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Stock returns, inflation and interest rate In Nigeria

Ogbebor, Peter Ifeanyi^{1*}, Awonuga Adesola¹, Oyamendan Nathaniel², and Oamen Gregory¹

¹Department of Finance, School of Management Sciences, Babcock University, Ilishan-Remo, Ogun State. Nigeria.
²Department of Accounting, School of Management Sciences, Babcock University, Ilishan-Remo, Ogun State. Nigeria.

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The generalized Fisher effect has attracted a great deal of controversy around the world. This is similar in the Nigerian scenario as study established that there exist no long-run relationship between stock returns and inflation while some studies reported that only a unidirectional causation of returns on stocks with money flow exist as the variation in the flow of money will alter returns on stocks significantly, but not in the opposite direction. Therefore, this study examined the relationship between stock returns, inflation and interest rate in Nigeria with objective of testing the Fisherian theory. The Fisherian theory of interest postulates that changes in the value of money would be reflected in nominal interest rates and stock returns in the same proportion over the long-run. This study tested the validity of this hypothesis in a small open economy, Nigeria. A battery of econometric techniques were employed (descriptive and inferential) for the sake of robustness. In line with the theoretical postulation of the Fisherian theory of interest, the findings established a long-run relationship among the selected series. Specifically, the study found that the price level coefficient exhibits a positive and significant relationship with stock price in the long-run. Therefore, evidence abounds of a great deal of the Fisherian postulation in the analyses carried out and conclude that common stocks are, indeed, a good hedge against inflation in Nigeria.

Key words: Fisherian theory, interest rates, Nigeria, small open economy, stock returns.

INTRODUCTION

The Fisherian theory of interest rate has attracted significant attention in finance and economics literature. The theory postulates that in an efficient market, the underlying value of goods accounts for the variations in interest rate over a period of time. If the monetary standard were always stable with reference to goods, the rate of interest, reckoned in terms of money, would be the same as if reckoned in terms of goods (Fisher, 1930). Mundell (1963) alluded to this postulation by arguing that purely monetary phenomenon triggers changes in real conditions in the economy. This postulation opened the flood gate of studies on how a nominal value can be discounted into its real value in such a way that

expectations regarding changes in values with passage of time should have minimal effects on asset values. Cifter (2015) stated that the 'generalized Fisher effect' asserts that common stocks can be taken as a hedge against inflation.

The generalized Fisher effect has attracted a great deal of controversies. Mundel (1963) posited that expected increase in prices will have partial effects on the money rate of interest while, Schwert (1981) pointed out that stock prices react negatively to unexpected inflation news. Fama (1981) attributed the negative relations between real stock returns and inflation 'proxy effects'. Fama (1981) adduced that stock returns are positively

*Corresponding author. E-mail: ogbebor.peter@yahoo.com. Tel: +2348037737142.

related to measures of real activity but that evidence of negative relations between inflation and real activity existed pointing out that the hypothesis for both common stocks and bonds is that expected real returns are determined in the real sector. Other studies established a positive trend between stock returns and inflation (Alagidede and Panagiotidis, 2012; Chang, 2013; Tiwari et al., 2015).

On the other hand, Luintel and Paudyal (2006) showed that common stocks are not good hedges against inflation since their study revealed that the retail price elasticity of stock return is above unity. Lee (2010) and Antonakakis et al. (2016) found mixed results in the stock returns and inflation relations. Other factors such as regime switches/dependency (Lee, 2010; Li et al., 2010; Cifter, 2015), model specification (Oxman, 2012), time (Tripathi and Kumar, 2014) were found to have effects on the relations between stock returns and inflation.

In the case of Nigeria, similar ambiguity exists. Lawal (2016) established no long-run relationship between stock returns and inflation. Apart from this and few other studies, there is a dearth of literature on the relationship among stock returns, inflation and interest rates in Nigeria; hence, interest rate was adopted as augmentation variable in the regression analysis carried out in this study. This study, therefore, fills this void.

The studies on the relationship between stock returns and inflation in Nigeria rather than provide a consensus added to the ever growing controversy which has increased the problems associated with high levels of inflation and their effects on returns in the country's financial markets. Moreover, most of the studies have failed to take cognizance of Geske and Roll (1983)'s reverse causality hypothesis which corroborated the contention by Fama (1981) that the negative relations between real stock returns and inflation observed during the post 1953 period in the United States of America were the consequences of proxy effects. Stock returns are determined by forecasts of more relevant real variables, and negative stock return-inflation relations are induced by negative relations between inflation and real activity (Fama, 1981). This study strives to overcome this major short-coming by infusing interest rate into the analysis in order to provide augmentation for interest rate which is assumed to be a relevant real variable like inflation rate. In particular, this study intends to investigate the relationship among the inferred variables in the long-run following the argument of Boudoukh and Richardson (1993) that investors prefer holding stocks over the long-run. The essence is to test whether the relationship between stock returns and inflation is positive in line with the theoretical underpinnings of the 1970s and 1980s which enthused a positive relationship between stock returns and inflation. The question is "does this situation hold in the case of Nigeria being a small open economy? The outcome of this research will provide a clear understanding as to whether stocks are a good

hedge against inflation in a small open market with a high inflationary environment. Furthermore, the expected augmentation of interest rate in the analysis is to validate the Fisherian theory of interest which asserts that a fully perceived change in inflation would be reflected in nominal interest rates and stock returns in the same direction which was also re-stated by Hassan (2008). In fact, Hasan (2008) asserted that the Fisher effect encompasses returns of securities relating to both interest bearing instruments and equity based investments; hence, interest rate has become an integral part of the analysis carried out. The objective of the study is to establish whether stock returns are a good hedge against inflation in Nigeria. Consequently, the hypothesis to be tested is as follows: Null Hypothesis - H_0 : There is no significant effect of stock returns on inflation in Nigeria.

