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The sensitivity of Nigerian stock exchange sectors to macroeconomic risk factors

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The Sensitivity of Nigerian Stock Exchange Sectors to Macroeconomic Risk Factors

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Abstract

This paper investigated the sensitivity of sectoral index returns on the Nigerian Stock Exchange to macroeconomic risk factors such as the spread between deposit and lending rates of banks, the slope of the yield curve, broad money supply, interest rates, exchange rates, inflation and the international price of oil. We found that the Banking, Food and Beverage, and Insurance sectors were sensitive to some macroeconomic risk factors but not to others. The Oil and Gas sector was sensitive to the slope of the yield curve only. This study estimated the elasticities of macroeconomic factors in the Nigerian Stock Exchange using the sectoral indices. It is also one of the few studies that has tested the Arbitrage Pricing Theory (APT) on distinct sectors of the Nigerian Stock Exchange. A number of policy implications on prudential guidelines, sectoral inventions, direction of investments and hedging strategies are indicated.

Keywords: Macroeconomic risk factors, Arbitrage Pricing Theory, Nigerian Stock Exchange, Sectoral Indices

JEL Classification:G12, G15

I. Introduction

This paper investigated the sensitivity of the sectoral indices in the Nigerian stock exchange to selected macroeconomic risk factors. We gauge the sensitivity to both short and long-term interest rates, inflation, exchange rates, and the international price of Bonny Light crude oil(due to the structure of Nigeria's economy).In addition, we estimate sensitivity to the interest rate spread, the slope of the yield curve, and broad money supply (M_2). This is broadly in line with Ross (1976); Ross and Stephen (1980); and Chen, Roll and Ross (1986) who tested the arbitrage pricing theory (APT).

A plethora of studies have been done on the sensitivity of the general stock market to macroeconomic variables, and have reported inconclusive results. Some studies, including Hall (2001), done on industries, such as banking, have found that the sensitivity to interest rates depends on the extent to which banking firms are hedged and that the industry-wide adoption of hedging strategies have increased over time.

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It would be interesting to study the sensitivity to macroeconomic factors by industry, which is the approach adopted in this study. Firms in the same industry are likely to have peculiar characteristics, which will affect their reactions to changes in macroeconomic variables. Market structure may also affect the sensitivity of firms to macroeconomic variables. For example, in an oligopolistic structure, firms may be able to pass on cost increases and may not be sensitive to certain macroeconomic variables. For example, in the Nigerian banking industry, there are indications that the particular level of interest rates is not as important as the spread between lending and deposit rates in determining the profitability of firms.

Section 2 reviews the literature, while Section 3 describes the data and methodology. Section 4 presents the empirical results, while the interpretation of results was presented in Section 5. Section 6 concludes the paper and discusses policy implications.

II. Literature Review

The response of stock markets to movements in macroeconomic variables has generated a lot of interest in the conduct of monetary policy. Most of the studies have been on the reaction of stock prices to benchmark interest rates and, to a lesser extent, inflation. Bernanke and Kuttner (2005) showed that a 25 basis point cut in the interest rate typically led to an increase in stock prices of about 1.0 per cent. They illustrated that there were varying reactions to changes in interest rates across various industries. The effect of the rate cuts was as a result of lower cost of capital, which is expected to have a positive impact on the returns of the firm. Also, a rise in interest rate resulted in the depreciation of stock prices brought about by the subsequent lower consumption level as a result of the higher cost of borrowing money in the economy. They also found that changes in rates, which were perceived to be permanent, were larger than changes that were perceived to be temporary, in keeping with the permanent income hypothesis of Milton Friedman.

Drakos (2001) showed that there was a significant relationship between stock market prices and interest rate movements in Greece. As an emerging market, Drakos points out that the lack of a derivatives market in Greece to provide hedging facilities against interest rate shocks could be accountable for the high sensitivity of stocks to interest rates.

Stevenson (2002), referring more specifically to banking stocks, stipulated that prices of banking stocks did respond to changes in interest rates. He further opined that changes in interest rates brought about more stock market reactions in countries within monetary unions than those operating independently. Stevenson, in the same manner as Drakos (2001), goes further to assert that banks that had hedged their interest rate risk were less likely to be affected by changes in the interest rates.

