AN EMPIRICAL ANALYSIS OF BUBBLES IN THE NIGERIAN STOCK EXCHANGE (1985-2018): A GENERALISED SUP AUGMENTED DICKEY-FULLER APPROACH

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Abstract

This study sets out to conduct an empirical analysis of the nature of bubbles in the Nigerian Stock Exchange (NSE). The paper achieved this in three inter-related steps. In the first step, a battery of tests, including the Generalised Supremum Augmented Dickey-Fuller(GSADF) test and Backwards Supremum Augmented Dickey-Fuller(BSADF)were conducted using monthly data on (the nominal and real values of the) All-Share Index of the NSE (NSE-ASI) to establish the existence of bubbles during the period 1985 - 2018. In the second step, the paper employed the Component-GARCH-in-mean (CGARCH-M) model to estimate the bubbles risk premium as well as decompose returns volatility into its transitory and permanent components. In the third step, the paper employs a Logistic Regression Model to examine the influence of the permanent and transitory volatility components in the likelihood of a bubble in the NSE. Results from the GSADF and BSADF tests show evidence of two episodes of bubbles based on the Nominal All-Share Index (ASI) and three episodes based on Real All-Share Index(RASI). Analysis of results obtained from the Component GARCH-M model shows thatboth episodeswere associated witha positive risk premium. Estimates of the Logistic Regression model suggest that periods dominated by permanent volatility were less likely to experience bubbles episodes, while periods dominated by transitory volatility have ahigher risk of experiencing bubbles.The paper, therefore, concludes that a prolonged period of a rising risk premium characterised by transitory volatility that is driven by market sentiments are more prone tobubbles than periods of higher volatility that is driven by fundamentals. Therefore, when a rise in the risk premium and transitory volatility are observed, financial regulators such as Central Bank of Nigeria (CBN) and Securities and Exchange Commission (SEC) should diagnose the Market for bubbles using modern econometrics techniques such as the one used in this study.

Keywords: *Nigerian Stock Exchange, Bubbles, Component GARCH-M, Logistic Regression, Generalised Supremum Augmented Dickey-Fuller.*

Introduction

Assets price bubbles occurred with some uniformities over the years, which historical evidence suggests the cumulative losses from the burst of such bubbles usually outweigh gains of riding them. The burst is also known to depress government revenue, raise public debtsand the costs of servicingsuch debts. The rising public debt is due to the need for fiscal expansion to boost aggregate demand and bail out failed/distressed financial increases amidst loss tax revenue from the distressed institutions. This is even more evident when a central bank does not respondto the bubbles at their early stage of development. Although the seminal work of Bernanke & Gertler (1999,2001) shows that when a central bank responds to both inflation and asset price, it results ina decline in both inflation andoutput, the loss in output is much more significant than the gains during the bubble regime.

However, the losses sustained during the 2008/2009 Global Financial Crisissuggest that central banks can no longer afford to ignore changes in asset prices. This is even more potent in countries such as Nigeria, where the financial system isvery fragile, vulnerable, less efficient and illiquid.In these developing countries, bubble burst often causesa financial crisis, damages conventional channels of monetary policy,heightened intervention costs, and sluggish recovery of output.Moreso, historical evidence revealed that the burst of a bubble often alters the speed of policy transmissionand the way the financial system responded topolicy measuressince *Tulip Mania* in the Netherland in 1936. Hence, when detected "forward-looking policies" become inevitably desirable to ensure "soft landing" of such bubbles (Garba, 2013) or at least manage their growth to a level that is consistent with monetary and fiscal policy targets (Iliyasu, Sanusi, & Suleiman, 2019).

Also, for monetary policy purposes, the size of the bubble matter for ascertaining whether it is large enough to cause macroeconomic distortion (Filardo, 2004) or affect central banks' forecast of monetary policy targets variables such as inflation and output gap. In Nigeria, considering the risk of bubble burston financial markets stability, Iliyasu and Saba (2019)emphasise a periodic bubble diagnosis on Nigerian Stock Exchange (NSE) so that emergence of a bubble can be early detected and manage to minimise/avoid possible losses that may result from an unanticipated bust.Linking the observation of Garba (2013), Iliyasu, Sanusi, and Suleiman (2019), and Iliyasu and Saba (2019) to the observed evolution of NSE All-Share Index (ASI) displayedin figure 1, it is evident that changes in the index be diagnosed against the occurrence of multiple bubble episodes.Visual inspection of figure 1, indicatedabout five cycles that could be related to boom-and-bust (shown by the grey region). The episodes started from December 1994 to September 1999, December 2002 to June 2005, May 2006 to February 2009, April 2012 to January 2016, and from January 2017 to October 2018.