Literature review

The stock market plays a major role in financial intermediation in both developed and developing countries by channelling idle funds from surplus to deficit units in the economy. It is also a mechanism for monetary transmission as interest rate and expected level of inflation play important roles in the achievement of macro-economic objectives. As the economy of a nation develops, more resources are needed to meet its rapid expansion. The stock market serves as a channel through which savings are mobilized and efficiently allocated to achieve economic growth (Alile, 1984). Large and long term capital resources are pooled through issuing of shares and stocks by industries in dire need of finance for expansion purposes. Thus, the overall development of the economy is a function of how well the stock market performs. Empirical evidences from developed economies as well as the emerging markets have proved that the development of the stock market is sacrosanct to economic growth (Asaolu and Ogunmuyiwa, 2010).

Inflation is one of the most frequently used terms in economic discussions, yet the concept is variously misconstrued. There are various schools of thought on inflation, but there is a consensus among economists that inflation is a continuous rise in the general prices of goods. According to Akinsola and Odhiambo (2017), inflation is seen as the continuous increase in the general level of prices of goods and services over time or more simply, as too much money chasing too few goods. Inflationary periods bring about a continuous decline in the purchasing power of money. Inflation can be seen as the surplus demand for commodities in the market as a whole. This indicates that the level of expenditure being engaged on home produced commodities surpasses the maximum yield of the home produced commodities that are achievable in the long run, based on the available

resources (Skene, 1992). Inflation refers to an overall rise in the Consumer Price Index (CPI), which is a weighted average of prices for different goods and services (Sinclair, 2010). Inflation rate occurs when the buying power of a currency falls due to a rise in the level of prices for goods and services in the economy (Comley, 2015).

Interest rate describes the amount of interest paid per unit of time expressed as a percentage of loans, - (Aluko et al., 2019). Chimaobi,- (2015) opined that interest rate can be regarded as prices of loanable funds and these prices affect decisions on the allocation of financial resources in the economy, therefore, serving as signals that direct financial resources in the economy. The concept of interest rate has objectives which cut across critical segment of the economy in the sense that its objectives are always in tandem with that of the overall monetary policy especially in the realm of maintaining price stability and generating rapid economic growth.

Theoretical framework

Theoretically, Fisher (1930)'s hypothesis which has evolved over the years as the 'generalized Fisher hypothesis' - simply postulated that the expected nominal return on common stocks comprised a real return in addition to the expected rate of inflation. This hypothesis provided the foundation for Mundel (1963)'s hypothesis which states that an increase in the expected rate of inflation causes portfolio substitution from money to stock returns which in turn reduces the real rate of stocks as well as interest rates; Fama (1981)'s proxy effect hypothesis and Modigliani and Cohn (1979) inflation illusion hypothesis provided further insights into the effects of inflation.

Chang (2013) explained that the Fisher hypothesis assumes a one to one relation between stock returns and inflation. The theoretical framework adopted by this study is the generalized Fisher Hypothesis by empirically testing the relation between stock returns, inflation and interest rate in Nigeria both in the short-and-long-run. Hasan (2008) pointed out that the Fisherian theory of interest asserts that a fully perceived change in inflation would be reflected in nominal interest rates and stock returns in the same direction. Mundel (1963) reviewing the basis for the Fisherian hypothesis; drew attention to some misgivings about the empirical reliability of Fisher (1981) explanation that the adjustment of money interest was only partial rather than the general understanding of the hypothesis which states that nominal interest should fully reflect changes in inflation.

Stock prices are expected to provide a hedge against inflation. Luintel and Paudyal (2006) argued that stock prices increase as inflation rate rises. However, Fama and Schwert (1977) provide some evidence that stock returns have negative relationship with inflation rate in the United States post 1953. Fama (1981) hypothesized that

the negative relations between stock returns and inflation proxy the positive relations between stock returns and real variables which are fundamental determinants of equity variables.

Empirical review

Valcarcel (2012) used two different structural VAR specifications that incorporated time variation in the covariance and drift of the system which showed that volatility in US economic activity is estimated to have taken place far more gradually than that of stock prices. On the basis of the Fisherian theory of interest which asserts that a fully perceived change in inflation would be reflected in nominal interest rates and stock returns in the same direction in the long-run; Hasan (2008) found empirical evidence of positive and statistically significant relationship between stock returns and inflation which established common stock as a good hedge against inflation in the United Kingdom.

In the case of Brazil, Russia, India, China and South Africa (BRICS) countries, Tripathi and Kumar (2014) studied the long term relationship between inflation and stock returns from 2000-2013. Tripathi and Kumar (2014) stated inter alia "changes in inflation may bring some short run movement in stock return but certainly equity does not seem to be a good hedge against inflation in the long run at least in emerging BRICS markets". Alagidede and Panagiotidis (2010) concluded that important indication emerged that the stock market tends to provide a hedge against rising consumer prices in African countries.

Cifter (2015) who studied the relationship between stock returns, inflation and real activity in developing countries (Mexico and South Africa), using Markov-switching dynamic regression approach established that stock returns respond differently to inflation in a regime according to the regime-dependent proxy effect hypothesis and concluded that the negative relationship puzzle in the empirical finance literature can be explained with the regime-dependency effect.