In another study on banks, Benink and Wolff (2003), using panel data, illustrated the negative interest rate sensitivity of the twenty largest U.S banks. They found that the relationship was most significant in the early 1980's but declined in the late 1980's and early 1990's due to the impact of hedging on interest rate risk. Using Australian data, Ryan and Worthington (2004) showedthat banking returns were significantly affected by short and medium-term interest rate changes. However, the Australian banks' returns were less sensitive to changes in long-term interest rates.

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Filardo (2000) found a positive correlation between consumer price inflation and stock prices. He also asserted that a good measure of inflation should include asset prices. He goes on to show that with the tightening of monetary policy rates, the cost of capital increases thereby leading to lower demands for goods, hence, the subsequent drop in inflation. A lower demand, following policy tightening, for goods and services implies lower future earnings for firms, hence, a drop in their share prices.

Tessaromatis (2003) investigated the sensitivity of UK stock prices to nominal and real interest rates and expected inflation. He found that stock prices responded negatively to changes in nominal and real interest rates. For more than half the portfolios examined, the sensitivity of equities to changes in long term inflation expectations was not statistically significant, suggesting that at least some stocks are good hedges against future inflation. The estimated sensitivities also suggested that equities were more sensitive to real interest rates than expected inflation or nominal interest rates.

Staikouras (2005) investigated the issue of whether financial intermediaries' common stock returns incorporated a risk premium for their inherent exposure to unexpected changes in interest rates. Weekly logarithmic returns were calculated for a total of 239 UK firms covering a sample period from 1989 to 2000. Portfolios of stocks from banks, finance firms, insurance companies, investment trusts and property investment companies were employed in order to measure the effect of interest rate risk above and beyond the market portfolio. The systematic market risk was measured by the FTSE All-Share Price Index return and the interest rate factor was represented by the one- and three-month Treasury bill discount rates. A two-factor model with the market portfolio and the changes in market yields, as exogenously specified risk variables, was employed. The model was estimated by means of a seemingly unrelated regression estimation (SURE) framework with both cross-equation restrictions and within equation nonlinear constraints on the parameters. The findings indicated that financial institutions' equity returns incorporated a risk premium for their exposure to market yield surprises.

Following recent revelations of the vulnerability of some depository institutions to changes in interest rates, bank supervisors, especially in the U.S., have placed more emphasis on monitoring the interest rate risk of commercial banks using the duration-based Economic Value Model (EVM), designed by the Federal Reserve Bank to estimate the interest rate sensitivity of banks. Sierra and Yeager (2004) utilised accounting-based bank performance measures such as the net interest margin (NIM), return on assets (ROA), and the book value of equity (BVE), from 1998 to 2002 to test whether measures derived from the Fed's EVM were correlated with the interest rate sensitivity of U.S. community banks. Their combined use of regression analysis, matched pairs, and correlation analysis demonstrated that the Fed's EVM is a useful supervisory tool to assess the relative interest rate risk at community banks.

Hahm (2004) investigated the interest rate and exchange rate exposures of Korean commercial and merchant banking corporations during the pre-crisis liberalization period. The sensitivity of stock returns was adopted as a measure of the exposure. The exposure was estimated in the context of factor models, which include interest rate and exchange rate changes in addition to market portfolio returns. Employing various time-series and panel regressions, the direction and patterns of risk exposures were investigated across different industries and time-periods using monthly stock prices, interest rate and exchange rate data from March 1990 to November 1997.

Closing prices of the last business day of the month were used to compute monthly stock returns, yield changes and currency depreciation rates. In addition to the Korean stock price index (KOSPI), banking and merchant banking industry indices and individual stock prices that were listed at the Korea Stock Exchange at the onset of the financial crisis were employed. The three-year corporate bond yield was used for the interest rate data and the won/dollar spot exchange rate was used for the exchange rate data.The results showed that both commercial and merchant banks became increasingly exposed to interest rate and exchange rate risks in 1994 to 1997. Also, commercial and merchant banks were significantly negatively exposed to the interest rate and exchange rate risks during this sub-period, implying that higher interest rates and exchange rates negatively impacted the firm values of the financial institutions.