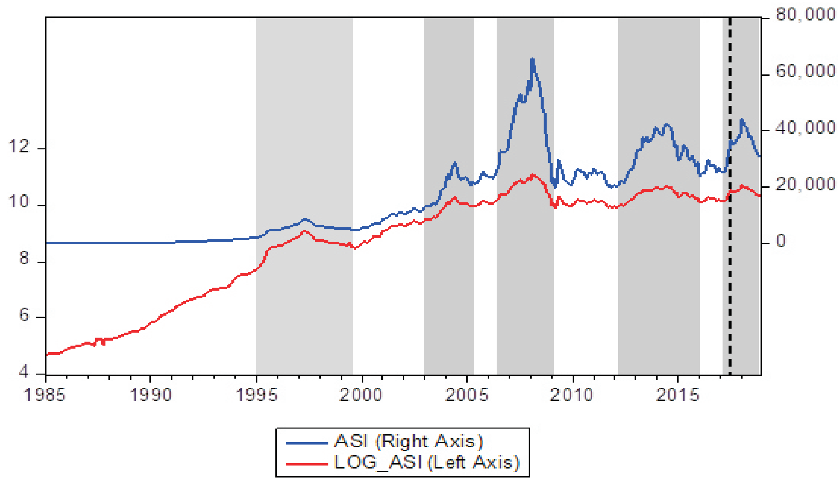


Figure : Trend of NSE ASI and its Logarithm from 1985 to 2018

The information in the above figure further revealsthat the ASI experienced a dramatic appreciation from 2005 to March 2008 after which itlost about 67.67 per cent of its value from March 2008 to 27th April 2009 (Kighir, 2009), while market capitalisation loss about 70 per cent (Gwarzo, 2016) following the Global Financial Crisis. Through domino effect and exposure to NSE, commercial banks' non-performing loans rose by 417.87 per cent from 7.19 per centin 2008 to 37.25 per cent in 2009. consequently, their capital adequacy ratio deteriorated from 17.95 per centin 2008 to4.08 per cent in 2009 (World Bank, 2019).These balance sheet impairments were due to their involvement in margin lending practice, trading of financial assets and contract based on financial assets as well as acceptance of those financial assets as collateral whose values depended on NSE prices. This means that Nigeria cannot afford not to pay attention to the NSE price developments or appearance of a new bubble,which on its financial surveillance, the Monetary Policy Committee (MPC) of Central Bank of Nigeria (CBN) observed a bubble-like behaviour following33.33 per centincrease in ASI from 25,516.34 on 31st March 2017, to 34,020.37 on 21st July 2017 (indicated by the dotted vertical line). The Committee, then, expressed concern describing the observed incident as “seeming bubble”(MPC-Communique', 2017). This remark of “seeming bubble” can be interpretedas the Bank was signalling to the investors that NSE stock prices might have been overvalued or there is a likelihood that a bubble may emerge, or as an attempt to talk down an existing bubble through verbal communication.

Also, Garba in 2017 at the Monetary Policy Committee Meeting between 20th and 21st November 2017, argues that NSE is in its third bubble regime since 2006, 2006-2008; 2012-2014 and from April 2017” but Iliyasu & Saba (2019) find no empirical evidence of bubble occurrence between 2010 and 2017, which suggest that NSE stock price evolution may be consistent with changes in fundamentals during the sample period. Also, researchers such as Chukwuma-Agu & Agu (2009), Njiforti & Chidiogo (2010), and Almudhaf (2017), produced evidence suggesting that evolution of NSE stock prices before 2008 crash was consistent with bubbles episodes.While these studies have improved the understanding ofthe mechanism behind the occurrence and burst of a bubble in Nigeria, someempirical questionsthat remain unaddressed include;(i) what is the estimate of the growth rate and size of the bubble?, (ii) to what extent is risk premium associated with the bubbles episodes, (iii) what is the roleof volatility in bubbles occurrence?

Therefore, this paper attempts to address the above questionsby conducting an *empirical analysis of bubbles in the Nigerian Stock Exchange (NSE).*This paper contributes to the extant bubble literature at least in two ways. First, it provides empirical support as obtainable in other climes with Nigerian data to the argument that the presence of a bubble can be diagnosed (Sornette & Cauwels, 2014; Phillips, Shi, & Yu, 2015; Brunnermeie, Simon, & Schnabel, 2018). Finally, it joins a broader literature that centred around detecting and dating of bubbles in Nigeria (Chukwuma-Agu & Agu, 2009; Njiforti & Chidiogo, 2010;Almudhaf, 2017; Iliyasu, Sanusi, & Suleiman; 2019; Iliyasu & Saba, 2019).

The rest of the paper is organised as follows; the next section presents the review of related literature on asset price bubble. Section three outlines the methodology, while section four presents the empirical results and discussion. Finally, section five concludes the paper.

Review of Related Literature

Researches on asset price bubbles are oftenmotivatedby the question of whether large swings in asset price are consistent withchanges ineconomic fundamentals.The fundamental component of a stock price is defined as the present value of the discounted value of future dividends (Filardo, 2004). Thus, bubbles are assumed to occur when changes in economic fundamentals cannot justify substantial changes in asset prices. Deng, Girardin, Joyeux, and Shi (2017) also explain that an explosion in the first-order autoregressive coefficient of asset price can be used to infer empirical evidence of the occurrence of a bubble. Thus, following, Phillips, Wu, andYu (2011), this paper defines a bubble as " explosive autoregressive behaviour" of price series.This conceptualisation allows for econometric measure and detection of a bubble occurrence in the data examined.