Antonakakis, Gupta and Tiwari (2016) using a time-varying approach showed that the correlations between inflation and stock prices in the United States covering the period of 1791 to 2015 evolved heterogeneously overtime. The results of Antonakakis,- et al (2016) specifically revealed that the correlations between stock prices and inflation were significantly positive in the 1840s, 1860s, 1930s and 2011, and significantly negative otherwise.

Toan (2019) investigated the nexus between inflation and stock index in Vietnam. Using quarterly data and employing the Autoregressive Distributed Lag (ARDL) approach, the results revealed the unidirectional impact of inflation on stock index in the short run and long run, which was significantly negative.

In the case of Nigeria, Izunobi et al. (2019) employed

GARCH (1.1) techniques to evaluate the existence of high stock market returns volatility, and the impact of the exchange rate, interest rate and inflation on stock market returns; using time series data from 1995 to 2014 showed that interest rate had a negative relationship with stock market returns, while the inflation rate and exchange rate had a positive relationship.

Okonkwo (2019) explored the casual nexus between stock return volatility and selected macroeconomic variables in an emerging stock market from 1981 to 2018. The result of the Johansen Co- integration analysis indicated the presence of a casual nexus between stock return volatility and selected macroeconomic variables in an emerging stock market in the long run.

Sokpo et al (2017) investigated the effect of inflation on stock market returns in Nigeria employing a volatility modeling approach from 1995 to 2016 and found that inflation is not an important variable in explaining stock market return volatility.

Njogo et al. (2018) studied the relationship between inflation rate and stock returns using the Consumer Price Index and the All Share Index of the Nigerian Stock Exchange covering the period 1995 to 2014. The data were analysed for evidence of co-integration and causality using Error Correction and Granger co-integration model. The Pearson Correlation result showed that, there was significant negative relationship between stock returns and inflation rates in Nigeria. Augmented Dickey Fuller result showed that the series are non-stationary in their level form and are integrated of order one. Johansen co-integration test result showed evidence of co-integration implying that there was a long run relationship between stock market returns and inflation rates.

Kurotamunobaraomi and Ebiware (2017) studied the relationship between inflation and stock prices of firms quoted in Nigeria Stock Market using data that spanned 1986 to 2014 from the Central Bank of Nigeria and National Bureau of Statistics, Ordinary Least Squares, Unit Root (Stationarity) Test, Johansen Cointegration and Granger Causality Test were employed to analyse the data. The study revealed that money supply and exchange rate portray statistically significant relationships with Stock prices. It also revealed that all but Interest Rate showed positive relationship with stock prices and no long run relationship were observed between any of the endogenous variables and the exogenous variable.

Fapetu et al. (2017) examined the impact of exchange rate on stock market performance using monthly data of market capitalization as indicators for stock market performance and monthly data on exchange rate as the parameters for measuring exchange rate volatility. The results revealed that exchange rate had a positive relationship with market capitalization rate in Nigeria. Emeka and Aham (2016) analysed the relationship between exchange rate and inflation volatility and stock prices volatility in Nigeria, using time series quarterly data from 1986 to 2012. The findings showed a negative

relationship between stock market prices volatility and exchange rate and inflation volatility.

Lawal (2016), examined the long-run relationships and dynamics interactions between stock returns, inflation and exchange rate in Nigeria using data from the period of 1995 to 2014. She concluded that there was no evidence of the existence of a long-run relationship between stock returns and inflation but except in the short-run in Nigeria. The study by Nkoro and Uko (2016) investigated the relationship between exchange rate and inflation volatility and stock price volatility in Nigeria from 1986-2012 using a time series data and established a negative relationship between stock market prices' volatility and exchange rate and inflation.

Ahmed and Igbinovia (2015) studied the impact of inflation rate on stock returns in the Nigerian Stock Market using monthly data covering the period 1995 to 2010. Data were extracted from the Nigerian Stock Exchange Fact Book and the Central Bank of Nigerian Statistical Bulletin. The result indicated that inflation rate had a negative but weak impact on stock return; hence, inflation is not a strong predictor of stock returns in Nigeria. Inflation variable appeared to significantly respond to stock price changes.

Henry and Clinton (2015) investigated the effects of inflation on aggregate stock prices in Nigeria during the period of 1980-2012. Employing the Engle-Granger and Johansen-Joselius method of co-integration in a Vector Error Correction Model (VECM) setting, in addition to Granger causality Test, Augmented Dickey Fuller Test (ADF) was employed. The results showed that there exist a negative and significant long run equilibrium relationship between inflation rate and aggregate stock prices; Broad Money Supply (M_2) had a negative and significantly effects on aggregates stock prices, Narrow Money Supply (M_1) showed positive and significant effects on aggregate stock prices.

Taofik and Omosola (2013), analysed the long-run relationships and dynamic interactions between stock returns and inflation in Nigeria using monthly data of the All Share Price Index from the Nigerian Stock Exchange and Nigerian Consumers Price Index from January 1997 to 2010. The analytical technique of Autoregressive Distributed Lag (ARDL) bound test was deployed. The results showed that there is a short and long run relationship between stock returns and inflation.

Emenike and Nwankwegu (2013), investigated whether stock market returns protect investors against inflation, Engle and Granger two steps Co- integration model and Error Correction Model was used. Results showed that stock returns and inflation were co- integrated.