Ballester *et al.,* (2009) using weekly bank stock returns for 23 banking firms and weekly data of the average three-month rate of the Spanish interbank market spanning January 1994 through December 2006, empirically investigated the main determinants of the interest rate exposure of Spanish commercial banks, using panel data methodology. The results indicated that interest rate exposure was systematically related to some bank specific characteristics. In particular, a significant positive association was found between bank size, derivative activities, and proportion of loans to total assets and banks' interest rate exposure. On the other hand, the proportion of deposits to total assets was significantly and negatively related to the level of bank's interest rate risk.

Huang and Hueng (2009) had extended the Fama–French three-factor model to include a risk factor that proxies for interest-rate risk faced by firms in an attempt to reduce the pricing errors that the three-factor model could not explain. These pricing errors were observed especially in small size and low book-to-market ratio firms, which were, in general more sensitive to interest-rate risk. Using U.S. monthly stock market data spanning July 2004 to December 2006, they showed that both modifications were essential to improving the performance of the three-factor model and also reduced the aggregate pricing errors generated by the three-factor model by more than 50 per cent. The results showed that their Time-Varying-Loadings Four-Factor (TVL4) model significantly reduced the pricing errors.

A number of relevant studies have been conducted on the Nigerian stock exchange also. Using monthly and quarterly data from 1985 to 2008, Omotor (2010) investigated the relationship between inflation and stock returns in Nigeria. He found support for the Fisher (1930) hypothesis in Nigeria, which suggested a positive relationship between stock returns and inflation.

Using quarterly data, Adaramola (2011) studied the impact of macroeconomic variables on stock prices in Nigeria, between 1985 and 2009. He found that interest rates, exchange rates and the international price of oil had a strong influence on Nigerian stock prices while money supply, inflation rate and GDP had a weaker influence on Nigerian stock prices.

Izedonmi and Abdullahi (2011) conducted a test of the APT using a sectoral approach and three macroeconomic variables—market capitalization, inflation and exchange rates. Surprisingly, they found that macroeconomic variables had no effect on stock prices in Nigeria. Incidentally, their adjusted r-squared of 0.38 was rather low, indicating some model misspecification.

Using quarterly data from 1985 to 2009 and a vector autoregressive approach, Arodoye (2012) investigated the relationship between stock prices and GDP, interest rates and inflation. He found both short-run and long-run relationships among the variables. Perhaps the greatest shortcoming of this study is the fact the sign of the relationships with stock prices tended to oscillate over time, thus making it difficult to establish the true relations among the variables.

This study is different from the previous studies in that it investigates the relationship between stock prices and selected macroeconomic variables using the sectoral indices that were instituted by the Nigerian Stock Exchange in January 2009. Besides using a new data set, this study also recognises that the sensitivity to macroeconomic risk factors may differ by industry, depending on the composition of balance sheets and other industry-specific vulnerabilities. The hypothesis is that the reactions to macroeconomic variables depend on the industry, and studies that investigate the sensitivity of the entire stock market index are unable to delineate the differences by industry.

III. Data and Methodology

III.1 Indices and Macroeconomic Risk Factor Data

Four sectoral indices—banking, insurance, food and beverage and, oil and gas—were utilized in this study. The all-share index was used to gauge the sensitivity of the sectoral indices to systematic risk. In addition to the sectoral indices, we also employed the NSE30 index, which tracks the performance of the 30 largest firms, in terms of market capitalization, on the NSE.

For macroeconomic risk factors, the interbank interest rate, the ten-year Treasury bond interest rate, headline inflation, the nominal naira/US$ Wholesale Dutch Auction (WDAS) exchange rate, the price of Bonny Light crude oil (Nigeria's variety), the spread between prime lending and consolidated deposit rates, the slope of the yield curve (as measured by the difference in yield between the ten-year government bond and 3-month treasury bills), and broad money supply (M_2) were chosen. Two interest rates were employed in order to ascertain the reaction of the sectoral indices to short-term (interbank) versus long-term (ten-year Treasury bond) rates.