In stockmarkets, empirical evidence of bubbles occurrence has been established by researchers. For example,Phillips, Wu, and Yu (2011) test the Alan Greenspan's"irrational exuberance" claim of 5th December 1996, againstthe Nasdaq Index from February 1973 to June 2005 using their newly developed bubble date-stamping technique (PWY or SADF test). The results obtainedconfirm the claim by showing evidence of the occurrence of a bubble from July 1995 to March 2001, about 173 per cent in size, and with an estimated monthly growth rate of 4 per cent. However, the PWY or SADF test detection power reduceswhen multiples bubbles episodes are involved (Phillips, Shi, & Yu,2015). Phillips, Shi, and Yu (2013,2015) address this weakness by developing a generalised version of the SADF test known as GSADF test and was applied to the S&P500 fromJanuary 1871 to December 2010. The GSADF testeffectively-identifiedwell-known bubbles episodes such as the great crash (1928M11-1929M10), the post-war boom in 1954, Black Monday in October 1987, and the Dot-Com bubble of the 1990s. Fulop and Yu (2017)use a two-state regime-switching model to test S&P500 for bubbles from 1871M01 to 2012M06, and the results obtained lend support for Phillips, Shi, and Yu (2013,2015). In the study, Fulop and Yu (2017) revealedsimilar bubble episodes such as the great market crash of September 1929, Black Monday of October 1987, Dot-Com bubble of 2000, and the subprime explosion of September 2008.

Similarly, in real estate markets, Kivedal (2012) establishes evidence of the presence of a rational bubble in US Housing Market before 2007 and a similar result was found by Nneji, Brooks, and Ward (2013). They produce evidence of the occurrence of an intrinsic bubble in US Real Estate Market before2000 and a rational bubble afterwards. Whereas in Israel Housing Price, Caspi (2015)find no evidence of bubbles occurrence using the PWY (SADF) test and concludes that the observed rise in housing price at the national and regional levels are consistent with changes in fundamentals.In Hong Kong Real Estate Market, from March 1993 to March 2011, Yiu, Yu, and Jin (2013) revealed ten bubbles episodes using the GSADF test.

Also, bubbles occurred in the prices of commodities such as oil and iron ore. For instance,Caspi, Katzke, & Gupta (2014) and Etienne (2016) established evidence that is consistent with bubbles episodes in such commodities. For example, Caspi, Katzke, and Gupta (2014) test oil price for bubble episodes from 1876 to 2014 and the results obtained from the GSADF (PSY) test show evidence of multiple occurrences, with the 1979M04-

1982 M03 episode being the longest lasting for 36 months. In iron ore market, Etienne (2016)examines the daily price ofIron Ore in Chinese Market for irrational Exuberance (bubble) from February 2015 to June 2016 and the results obtained from the GSADF test confirm the occurrence of Exuberance.

In South Africa, Zhoua and Sornette (2009) test 45 indices and common stocks for bubbles from January 2003 to May 2006 and the results obtained from the Log-Periodic Power Law (LPPL) model show evidenceof bubbles in five of the stocks.In the same country, Balcilar, Gupta, Jooste, and Wohar (2016) using Regime-Switching model detect a bubble in the Johannesburg Stock Exchange (JSE) All Shares Price Index between January 1954 and April 2015. Similarly, researchers in Nigeria produced evidence showing the evolution of NSE stock prices is consistent with bubbles and with bubbles contagion from Global Stock Market into NSE. For example, motivated by the NSE of crash 2008, Njiforti and Chidiogo (2010) test the daily stock price of selected listed insurance companies and banks for bubble from 2008 to 2009. In the study, Njiforti and Chidiogo (2010) find no co-integrating relation among stock price, price-dividend ratio, and dividend in most of the banks and the insurance companies, and conclude that the behaviour of stock prices of the examined insurance companies and banksare consistent with bubbles behaviour. Agu and Chukwuma-Agu (2010)further substantiated the evidencewhen examiningthe role of market fundamentals and bubbles in NSE stock prices to unearth the causes of the 2008 crash. Using quarterly data on the All-share index (ASI), exchange rate, interest rate, output growth and inflation rate from 1990 to 2007 and co-integration technique, Chukwuma-Agu (2010) finds no co-integrating relation between All-share index and the market fundamentals. The non-co-integrating relation discovered,led Chukwuma-Agu (2010) to conclude that NSE stocks prices were driven by bubbles for the period studied.

Also, Nwidobie (2015) conducts an empirical investigation of the effects of macroeconomic variables (fundamentals) on NSE stock prices from 1985 to 2013. In the study, Nwidobie (2015) finds no co-integration relation between the NSE-ASI and the macroeconomic variables, which suggeststhe presence of a rational bubble and is consistent with Njiforti and Chidiogo (2010) and Chukwuma-Agu (2010). However, unit root co-integration tests have difficulties in identifying periodically collapsing bubbles, while the PSY (2015) test is acknowledged to be the most effective bubbles date-stamping strategy. The PSY or GSADF testoutperforms comparable approaches in terms of size and detection power, particularly when multiple bubble episodes are involved(Brunnermeie, Simon, & Schnabel, 2018).