METHODOLOGY

The generalized Fisher hypothesis postulates that common stocks represent claims against real assets of a business, hence, serves as a hedge against inflation. This theory was hinged on a stable

rate of inflation and by extension, interest rate. Chang (2013) explained that the hypothesis assumes a one to one relation between stock returns and inflation.

The theoretical framework adopted by this study is the generalized Fisher Hypothesis by empirically testing the relation between stock returns, inflation and interest rate in Nigeria both in the short-and-long-run; in particular, trying to establish the relationship among the inferred variables in the long-run following the argument of Boudoukh and Richardson (1993) that investors prefer holding stocks over the long-run. The essence is to test whether the relationship between stock returns and inflation is positive in line with the theoretical underpinnings of the 1970s and 1980s which enthused a positive relationship between stock returns and inflation.

Empirical analysis and results

This study employed Augmented Dickey-Fuller (ADF) (1979) unit root test to check for the stationarity of the selected series after the description of the series and thereafter, robust inferential analytical techniques.

Unit-root

One basic requirement of econometric estimation is that the variables contained in a regression model should be stationary. If non-stationary variables are used in a regression model, it could lead to spurious results. To test the stationarity properties of our variables, Augmented Dickey Fuller test (ADF) is deployed.

Linear regression

Computationally and conceptually stock returns and inflation rate are derived from stock prices and consumer price index, respectively by way of log first differencing each of the series. The series should be stable, thereby confirming the time series property. Thus, the linear relation between stock returns and inflation in Nigeria in their level form is examined using linear regression. The rationale behind the underlying equation can be deduced from the assertion by Hasan (2008) that since the Fisher effect encompasses returns of securities relating to both interest bearing instruments and equity based investments, it is important to see the inter-relationship between stock returns, inflation and interest rates.

$$SR_t = \alpha + \beta\pi_t + \gamma\Delta\ln(i_t) + \varepsilon_t \quad (1)$$

Where,

SR_t = stock return, α = constant, $\beta = 1$ following the joint hypotheses of efficiency and Fisherian theory of a constant real rate of return, γ coefficient of Interest rate, π_t = inflation rate and it is strictly exogenous, i = Interest rate and it is strictly exogenous and $[\varepsilon_t = u_t + v_t]$ is a composite error term. The above econometric equation is estimated to test the joint hypothesis of efficiency and Fisherian theory of a constant real rate of return. However, the preliminary analysis begins with estimating a regression model specified below to the relationship hypothesis between stock returns and inflation rate, viz:

$$SR_t = \alpha + \beta\pi_t + \varepsilon_t \quad (2)$$

Where, all the parameters remained as described previously.

To test the $H_{0i}: \beta = 1$, we used Wald-Coefficient Restriction Test approach as in:

$$t = \frac{\hat{\beta} - \beta}{se(\hat{\beta})} \quad (3)$$

Where,

t = test statistic, $\hat{\beta}$ = estimated regression coefficient of inflation, $\beta=1$ and $se(\hat{\beta})$ = standard error of the estimated regression coefficient of inflation.

Lag selection criteria

The Johansen Cointegration test and VECM involves the use of a VAR model and the different maximum likelihood ratios. The theoretical properties of the approaches require that they choose the number of lag k terms to be large enough to eliminate the effect of the correlation structure of the errors on the asymptotic distribution of the statistic. This Lag length selection describes the method for selecting the lags k for the co-integration test and VEC regression model. Different information criteria such as Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), Hannan-Quinn Information Criterion (HQ), Final Prediction Error and Sequential Modified test Statistic are used in determining the lag length. The appropriate lag length is selected using VAR Lag Order Selection Criteria and the lag order selected by the criterion is usually AIC or SIC or HQ or the majority becomes the optimal lag length.

Johansen cointegration test and VEC model

It is important to state here that due to the time series property of the data as revealed by the unit-root test results, the above models were - in line with Hasan (2008) approach - estimated using stationary series and these do not reveal both the long-run and short-run relationships among the variables. Therefore, to fulfill the time series econometric modeling requirements that accounts for the unit-root property of the selected series and capable of producing adequate estimates; they further employed Johansen and Juselius (1990) maximum likelihood procedure to test for cointegration (long-run relationship) while causal long run relationship is determined using a time series Vector Error Correction Model (VECM) which will reveal both the short run and long run relationship among the variables of interest.

Cointegration analysis

VEC specification relies on co-integrated series; the authors first ran the Johansen cointegration test to determine the number of cointegrating relations. Besides, co-integration analysis enables them to test for spurious regressions. A cointegration test that shows cointegrating relation between series that are integrated of order one (I(1)) validates the regression parameter estimates and on the other hand, failure to find cointegration signals spurious regressions; hence, invalidating the inferences drawn from such regressions. In this study, we estimate the cointegrating relations using the Johansen approach. This would be used in constructing the error correction terms from the estimated cointegrating relations. We then proceed to the estimation of a VAR in first differences including the error correction terms as repressors (VECM).

Vector error correction (VEC) model

A vector error correction (VEC) model is known as a restricted VAR

Table 1. Summary statistics.