The sectoral indices as well as the all-share and NSE30 indices were obtained from the Nigerian Stock Exchange (NSE), the interbank rate, nominal naira/US$ exchange rate, and crude oil prices, the spread variable and M_2 were obtained from the Central Bank of Nigeria (CBN), inflation rate was obtained from the National Bureau of Statistics (NBS), while the ten-year treasury bond rate and yield curve variables were obtained from the Financial Markets Dealers Association (FMDA).

Since the sectoral indices were inaugurated by the NSE in January 2009, the data, with the exception of the Food and Beverage index, were taken from January 2009 to June 2013; the Food and Beverage index was taken from January 2009 to December 2011 as it was reconstituted in January 2012, introducing some discontinuity in the data series. This reduced the number of observation for the Food and Beverage index to 36, compared with 54 for the other variables. The sectoral indices account for64.19 per cent of the total market capitalization.

II.2 Methodology

The elasticities of the sectoral indices to the risk factors were estimated by running the following regressions:

$$\Delta LOG(Banking) = \beta 0 + \beta 1 \Delta LOG(ASI) + \beta 2 \Delta LOG(INFLATION) + \beta 3 \Delta LOG(IBR) + \beta 4 \Delta LOG(TBR) + \beta 5 \Delta LOG(EXR) + \beta 6 \Delta LOG(OIL) + \beta 7 \Delta LOG(SPREAD) + \beta 8 \Delta LOG(YLDCRV) + \beta 9 \Delta LOG(M2) + \varepsilon$$

(1)

$$\Delta LOG(Food\ and\ Bev.) = \beta 0 + \beta 1 \Delta LOG(ASI) + \beta 2 \Delta LOG(INFLATION) + \beta 3 \Delta LOG(IBR) + \beta 4 \Delta LOG(TBR) + \beta 5 \Delta LOG(EXR) + \beta 6 \Delta LOG(OIL) + \beta 7 \Delta LOG(SPREAD) + \beta 8 \Delta LOG(YLDCRV) + \beta 9 \Delta LOG(M2) + \varepsilon$$

(2)

$$\Delta LOG(Insurance) = \beta 0 + \beta 1 \Delta LOG(ASI) + \beta 2 \Delta LOG(INFLATION) + \beta 3 \Delta LOG(IBR) + \beta 4 \Delta LOG(TBR) + \beta 5 \Delta LOG(EXR) + \beta 6 \Delta LOG(OIL) + \beta 7 \Delta LOG(SPREAD) + \beta 8 \Delta LOG(YLDCRV) + \beta 9 \Delta LOG(M2) + \varepsilon$$

(3)

$$\Delta LOG(Oil\ and\ Gas) = \beta 0 + \beta 1 \Delta LOG(ASI) + \beta 2 \Delta LOG(INFLATION) + \beta 3 \Delta LOG(IBR) + \beta 4 \Delta LOG(TBR) + \beta 5 \Delta LOG(EXR) + \beta 6 \Delta LOG(OIL) + \beta 7 \Delta LOG(SPREAD) + \beta 8 \Delta LOG(YLDCRV) + \beta 9 \Delta LOG(M2) + \varepsilon$$

(4)

In addition, we estimate the following equation for the NSE30:

$$\Delta LOG(NSE30) = \beta 0 + \beta 1 \Delta LOG(ASI) + \beta 2 \Delta LOG(INFLATION) + \beta 3 \Delta LOG(IBR) + \beta 4 \Delta LOG(TBR) + \beta 5 \Delta LOG(EXR) + \beta 6 \Delta LOG(OIL) + \beta 7 \Delta LOG(SPREAD) + \beta 8 \Delta LOG(YLDCRV) + \beta 9 \Delta LOG(M2) + \varepsilon$$

Where β_0 is the constant, $\beta_1 \ldots \beta_5$ are the factor sensitivities and ε is the error term, in each equation. By running regressions with the change in the natural logarithms of the indices and risk factors, we compute the percentage change in the indices for each percentage change in the risk factors, or elasticities. Autoregressive moving average (ARMA) terms were used in the econometric equations to ensure white noise error terms.