Almudhaf (2017) utilised the PSY or GSADF test todate-stamp bubble episodes in African Frontier Markets of Botswana, Egypt, Morocco, Ghana, Kenya, Nigeria, Mauritius, and Tunisia. The results obtained from GSADF test by Almudhaf (2017) show multiple bubbles episodes in Botswana, Egypt, Ghana, Kenya, Nigeria, and Tunisia. For Nigerian Stock Exchange market, four episodes of Exuberance were revealed, including the 2007 bubble. Also, Iliyasu, Sanusi, & Suleiman (2019) examine NSE for bubble contagion from Global Stocks Market before March 2008, and the result obtained from Greenaway McGreevy and Phillips (2016) bubble contagion model revealed evidence of the occurrence of contagion from the Global Stock Markets. In the same study, Iliyasu, Sanusi, and Suleiman (2019) reveal that the contagion took about five months to spread to NSE, which led the study to conclude that the participation of foreign investors through portfolio inflows also contributed to price escalation and subsequent boom-and-bust cycles on NSE. On the other hand, Iliyasu and Saba (2019) examine NSE for a single bubble episode from January 2010 to December 2017 and find no evidence of a bubble occurrence, which led to the conclusion that bubbles do not drive the evolution of NSE stock prices.

The reviewed literature demonstrates that empirical works on bubbles are meagre, particularly, in Nigeria. On the above note, this study provides an empirical analysis of bubbles in the NSE from 1985 to 2018. Thus, it builds on the existing studies by providing the estimates of size and speed, and premium of riding the bubble that can be used to determine if the size of the bubble is large enough to cause macroeconomic distortions. Furthermore, it analyses and decomposes volatility in Nigerian Stock All-Share Index into permanent and transitory components to determine their influence on the likelihood of bubbles occurrence.

Methodology

Date-Stamping Bubbles in the Nigerian Stock Exchange Market

Following Greenaway-McGreevy and Phillips(2016) and Almudhaf (2017), this study used the Generalised Supremum Augmented Dickey-Fuller(GSADF) test to date-stamp multiple bubbles episodes in the Nigerian Stock Exchange Market. The GSADF test has been established as the most efficient bubbles technique when multiple bubble episodes were involved (Brunnermeie, Simon, & Schnabel, 2018). This study specified the first-order auto regression AR(1) process in the spirit of Greenaway-McGrevy and Phillips(2016) as follows;

$$\Delta y_t = \alpha + \beta y_{t-1} + +\varepsilon_t, t=1,\dots\dots T \qquad 3.1a$$

The rolling form of equation (3.1a) is specified below as in Phillips, Shi, and Yu (2015);

$$\Delta y_t = \hat{\alpha}_{r_1,r_2} + \hat{\beta}_{r_1,r_2} y_{t-1} + \sum_{i=1}^{k} \hat{\gamma}_{i,r_{21}r} \Delta y_{t-i} + \hat{\varepsilon}_t \qquad (3.1b)$$

Where y_t is the NSE-ASI, α is the intercept, κ is the maximum number of lags, γ_i are the differenced lagged coefficients for i=1…κ, ε_t is the error term, r_1^{th} is the start of the rolling window as a fraction of the total sample, r_2^{th} is the end of r_1^{th} sample, where $r_2=r_1+r_w$ and $r_w>0$ is the (fractional) window size of the regression. Estimation of equation (3.1b) followed the GSADF approach of Phillips, Shi, and Yu (2015), which involved repeated ADF test of equation (3.1b) on subsamples of NSE-ASI in a recursive way. The null hypothesis at each sub-sample is of a unit root against the alternative of a mildly explosive autoregressive coefficient, stated formally as:

$$H_0 : \beta = 0$$
$$H_1 : \beta > 0$$

Testing for Bubble Premium: Component Generalised Autoregressive Conditional Heteroscedasticity (CGARCH-M)

The GARCH-in-mean(GARCH-M) modelwas designed to show the premium per unit of risk, while the Component GARCH-M model decomposes volatility into permanent (long-run) and transitory (short-run) components.Li, Ghoshray, and Morley (2012) explainthat the permanent component is usually driven by economic fundamentals and the transitory component by market sentiment (Li, Ghoshray, & Morley, 2012) and positive sentiments closely characterised bubbles regimes. This infers that market sentiment could have occurred when the transitory volatility component dominated the permanent component. Therefore, this study employed the Component GARCH-M (CGARCH-M) to determine risk premium associated with the bubbles episodes and to decompose volatility into permanent and transitory components. The study also added to the mean equation (equation 3.2a) a Bubble Risk (BR),while controlling for the effects of the Global Financial Crisis Risk (GFCR), Tranquil Time (TR), and Previous month return (R_{t-1}). The model is specified in the spirit ofLi, Ghoshray, and Morley (2012)as follows;

$$R_t = \alpha_0 + \alpha_1\sigma_t + \alpha_2 BR_t + \alpha_3 GFCR_t + \alpha_4 TR_t + \alpha_5 R_{t-1} + \varepsilon_t \quad 3.2a$$

$$m_t = \omega + \rho(m_{t-1} - \omega) + \theta(\epsilon_{t-1}^2 - \sigma_{t-1}^2) \quad 3.2b$$

$$\sigma_t^2 - m_t = \varphi(\epsilon_{t-1}^2 - m_{t-1}) + \pi(\epsilon_{t-1}^2 - m_{t-1})d_t + \phi(\sigma_{t-1}^2 - m_{t-1}) \quad 3.2c$$

$$\sigma_t^2 = m_t + \varphi(\epsilon_{t-1}^2 - m_{t-1}) + \pi(\epsilon_{t-1}^2 - m_{t-1})d_t + \phi(\sigma_{t-1}^2 - m_{t-1}) \quad 3.2d$$