Variable	s	p	i	sr	π
Mean	8.30	80.81	12.17	0.27	18.61
Median	8.19	56.16	12.50	0.09	12.83
Maximum	27.61	274.57	28.00	8.45	72.80
Minimum	0.88	5.54	1.04	-0.90	0.92
Std. Dev.	4.48	70.09	4.96	0.89	15.57
Observation	348	348	348	348	348

Source: Authors' Computation 2020; Note: **s** represents share price, **p** represents price level, **i** represents interest rate, **sr** represents stock return and π represents inflation.

intended for use with non-stationary series that are known to be cointegrated. The VEC has cointegration relations built into the specification so that it restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. In this study, the VEC model was estimated with the aid of Seemingly Unrelated Regression (SUR) model proposed by Zellner (1962). This is due to the fact that this approach produces more robust estimates that allow each of the variables to be considered as dependent variables and the error terms are assumed to be correlated across the equations. The VECM model in a vector form is as shown below:

$$\begin{pmatrix} \Delta s_t \\ \Delta p_t \\ \Delta i_t \\ v_{1t} \\ v_{2t} \\ v_{3t} \end{pmatrix} = \begin{pmatrix} C_1 \\ C_2 \\ C_3 \end{pmatrix} + \begin{pmatrix} d_{11}^k(\beta_1)d_{12}^k(\beta_2)d_{13}^k(\beta_3) \\ d_{21}^k(\beta_1)d_{22}^k(\beta_2)d_{23}^k(\beta_3) \\ d_{31}^k(\beta_1)d_{32}^k(\beta_2)d_{33}^k(\beta_3) \end{pmatrix} \begin{pmatrix} \Delta s_t \\ \Delta p_t \\ \Delta i_t \end{pmatrix} + \begin{pmatrix} \gamma_1 \xi_{t-1} \\ \gamma_2 \xi_{t-1} \\ \gamma_3 \xi_{t-1} \end{pmatrix} \quad (4)$$

The lag polynomial d_{ij}^k represents the 4-lag coefficients on variable j in equation i , Δ is the operator for a first differenced series to achieve stationarity, ξ_{t-1} is the error correction term, β is the coefficient of the series, γ is the coefficient error correction term, C_i is constant and v_t is the error term. All the series are in their log first difference forms. However, it should be noted that one-step VECM model in Equation (4) implemented using Eviews 10 is employed for a more precise parameter estimate as against unlike the two-step (General –to- Specific) approach.

Data

The study utilized monthly time series data from January, 1990 to December, 2018. The data were collected from Central Bank of Nigeria Statistical Bulletin (2018) and the Nigerian Stock Exchange Annual Reports (1990 to 2018). The variables selected for this study are stock price (s) measured by monthly average stock prices, price level (p) measured by monthly consumer price index, interest rate (i) measured by the 3-month Treasury bill rate, stock return (sr) measured as change in share price (Δs) equivalent to log first difference of stock price (s) and inflation rate (π) measured as change in price level (Δp) equivalent to first difference of the log transformed consumer price index (CPI).

Summary statistic

Table 1 presents the results in this study for the considered

variables' descriptive statistics. Share price (s) which is measured by monthly average stock price (s) has an average value of N8.30 of which its values spanned N0.88 to N27.61, being minimum value and maximum value respectively, with standard deviation of 4.48. Price level (p) measured by consumer price index is seen to have an average value of 80.81 with standard deviation of 70.09 and its values are found to be between 5.54 and 274.57 that is its minimum and maximum values respectively. Interest rate (i) measured by 3-month Treasury bill rate has a minimum value of 1.04% and maximum value of 28.00%, with its rate of dispersion (standard deviation) being 4.96, and its average value being 12.17%. Also, the minimum and maximum values of Stock return (sr) measured as change in share price (Δs) equivalent to log first difference of stock price are seen to be -0.90 and 8.45 respectively, with an average value of 0.27 and standard variation of 15.57 which depicts wide range of variation in the values of this particular variable. Furthermore, inflation (π) measured as change in price level (Δp) equivalent to first difference of the log transformed consumer price index (CPI) takes its values between 0.92% and 72.80%, lowest and highest values respectively, in which the value of rate of spreading out (standard deviation) is 15.57, which also reflects wide range in variation in the values of these variables; its average value being 18.61%.

Stationarity test

The summary of the results of the unit root tests carried out in their level and first difference forms using Augmented Dickey Fuller (ADF) approaches is presented in Table 2. The ADF test results revealed clearly that all the series besides stock return (sr) and inflation (π), have unit roots that can be safely accepted at level within the 1% and 10% alpha levels of significance. In other words, the acceptance of null hypothesis indicates that the series are not stationary at level. In addition, the results also showed that the series can only be made stationary by first difference. However, the rejection of the null hypothesis at level within the 1% to 10% alpha levels of significance when stock return (sr) and inflation (π) series are tested for unit roots; strongly indicates that the series are integrated of order zero (0). It is, therefore, worth concluding that stock price (s), price level (p) and interest rate (i) are integrated of order One (I(1)) and they have to be first differenced to achieve stationarity while stock return (sr) and inflation (π) are integrated of order zero (I(0)).

Linear Regression models for Equation (1) and Equation (2)

Following the unit root test results in Table 2, the Fisher Hypothesis was tested empirically and results are depicted in Table 3.

In row (2) of Table 3, the estimates of regression model specified

Table 2. Unit root test.