The precise levels of significance were determined by using probability values, instead of using t-statistics to see if the computed elasticities were significant at the traditional 1.0 per cent, 5.0 per cent or 10.0 per cent levels.

IV. Empirical Results

IV.1 Graphical Plots and Descriptive Statistics

Figures 1 and 2 showed graphical representations of the indices, the index returns,and the macroeconomic variables. Table 1 shows the descriptive statistics for all the variables used in the analysis. With the exception of the all share index, insurance, oil and gas series, and the slope of the yield curve, one cannot reject the hypothesis of normal distribution for the variables, judging by the Jarque-Bera statistic. The yield curve series has the smallest mean of 3.35 while M_2 has the largest mean of 12,039,475.00. However, since the regression model use change in logs specification (i.e., percentage changes), all the variables are on the same scale.

Figure 1: Indices and Index Returns

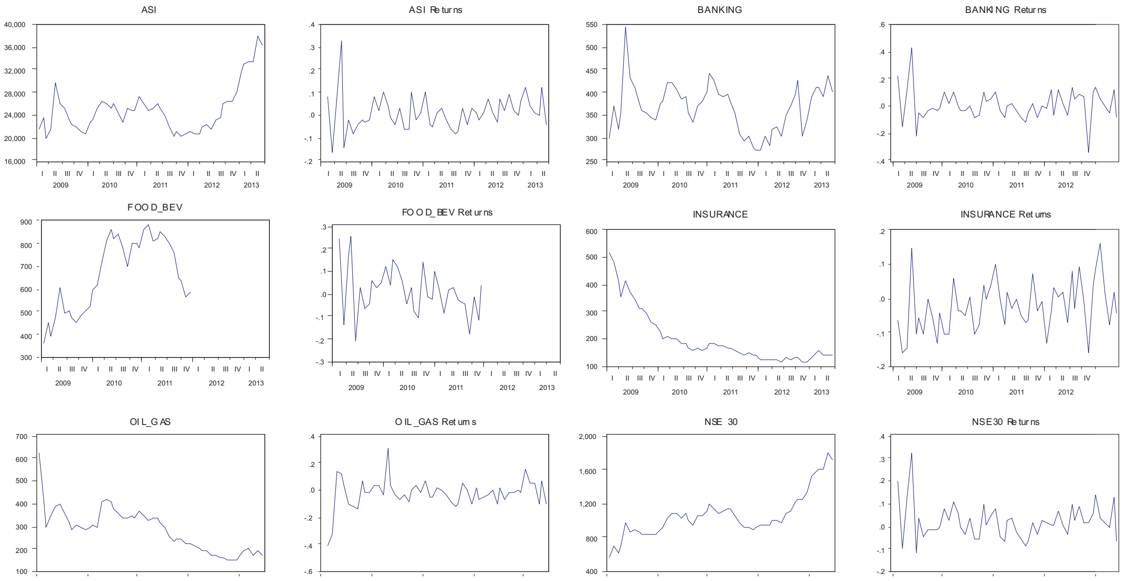

Figure 2: Macroeconomic Variables

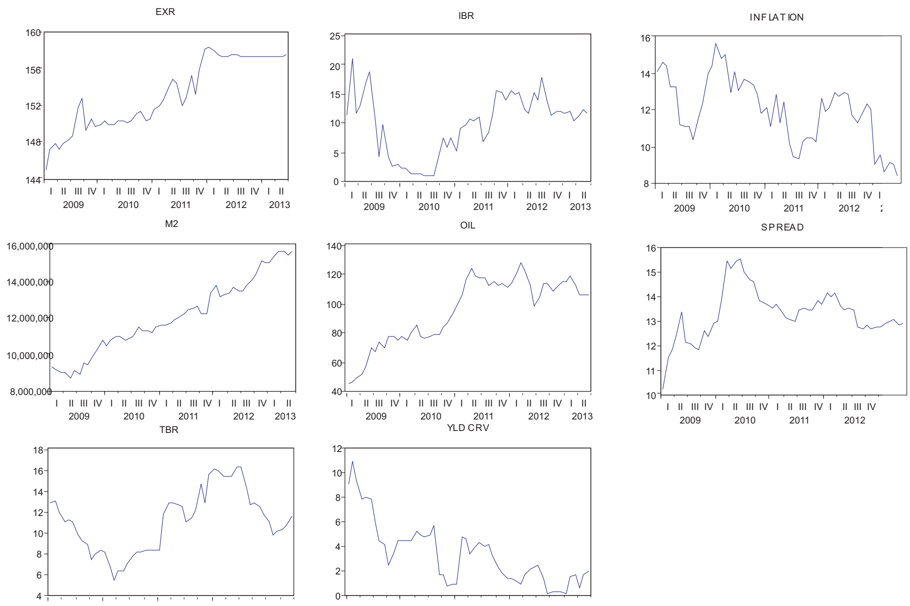

Table 1
Descriptive Statistics

Sample: 2009M01 2013M06

	ASI	BANKING	FOOD_BEV	INSURANCE	OIL_GAS	EXR	IBR	INFLATION	M2	OIL	SPREAD	TBR	YLDCRV
Mean	24868.64	366.81	663.62	201.22	283.58	153.14	9.73	11.98	12039475.00	94.96	13.28	11.13	3.35