Where R_t is monthly returns on NSE-ASI, $BR_t$and $GFCR_t$ are interaction dummies measuring returns uncertainty associated with bubbles and Global Financial Crisis regimes, R_{t-1} is last month return,$\boldsymbol{\varepsilon_{t-1}^2}$is the news about volatility from the previous period, measured as the lag of the squaredresiduals from the mean equation(ARCH term), while$\boldsymbol{\sigma_{t-1}^2}$is the time-varying volatility, measured by previous forecast variance (GARCH term), $m_t$is the permanent (long-run) volatility, which reflects shock to economic fundamentals and ρ is the degree of convergence to long-run volatility $\boldsymbol{\omega}$(Li, Ghoshray, & Morley, 2012)**.** The value of ρ between 0 and 0.99shows how fast or slow $\boldsymbol{m_t}$ converges to $\boldsymbol{\omega}$.$\boldsymbol{(\sigma_t^2 - m_t)}$is the transitory (short-run) volatility usually driven by sentiments (Li, Ghoshray, & Morley, 2012) and converges to zero by ($\boldsymbol{\phi + \varphi}$) $\boldsymbol{d_t}$is a dummy variable indicating negativeshocks and $\boldsymbol{\pi}$measures reaction of transitory volatility to negative shock(Guo & Neely, 2008).
When, $\boldsymbol{\pi > 0}$ it shows the impact of fall in prices on the conditional variance is higher than that of an increase in prices, suggesting the presence of transitory leverage effects on volatility.The value of ρ should exceed ($\boldsymbol{\phi + \varphi}$) for the model to be stable, indicating transitory volatility converges faster than the permanent volatility.

Testing the Influence of Permanent and Transitory Volatily on Bubbles in NSE

This paper employed a Logistic Regression Model to examine the influence ofPermanent Volatily (PVol) and Transitory Volatility(TVol) on the likelihood of bubbles occurrence in the NSE. This is becausea bubble is categorised asa binary dependent variable with two categories, bubble and non-bubble regime. This paper specified the Logistic Regression Model follows;

$$Bubble_t = lin(\frac{p}{1-p}) = \alpha_0 + \beta_1 MPR_t + \beta_2 PVol_t + \beta_3 TVol_t + \varepsilon_t \quad 3.3$$

Where; $Bubble_t$=(1= for bubble regime, 0= for the non-bubble regime), MPR=(1= for MPR regime, 0= for the MMR regime), p is the likelihood of bubble occurrence, while $lin(\frac{p}{1-p})$ is the odds ratio.

Data Sources and Description

This paperused monthly data on NSEAll-Share Index from 1985 to 2018andConsumer Price Index (CPI) from 1995 to 2018sourced from Central Bank of Nigeria Statistical Bulletin. Annual data from 1985 to 2018 was obtained from Securities and Exchange Commission (SEC) Statistical Bulletins, while annual data spanning 2007 to 2018 on Banks Non-Performing loans and Capital Asset Ratio were obtained from World Databank. The Nominal ASI was adjusted for inflation (Real ASI) based on2018 constant prices, and the DY was decomposed into monthly as it was available in monthly frequency.The DY was converted into monthlyusing the formula below;

$$DY_{monthly} = DY_{annual} \times \frac{W_i}{12} \quad 3.4$$

Where; w is the weight attached to each month (i) of the year with i (January=1, February=2,…., December=12).

Empirical Results and Discussion

This section presents empirical results on the occurrence of bubbles in the NSE.

Statistical Properties of Nominal and Real ASI Returns

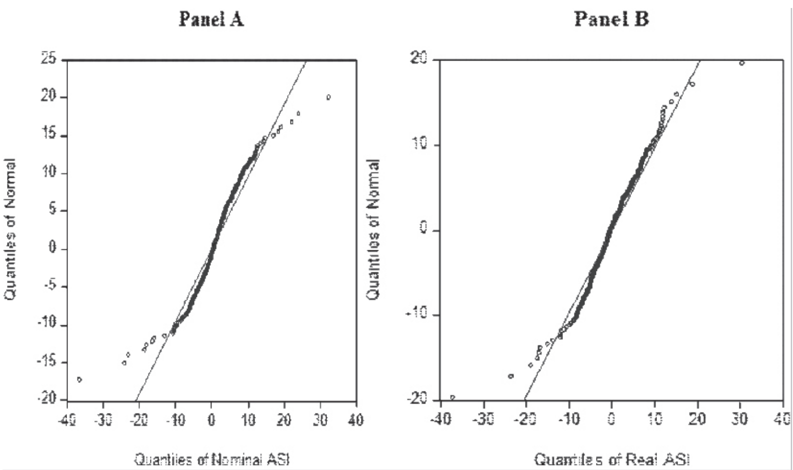
Table 1 reports the *descriptive* statistics and test of Arch Effect for the nominal (1985-2018) and real ASI (1995-2017).