Variable/t-stat/critical value		Augmented dickey-fuller		
		@Level	@1 st Difference	Order
<i>s</i>	t-Stat	-2.975	-16.992***	I(1)
	1% level	-3.985	-3.985	
	5% level	-3.423	-3.423	
	10% level	-3.134	-3.134	
<i>p</i>	t-Stat	3.465	-17.817***	I(1)
	1% level	-3.985	-3.985	
	5% level	-3.423	-3.423	
	10% level	-3.134	-3.134	
<i>i</i>	t-Stat	-2.979	-16.923***	I(1)
	1% level	-3.985	-3.985	
	5% level	-3.423	-3.423	
	10% level	-3.134	-3.134	
<i>sr</i>	t-Stat	-14.513***	-16.244***	I(0)
	1% level	-3.985	-3.985	
	5% level	-3.423	-3.423	
	10% level	-3.134	-3.134	
<i>π</i>	t-Stat	-4.349***	-4.049***	I(0)
	1% level	-3.985	-3.985	
	5% level	-3.423	-3.423	
	10% level	-3.134	-3.134	

Source: Authors' Computation 2020. Note: *s* represents share price, *p* represents price level, *i* represents interest rate, *sr* represents stock return and π represents inflation, ***, ** and * represents the level of significance at 1%, 5% and 10% , respectively.

Table 3. Linear regression models for equation (1) and equation (2).

Dependent Variable	C: Constant (t-stat.)	π : Inflation rate (t-stat.)	Δi : interest rate (t-stat.)	R ²	F (Sig.)	DW
Equation (1)	3.3970 (0.428)	1.2469*** (3.406)	- -	0.0472	17.1580 (0.000)	1.5791
Equation (2)	3.2936 (7.327)	1.2572*** (0.303)	3.294 (29.501)	0.0476	8.6022 (0.000)	1.5804

Source: Authors' computation, 2020. Note: for $H_{01}: \beta = 1$ and $H_{02}: \beta = 1$ tests, the computed t-statistics are $t_1 = 0.674$ and $t_2 = 0.848$ respectively. ***, ** and * denote 1%, 5% and 10% levels of significance.

in Equation (1) to test Fisherian direct relationship hypothesis between stock returns and inflation rate shows that the inflation rate (π) exhibits positive relationship with stock return (SR) [$\hat{\beta} = 1.247$; $p = 0.001$] and the positive relationship is significant at 1% level. This supports the result of Hasan (2008) and some other previous studies. Also, we tested the hypothesis of whether β is not significantly different from unity using Wald-Coefficient Restrictions Test approach as in Equation (3) to investigate the hypothesis that assumes a one to one relation between stock returns and inflation. Given the computed $t = 0.674$ (which is < 1.96 ; the Conventional Table value), the null hypothesis of $H_{01}: \beta = 1$ is accepted suggesting that a one to one relation exists between stock returns

and inflation. This is consistent with the Fisherian theory that the expected nominal return on common stock varies in one-to-one correspondence with expected returns. Furthermore, the regression model diagnostics, F- stat = 17.158 ($p = 0.000$), $R^2 = 0.047$ and Durbin-Watson stat (DW) = 1.579 confirmed that the model is significant (fit) and free from serial correlation problem.

Again, in row (3) of Table 3; the estimates of regression model specified in Equation (2) to examine the relationship between stock return, inflation and interest rates showed that the inflation rate (π) exhibited positive relationship with stock return [$\hat{\beta} = 1.257$; $p = 0.000$] and the positive relationship is significant at 1% level as expected. However, the coefficient of interest rate (*i*) appears

Table 4. Lag order selection criteria.

Lag	LogL	LR	FPE	AIC	SC	HQ
1	481.5097	NA	1.27e-05	-2.763214	-2.662298	-2.723012
2	509.7719	55.53278	1.13e-05	-2.875859	-2.674027*	-2.795455
3	521.2328	22.31860	1.12e-05	-2.890250	-2.587502	-2.769644
4	545.2555	46.35966*	1.02e-05*	-2.978103*	-2.574438	-2.817294*
5	551.1036	11.18314	1.04e-05	-2.959670	-2.455090	-2.758659
6	558.6869	14.36843	1.05e-05	-2.951386	-2.345889	-2.710172

Source: Authors' computation, 2020. Note: *indicates lag order selected by the criterion, LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion and HQ: Hannan-Quinn information criterion.

negative (rightly signed) but statistically insignificant [$\hat{\gamma} = -2.966$; $p = 0.920$].

Focusing on the hypothesis of whether β is not different from unity; using Wald-Coefficient Restrictions Test approach as in equation (3), the computed $t = 0.848$ (which is < 1.96 ; the conventional table value), supports the null hypothesis of $H_{01}: \beta = 1$, thus we conclude that a one to one relation exists between stock returns and inflation. Besides, the regression model diagnostics, F-stat = 8.602 ($p = 0.000$), $R^2 = 0.048$ and Durbin-Watson stat (DW) = 1.580 confirmed that the model is significant (fit) and free from serial correlation problem.

Lag selection criteria

Following the argument of Boudoukh and Richardson (1993) that investors prefer holding stocks over the long-run and due to the fact that the linear regression equations above are assumed to be carried out using differenced series that have lost their long run properties; there is a need to investigate the long run properties of the variables of interest. To achieve this, the authors began by selecting the appropriate lag length using VAR Lag Order Selection Criteria and the results are presented in Table 4. As in Table 4, for the selection of the appropriate lag length; Sequential modified LR test statistic (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ) are reported tested at 5% level each. However, the majority (especially AIC) of the criterion showed the optimum lag of 4. Therefore, they considered the optimal lag length of 2 in our subsequent analysis.