Median	24443.04	372.875	672.185	165.37	296.70	152.59	11.155	12.10	11776290.00	105.09	13.38405	11.2275	2.815
Maximum	37794.75	542.45	881.34	515.38	624.91	158.38	21.07	15.65	15622667.00	128.00	15.5581	16.34	10.994
Minimum	19803.60	270.99	355.94	114.07	152.92	144.85	1.10	8.40	8720581.00	45.64	10.1978	5.53	0.07
Std. Dev.	4105.70	52.84	160.10	97.37	93.93	3.78	5.20	1.79	2021246.00	22.83	1.02	2.94	2.58
Skewness	1.35	0.32	-0.26	1.65	0.75	-0.11	-0.21	-0.16	0.17	-0.54	0.00	0.09	0.96
Kurtosis	4.54	3.73	1.64	4.90	4.35	1.71	2.22	2.30	2.07	2.14	3.87	2.08	3.51
Jarque-Bera	21.71	2.11	3.20	32.57	9.09	3.84	1.79	1.34	2.22	4.27	1.71	1.96	8.92
Probability	0.00	0.35	0.20	0.00	0.01	0.15	0.41	0.51	0.33	0.12	0.43	0.38	0.01
Sum	1.34E+06	1.98E+04	2.39E+04	1.09E+04	1.53E+04	8.27E+03	5.25E+02	6.47E+02	6.50E+08	5.13E+03	7.17E+02	6.01E+02	1.81E+02
Sum Sq. Dev.	8.93E+08	1.48E+05	8.97E+05	5.02E+05	4.68E+05	7.58E+02	1.43E+03	1.70E+02	2.17E+14	2.76E+04	5.55E+01	4.57E+02	3.53E+02
Observations	54	54	36	54	54	54	54	54	54	54	54	54	54

Table 2

Correlation Coefficients

Covariance Analysis: Ordinary
Sample (adjusted): 2009M01 2011M12
Included observations: 36 after adjustments

Correlation Probability	ASI	BANKING	FOOD_BEV	INSURANCE	OIL_GAS	EXR	IBR	INFLATION	M2	OIL	SPREAD	TBR	YLDCRV
ASI	1.000000												

