown in table 5 below indicates the absence of autocorrelation in the results. Specifically, the AR(1) and AR(2) statistics are not significant at 0.05 level. The implication of this results is that there is no biasness in the regression and that the result is consistent as all the instrumental variables used are exogenously related to their respective error term.

Based on the impressive outcome of the diagnostics tests and the fact all the necessary conditions for a valid and reliable model are satisfied, we went ahead to interpret the results of the GMM regression as displayed in table 4 below.

Table 4: *GMM Regression Outcome (MKR as Dependent Variable)*

Variables	Coefficient	T.Statistic	Probability
MKR(-1)	-0.0697	-150.1740*	0.0000
MKV	0.0137	72.0735*	0.0000
TOR	-5.5903	-265.4716*	0.0000
J. Statistic: 13.6597 Probability of J.Statistic: 0.3982 Ranking of Instrument: 16 * = Significant at 1% level			

Source: Researchers' estimation using E-view 9.0

The result of the Generalised Method of Moment (GMM) estimates in table 4 reveals that the speed of adjustment of the African Stock Market to equilibrium which stood at a value of 0.0697 in absolute term is significant at 1% level, and implies that the inclusion of liquidity variables into asset pricing model facilitate the rate at which stock markets adjust back to equilibrium. That is, efficiency is boosted in the presence of liquidity, hence the market ability to absorbed shocks is enhanced. The negative sign of the adjustment speed in this result is an indication of how fast the variables engaged are incorporated and how fast they are united in the model. The result agrees with Berstein (1987) that in an efficient market, the arrive of news causes the stock price to change at great speed; and Bali, et al (2013) that liquidity interrupt news from being incorporated in asset prices.

The coefficient of stock market volatility (MKV) in this study is positive and significant at 1% level. The implication of this result is that market systematic risk is a major determinant of stock market returns in Africa meaning, the volatility of stock market constitute risk because it pressured the market to deviate from

equilibrium. The result clearly shown that aggregate market risk is priced in Africa, and that investors demand high returns for bearing market risk. The result further shows that stock market liquidity determines returns in Africa. The negative impact of liquidity on returns is due to low liquidity of most African Stock Markets. However, the market takes advantage of the low liquidity to equilibrate at great speed. Notwithstanding its impact, liquidity does not totally absorb market risk, hence the positive impact of volatility on returns.

Overall, this result is in line with the high-risk, high-returns advanced by Sharpe (1964) in his asset pricing model. The result also provide support for Chiang and Zhang (2018) who reported a positive relationship between volatility and market returns. This finding however disagrees with Saleem, Sulong and Isa (2019) who documented a negative and significant impact of volatility on firm stock performance; Li, Yang, Hsiao and Chang (2005) that volatility and expected return are negatively but significantly related; and Santis and Imrohoroglu (1994) that aggregate market risk is not priced, meaning investors are not compensated for taking risk.

3.2.3 DISCUSSION OF FINDINGS

The volatility of the stock price constitute risk to investors because of its unpredictable nature. It denotes uncertainty about the future market price and therefore influence investment behavior (Bhowmik & Wang, 2020). However, it can be taking advantage of by discerning investors to make abnormal returns, meaning it also presents with opportunities. Our findings revealed that stock market volatility positively and significantly influence market returns in Africa. This implies that if the risk level of the markets intensifies, investors will demand high returns. Meaning that risk is priced in African Stock Market. Indeed, to woo investors to trade on financial security in a risky market condition, they have to be offered more than normal returns to compensate then for the risk. This is in line with the high-risk, high-return asset pricing model of Sharp (1964). The result also agrees with Chiang and Zhang (2018) who reported a positive relationship between volatility and market return, but different from Santis and Imrohoroglu (1994) that aggregate market risk is not priced.

4. CONCLUSION AND RECOMMENDATIONS

The volatility of stock market constitute risk to investors because of the uncertainty associated with it. The behavior of volatile stock market with low liquidity is the focus of this study. A panel of sixteen (16) African countries covering the period 2013 to 2019 were selected for the investigation.

The Generalised Autoregressive Conditional Heteroscedasticity (GARCH) was activated to detect volatility in market index, while the Generalised Method of Moments in first difference transformation (DGMM) was engaged for the estimation. The findings of this study revealed that stock market volatility positively and significantly influence market returns, while stock market liquidity significantly

but inversely influence returns in Africa. The study conclude that systemic risk is priced in Africa and recommend that market regulators should introduce more derivative investment instruments capable of minimizing market risks. Also, that liberal listing policies aimed at encouraging the listing of new firms should be implemented to stimulate trading activities and boost stock market liquidity.

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