Johansen system cointegration test and long-run relationship

To investigate the long run properties of the variables of interest, Johansen System Cointegration Test approach is considered using the variables: Stock price (s), Price level (p) and Interest rate (i) all in their log first difference form since the unit root tests results showed that they are integrated of same order ($I(1)$) and the result is presented in Table 5.

From the result in Table 5, both the trace and maximum – eigenvalue test statistics suggest that the null hypothesis of no cointegration (H_0) among the variables can be rejected. It showed that there is at least 1 cointegrating relation among the variables. This means that long run relationship exists among the variables of interest. Furthermore, the normalized cointegrating equation in the lower portion of Table 5 showed that the coefficient of price level (log first difference: $\Delta \ln(p) \approx \pi$) exhibits positive and significant relationship with stock price (log first difference: $\Delta \ln(s) \approx sr$) in the long-run [coefficient = 1.285; t – stat. = 4.105]. It suggests that

the stock market provide hedge against inflation. Using equation (3), the computed t -statistic = 0.911 suggests that stock prices move one-to-one with price level. Additionally, the coefficient of interest rate (log first difference: $\Delta \ln(i)$) is found to have negative and significant relationship with stock price (log first difference: $\Delta \ln(s) \approx sr$) [coef. = 2.657; t – stat. = 5.570].

VEC model using SUR for efficient estimates

Following the series of tests carried out in this study and in line with the argument of Boudoukh and Richardson (1993) that investors prefer holding stocks over the long-run, there is a need to construct a model that would combine both the short run and long run properties of the variables in the model. Therefore, the estimates of the VEC model using SUR (seemingly unrelated regression) implemented through the make model/system precise option to obtain more efficient parameters estimates as postulated by Hasan (2008) is presented in Table 6. However, it should be noted that one-step VECM model in Equation (4) Implemented using Eviews 10 is employed for a more precise parameter estimate unlike the two-step (General –to- Specific) approach usually employed by other researchers.

According to the results in Table 6, the R^2 values of the Stock return (s), Price level (inflation) and Interest rate (i) models (0.414, 0.207 and 0.072) showed that the explanatory variables explain about 41.4%, 20.7% and 7.2%, respectively of the variation in dependent variables. Furthermore, the F-Statistics values which are 19.416, 4.981 and 2.146 for the Stock return, Price level (inflation) and Interest rate models, respectively indicate that the models are significant. The Durbin-Watson statistic values which are approximately 2 suggest that the models are free from autocorrelation problem. The negative and significance of the coefficients of error correction terms provide the evidence that each of the dependent variables responds to disequilibrium from its own lag and lags of other variables as the case maybe. Overall, the short run effect estimates of parameters associated with the lagged differences of the independent variables showed that neither Price level (inflation) nor Interest rate (i) exhibits significant relationship with Stock return.

VEC granger causality/block exogeneity wald test

The study proceeds by examining the joint significance of each of the explanatory variables in Table 6 in the short-run. VEC Exogeneity Wald Chi-squared Test is utilized and the results are presented in Table 7. As can be seen in Table 7, the results showed that Price level (inflation) and Interest rate do not have joint significant effect on Stock return, $\chi^2 = 4.470$ (P – value = 0.813).

Table 5. Johansen system cointegration test.

Hypothesized no. of CE(s)	Trace statistic	5% critical value	Prob.
R = 0	41.263**	24.276	0.000
R = 1	10.810	12.321	0.088
R = 2	3.033	4.130	0.097

Hypothesized no. of CE(s)	Maximum eigenvalue statistic	5% critical value	Prob.
R = 0	30.452**	17.797	0.000
R = 1	7.777	11.225	0.189
R = 2	3.033	4.130	0.097

Long-run relationship (Normalized cointegrating coefficients)

<i>s</i> : stock price	<i>p</i> : price level (CPI)	<i>i</i> : interest rate
1.000	-1.285** (0.313) [-4.105]	2.657** (0.477) [5.570]

$s = 1.285p - 2.657i$

Source: Authors' computation, 2020. Note: Standard Error in Parenthesis, T-statistic in square bracket and ** denotes 5% level of significance.

Table 6. VEC model using SUR for efficient estimates.

Variable	$\Delta \ln(s)$ (Stock return model)	$\Delta \ln(p)$ (Price (inflation) model)	$\Delta \ln(i)$ (Interest rate model)
	Coefficient (Sig.)	Coefficient (Sig.)	Coefficient (Sig.)
ξ_{t-1}	-0.0627** (0.012)	-0.0161*** (0)	0.0066 (0.512)
$\Delta \ln(s_{t-1})$	-0.7306*** (0)	0.0138* (0.053)	0.0039 (0.862)
$\Delta \ln(s_{t-2})$	-0.5835*** (0)	0.0107 (0.187)	0.0118 (0.645)
$\Delta \ln(s_{t-3})$	-0.4681*** (0)	0.0062 (0.434)	0.012 (0.637)
$\Delta \ln(s_{t-4})$	-0.1592*** (0.003)	0.0044 (0.516)	0.0013 (0.95)
$\Delta \ln(p_{t-1})$	-0.0012 (0.998)	-0.0528 (0.328)	-0.0166 (0.923)
$\Delta \ln(p_{t-2})$	-0.3674 (0.387)	-0.0547 (0.311)	0.0158 (0.926)
$\Delta \ln(p_{t-3})$	0.1351 (0.75)	-0.0255 (0.637)	0.1194 (0.486)
$\Delta \ln(p_{t-4})$	-0.2615 (0.537)	-0.0869 (0.107)	0.0885 (0.605)
$\Delta \ln(i_{t-1})$	0.1144 (0.394)	-0.0076 (0.654)	0.2256*** (0)
$\Delta \ln(i_{t-2})$	0.1751 (0.197)	-0.0015 (0.93)	0.0293 (0.593)
$\Delta \ln(i_{t-3})$	-0.0807 (0.553)	-0.012 (0.486)	-0.1488*** (0.007)
$\Delta \ln(i_{t-4})$	0.0759 (0.572)	-0.0048 (0.778)	0.0322 (0.553)
F-stat.	19.416	4.981	2.146
R-squared	0.414	0.207	0.072
Durbin-Watson stat	1.986	2.007	1.993

Source: Authors' computation, 2020. Note: ***, ** and * denote 1%, 5% and 10% levels of significance.