Table : Statistic Properties of Nominal and Real ASI Returns

Statistic	**Real Return (%)**	**Nominal Return (%)**
Mean	-0.01	1.39
Maximum	30.52	32.35
Minimum	-37.13	-36.59
Std. Dev.	6.75	6.16
Skewness	-0.44	-0.45
Kurtosis	7.58	9.59
Jarque-Bera	247.99	749.42
Probability	0.00	0.00
Arch Effect Test		
F-statistic *P-Value*	5.90 *0.02*	14.37 *0.00*
Obs*R-squared *P-Value*	5.82 *0.02*	61.73 *0.00*

Source : Researchers' Calculation using Eviews 10.

Table 1 shows a monthly average return of -0.01 per cent and 1.39 per cent for the real and nominal All-Share Index. The results from Table 1 further show that the returns fluctuate around the monthly average by 6.75 per cent and 6.16 per cent in real and nominal terms, respectively. Extreme market events are prevalent and are predominantly losses as indicated by the presence of fat tails and negative skewness (Table 1). Further, the test of Arch effect shows volatility clustering, suggesting that periods of high volatility tend to be accompanied by periods high volatility likewise periods of low volatility tend to be followed by a period of low volatility. This arch effect allowed for the use of Garch Model to analyse the evolution of the returns in the NSE. The Jarque-Bera statistic and its associated *p-value* show the distributions of both returns are not normal (Table 1) and Figure 2 shows extreme gains and losses drive the distribution away from normal (indicated by the Q-Q plot in Figure 2).



Detectingthe Occurrence ofBubbles in the NSE

Table 2 reports the GSADF test results from the estimation of equation 3.2bfor the NSE-ASI and ASI Dividend Yield (ASIDY).

Table 2: GSADF Test Results for the Occurrence ofBubble in the NSE

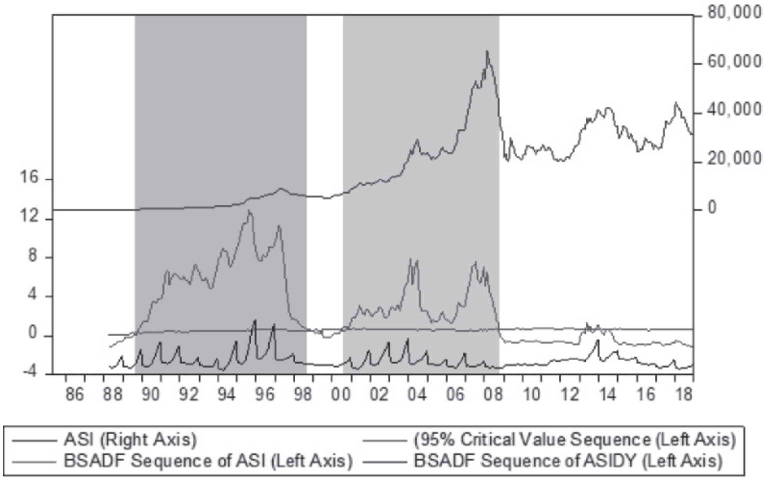
Variable			Critical Values		
	GSADF Statistic	***P-Value****	**90%**	**95%**	**99%**
ASI	12.86920	0.0000	2.014510	2.263398	2.930071
ASIDY	1.651226	0.2260	2.014510	2.263398	2.930071
RASI	2.904743	0.0080	1.890127	2.095073	2.700651
RASIDY	1.927571	0.0900	1.890127	2.095073	2.700651
*Right-tailed test **Critical values are based on a Monte Carlo simulation with 1,000 (run with EVIews 10)					

Source : Researchers' Computation using Eviews add-in Rtadf

Table 2 showsthat Real and Nominal All-Share Index have explosive roots, while the Real ASI Dividend Yield (RASIDY) and Nominal ASI Dividend Yield (ASIDY) do not. This indicates the occurrence of bubbles within the sample period as supported by the statistical significance of the GSADF statistic at 0.05 level.

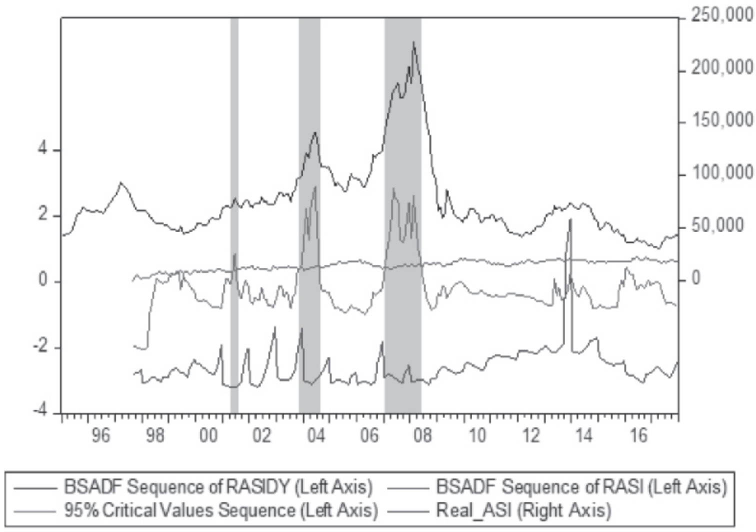
Date-Stamping the Occurrence of the Bubbles in the NSE

Table 2 reports evidence ofthe presence of bubbles but does not reveal the origination and termination dates of the bubbles. Figure 2 and 3 show the origination and termination dates of the bubbles estimated using the Backwards Supremum Augmented Dickey-Fuller (BSADF) test and statistic. The Backward SADF (BSADF) statistic was generated through a Monte Carlo simulation with 1,000 replications. TheBSADF statistic (green line in Figure 2 and 3) was then compared with the 95 per centGSADF critical value (red line in Figure 2 and 3). When it crosses the 95 per cent critical value from below and above, then the formeris the origination date, while later is the termination date of the bubbles(Phillips, Shi, & Yu, 2015; Greenaway-McGrevy & Phillips, 2016).



Source : Researchers' Computation using Eviews add-in Rtadf
Figure : Backwards SADF (BSADF) Test Results for NominalASI from 1985 to 2018

Figure 2 indicates two bubbles episodes. The first episode of the bubble occurred from September 1989 to August 1998 with ASI being 279.90 and 5,795.70 points respectively. While the second episode occurred from August 2000 to September 2008 with ASI being 7,394.10 and 46,216.13 points respectively. However, Figure 3 indicates the occurrence of three bubbles episodes when the Norminal All-Share Index (ASI) was adjusted for inflation. The first episode occurred from April 2001 to July 2001 when ASI was 69,710.49 and 74,330.38. While the second episode started in November 2003 when ASI was 98,268.03 and ended on July 2004 when ASI was 131,667.16. Whereas the third episode started in January 2007 when ASI was 138,701.94 and ended in May 2008, with an ASI value of 195,721.49.



Source : Researchers' Computation using Eviews add-in Rtadf
Figure : Backwards SADF (BSADF) Test Results for Real ASI from 1995 to 2018.

The Speed, Duration, and Relative Size of the NSE Bubble

Table 3 reports the estimates of the dates, growth rate, and size of the NSE bubbles.

Table : Estimates of the Date, Duration,Growth, and Size of the NSE Bubble

Episode	Assumption	Growth	Duration (Months)	Size of the Exuberance
2003M11-2004M06	29.00%	4.80%	8	30.38%
2007M01-2008M03	39.00%	3.00%	17	50.49%
1989M09-1997M07	24.00%	2.90%	108	322.40%
2000M08-2008M03	30.00%	2.70%	105	202.12%

This study assumes an initial overvaluation of 29 per cent before the GSADF test detects bubbles in the NSE. Table 3 shows that in that episode, NSE stock prices in real terms were 33.38 per cent overvalued, and the bubble grew at the rate of 4.8 per cent per month. For the second episode of the bubble in real terms, the estimated size was 50.49 when 39 per cent initial overvaluationwas assumed, and it grew monthly by 3 per cent (Table 3). However, in nominal terms, the overvaluation is about 322.40 per cent and 202.12 per cent by assuming 24 per cent and 30 per cent initial overvaluation with an estimated monthly growth rate of 2.9 per cent and 2.7 per cent for the first and second episode.

Risk Premium, Volatility State and Bubbles in the Nigerian Stock Exchange

Table 4 reports the results of the estimation of equation 3.2a to 3.2d. The results show that an increase in volatility (uncertainty) is associated with higher real returns but a decrease in nominal terms. This is indicated by the statistical significance ofthe conditional standard deviation(σ_t) at 1per cent and 5per cent level. These results suggestthe presence of feedback from the conditional standard deviation to the conditional mean.

Table 4: Component GARCH-M Model Results for Real and Nominal ASI

	Real ASI Returns (R_t)	Nominal ASI Returns (R_t)
Risk (σ_t)	0.9688*	-0.49958**
Bubble Risk (BR)	0.91314*	0.00070*
Global Financial Crisis Risk (GFCR)	0.99800*	-0.00020***
Tranquil Time (TR)	0.99549*	0.00028**
R_{t-1}	-0.00069**	0.22671*
α_0	-0.00350*	0.02994**
ω	0.00003*	0.00476***
ρ	0.79906*	0.95883**
θ	0.07181**	0.28681*
φ	0.30615*	0.02081**
π	0.36827*	0.09128**
ϕ	0.25264*	-0.71191*
*Denotesstatistical significance at 1% level. **Denotesstatistical significance 5% level. ***Denotesno statistical significance at 5% level.		