The joint effect of Interest rate and Stock return on Price level (inflation) is not significant $\chi^2 = 4.235$ ($P = 0.835$). Additionally, it is found that Stock returns and Price level (inflation) failed to exhibit joint significant effect on Interest rate $\chi^2 = 1.120$ ($p = 0.997$). These are consistent with the parameter estimates in Table 6 and suggest that each of the explanatory variables does not have joint significant effect on each of the dependent variables in the short-run.

DISCUSSION OF FINDINGS

The study investigated the generalized Fisher hypothesis that common stocks represent claims against real assets of a business, hence, serves as a hedge against inflation. The study utilized time series data that covered the period

Table 7. VEC granger causality/block exogeneity wald test.

Model	ξ_{t-1}	Wald χ^2 Test $\Delta \ln(s)$	Wald χ^2 Test $\Delta \ln(p)$	Wald χ^2 Test $\Delta \ln(i)$
$\Delta \ln(s)$ (Stock return)	--0.063** (0.012)		3.669 (0.453)	0.361 (0.986)
$\Delta \ln(p)$ (Price (inflation))	--0.016*** (0.000)	1.190 (0.880)		0.714 (0.950)
$\Delta \ln(i)$ (Interest rate)	0.0066 (0.512)	3.086 (0.544)	0.927 (0.921)	
Joint Effect		4.470 (0.813)	4.235 (0.835)	1.120 (0.997)

Source: Authors' computation, 2020. Note: P- values (sig.) in parentheses. ***, ** and * denote 1%, 5% and 10% levels of significance.

from January 1990 to December 2018 in Nigeria. The major empirical tools that were used in this study are unit root test, co-integration test, and VECM based granger causality. The unit root test results showed that all the series are integrated of order 1, except stock return and inflation rate which are assumed to be log first difference series originally derived from stock price and consumer price index (CPI). The linear regression models adopted revealed a one to one positive relation between stock returns and inflation (using Wald-Coefficient Restrictions Test approach) which corroborated the Fisherian theory that the expected nominal return on common stock varies in one-to-one correspondence with the expected return. Furthermore, the results showed a negative but insignificant relationship between interest rate and stock returns. This study is in tandem with Hassan (2008) and Alagidede and Panagiotidis (2010) which states that Fisherian hypothesis that the expected nominal return on common stock varies in one-to-one correspondence with inflation. The Wald-Coefficient Restrictions Test approach also supports the null hypothesis of $H_{01}: \beta = 1$. In a bid to examine both the long-run and short-run relationship among stock price, inflation and interest rates, Johansen co-integration test and VECM based granger causality were used. The Johansen co-integration test indicated that long-run relationship exists among the selected series. Besides, it was established that the coefficient of price level (log first difference: $\Delta \ln(p) \approx \pi$) exhibits positive and significant relationship with stock price (log first difference: $\Delta \ln(s) \approx sr$) in the long-run which supports the long-run Fisher effect suggesting that stock prices move one-to-one with price level. Additionally, the coefficient of interest rate (log first difference: $\Delta \ln(i)$) was found to have negative and significant relationship with stock price (log first difference: $\Delta \ln(s) \approx sr$) which are in line with previous findings from some previous studies and the Fisherian theory that the expected nominal return on common stock varies in one-to-one correspondence with the expected return. However, VEC granger causality/Exogeneity Wald Chi-squared Test revealed that inflation and interest rates do not have joint significant effect on stock prices in the short-run.

Conclusion

The findings revealed that there is a one-to-one relation

between stock returns and inflation as the results of the regression analysis showed a positive and significant relationship between stock returns and inflation in Nigeria. This empirical evidence is consistent with the findings by Hasan (2008), Alagidede and Panagiotidis (2010) and the Fisherian hypothesis that the expected nominal return on common stock varies in one-to-one correspondence with inflation. A slightly different result was established in the relation between stock returns and interest rate as a negative and significant relationship was found between interest rate and stock returns.

Additionally, the result of the study showed that the coefficient of interest rate has a negative and significant relationship with stock prices in line with English (2018) who found a unidirectional causation of returns on stocks with money flow. In terms of causality, the study showed that inflation and interest rate do not have joint significant effects on stock returns and equally established the fact the effect of both interest rate and stock returns on inflation is not significant. Furthermore, it was found that stock returns and inflation failed to exhibit joint significant effects on interest rate. Based on the findings of this study, the conclusion is that common stocks are a good hedge against inflation in Nigeria.

RECOMMENDATION

Based on the findings and conclusion, the study recommends that government, monetary and other regulatory authorities in Nigeria should use macro-economic tools like interest and inflation rates reduction to achieve macro-economic objectives in order to boost real activity towards making common stocks better hedges against inflation.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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