The results further indicated that bubble episodes (*BR*) and tranquil period (*TR*) (both in real and nominal terms)are associated with positive and statistically significant risk premium, suggesting that investors get compensated for taking additional risk. However, the results show during Global Financial Crisis (GFCR) in nominal terms, investors get punished for taking additional risk, while in real terms taking an additional risk during the Crisis is associated with positive returns.In the long-run trend equation 3.2b, the results show that average long-run (permanent) volatility (ω) is positive but very small with a value of 0.00003 and 0.00476 in real and nominal terms, respectively. The results also reveala slow convergence of volatility to its long-run value (ω) , suggesting long-run volatility persistence. This is indicated by the statistical significance of ρ with respective values of 0.7990 and 0.9988 in real and nominal terms, respectively. However, real volatility converges faster than the nominal. Furthermore, ρ exceeds ($\phi + \varphi$) both in real and nominal terms, suggesting the model is stable and transitory volatility converges faster than the permanent volatility. This suggests that risk premium in NSE is mostly determined by changes ineconomic fundamentals instead of changes market sentiments. However, the result revealsthe impact of fall in prices on the conditional variance is higher than that of an increase in prices, suggesting the presence of transitory leverage effects in volatility. This indicated by the statistical significance of π in real and nominal terms with a respective value of 0.3682 and 0.0912. Diagnostic tests show no evidence of ARCH effect and serial correlation in the residuals, but the residuals are normally distributed.

The Influence of Permanent and Transitory Volatilitieson Bubble Emergence in NSE

Table 5 presents the result from the estimation of equation 3.3and inferential statistical tests for the model evaluation. The results show that the transition from MRR to the MPR has reduced the likelihood of nominal bubble occurrence, while in real terms there is no significant difference betweenthe transition from MRR to MPR. This is indicated by the negative sign and statistical significance of the coefficient of the MPR dummy (Table 5). The results further reveal that an increase in permanent volatility stymied the likelihood of bubble occurrence in both nominal and real terms. However, statistical significance is only established at 5per cent level for the nominal bubble, while for the realbubble, there is no statistical significance even at 10per cent level.

Table 5: Logistic Regression Results on the Influence of Transition from MRR to MPR, Permanent and Transitory Volatility on the likelihood of Bubbles Occurrence in NSE

Dependent variable: NSE Bubble in Real and Nominal Terms (Dummy=1)		
	Nominal	**Real**
Constant	1.37856*	-1.67848*
Monetary Policy Rate Regime (Dummy=1)	-2.279*	0.76057***
Permanent volatility	-0.02399*	-209.212***
Transitory Volatility	0.01576***	174.7702***
McFadden R-squared	0.27432	0.0225
LR statistic	154.0017*	4.06168***
Wald Test (F -stat)	34.77544*	1.247621***
Percentage of Correct Prediction	66.99%	81.93%
Jargue-Bera	2.10885**	864.0766*
* Denotes statistical significance at 1% level. ** Denotes statistical significance 5% level. *** Denotes no statistical significance at 5% level		

The influence of transitory volatility is positive but not significant, suggesting an increase in transitory volatility might increase the likelihood of bubbles occurrence in NSE. It is also worth noting that the estimated models correctly predicted 66.99 per cent and 81.93per cent of the observationsused in the estimation for the nominal and real ASI. Also, the Likelihood Ratio (LR) and Wald tests of joint hypothesis of the significance of all the independent variables except the constant show the addition of theindependent variable significantly improves the estimated nominal bubble model but not the real bubble model. This is indicated by the statistical significance of the LR and Wlad tests.

The findings from this study complement Agu and Chukwuma-Agu (2010); Njiforti and Chidiogo (2010); Mike and Abraham (2015); and Nwidobie (2015). It also lends further empirical support to Almudhaf (2017) and Iliyasu, Sanusi, and Suleiman (2019) who find evidence of the occurrence of the bubble before March 2008. Like Iliyasu and Saba (2019), This study could not find any empirical evidence of bubble between 31st March 2017, and 21st July 2017, to which Monetary Policy Committee (MPC) of CBN made a remark of “seeming bubble” suggesting the MPC's remark is not empirically substantiated.

Conclusion

This study examines key empirical questions involving bubbles in the Nigerian Stock Exchange (NSE) Market from 1985 to 2018. To achieve this objective, the Generalised Supremum Augmented Dickey-Fuller (GSADF) and Backwards Supremum Augmented Dickey-Fuller (BSADF) tests were applied to NSE All-Share Index and the results revealed the occurrence of two bubble episodes in Nominal All-Share Index (ASI) and three episodes in Real All-Share Index (ASI). Furthermore, the results from the Component GARCH-M model indicated thatbubbleregimesinduced higher positive a risk premium than non-bubble regimes. Whereas Logistic Regression model estimates produced evidence that periods of higher permanent volatility were less likely to experience bubbles episodes, while periods with the dominance of transitory volatility were at a high risk of experiencing bubbles. This led to the conclusion that a prolonged period of a rising risk premium and transitory volatility are more prone to experience bubbles than periods of higher fundamental volatility in the Nigerian Stock Exchange. Therefore, when a rise in the risk premium and transitory volatility are observed, financial regulators such as Central Bank of Nigeria (CBN) and Securities and Exchange Commission (SEC) should diagnose the Market for bubbles using modern econometrics techniques such as the one used in this study.

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