BANKING	0.912611	1.000000											
	0.0000	-----											
FOOD_BEV	0.592886	0.337297	1.000000										
	0.0001	0.0442	-----										
INSURANCE	-0.047635	0.159676	-0.760308	1.000000									
	0.7826	0.3523	0.0000	-----									
OIL_GAS	0.418193	0.338471	-0.049909	0.556080	1.000000								
	0.0111	0.0435	0.7725	0.0004	-----								
EXR	-0.161101	-0.333818	0.399987	-0.745948	-0.684865	1.000000							
	0.3479	0.0466	0.0156	0.0000	0.0000	-----							
IBR	-0.118913	-0.082764	-0.382641	0.405253	-0.011524	0.071008	1.000000						
	0.4897	0.6313	0.0213	0.0142	0.9468	0.6807	-----						
INFLATION	0.148989	0.251928	-0.076815	0.297929	0.451766	-0.614754	-0.364189	1.000000					
	0.3858	0.1383	0.6561	0.0776	0.0057	0.0001	0.0290	-----					
M2	-0.091564	-0.354145	0.657699	-0.886758	-0.486997	0.818390	-0.143381	-0.414471	1.000000				
	0.5953	0.0341	0.0000	0.0000	0.0026	0.0000	0.4041	0.0120	-----				
OIL	0.022801	-0.180387	0.621876	-0.813321	-0.531931	0.863627	0.020762	-0.613388	0.897406	1.000000			
	0.8950	0.2924	0.0001	0.0000	0.0008	0.0000	0.9043	0.0001	0.0000	-----			
SPREAD	0.368188	0.201542	0.748473	-0.713319	-0.183989	0.285313	-0.546425	0.185769	0.511384	0.335379	1.000000		
	0.0271	0.2385	0.0000	0.0000	0.2827	0.0917	0.0006	0.2780	0.0014	0.0455	-----		
TBR	-0.287711	-0.357889	-0.199862	0.118903	-0.138621	0.367620	0.825397	-0.494935	0.227390	0.344806	-0.467182	1.000000	
	0.0888	0.0321	0.2425	0.4898	0.4201	0.0274	0.0000	0.0021	0.1823	0.0395	0.0041	-----	
YLDCRV	0.054167	0.186351	-0.474810	0.811516	0.528251	-0.661467	0.355608	0.376811	-0.684953	-0.652748	-0.432471	0.180836	1.000000
	0.7537	0.2765	0.0034	0.0000	0.0009	0.0000	0.0333	0.0235	0.0000	0.0000	0.0084	0.2912	-----

The correlation coefficients are shown in Table 2. Among the indices, the highest correlation coefficient in Table 2 is between the ASI and Banking, at 0.9126. This may be partly explained by the dominance of the banking industry in the Nigerian stock market, accounting for 32 per cent of market capitalisation. In addition, the Banking index is negatively correlated with the exchange rate, M_2 and the Treasury bond rate. The Food and Beverage index is positively correlated with the exchange rate, M_2, oil prices and interest rate spread but negatively correlated with the yield curve. The insurance index is positively correlated with the interbank rate and yield curve, but negatively correlated with the exchange rate, M_2, oil prices, and interest rate spread. Finally, the oil and gas index is positively correlated with inflation and the yield curve, but negatively correlated with the exchange rate, M_2, and oil prices.

Among the risk factors, there are some high values such as 0.8636 for the correlation between the nominal exchange rate and oil prices, 0.8974 for the correlation between M_2 and oil prices, and 0.8254 for the correlation between IBR and TBR. Since Nigeria obtains more than 90 per cent of its export earnings from crude oil sales, one can understand the high correlation between the nominal exchange rate and crude oil price, and between crude oil price and M_2. Since interest rates mostly move in tandem, the high correlation between interbank and ten-year Treasury bond rates is not surprising.

Consistent with the nature of macroeconomic variables, Table 3 showed that most of the variables areI(1) with the exception of the oil and gas index in the Augmented Dickey-Fuller unit root test, which is I(0). However, with the Phillips-Peron test, the insurance and oil and gas indices are I(0) while the rest of the variables are I(1). This suggests that, on the whole, our taking the log differences of the variables is appropriate. Any residual autocorrelation is accounted for by using ARMA terms in the equations. Plots of correlograms and squared residuals suggest that the error terms in the equations are white noise. We utilise White heteroscedasticity-consistent estimation in the regressions.

Table 3
Unit Root Tests

ADF Tests

Null Hypothesis: Variable has a unit root

	Levels		**First Differences**		
Variable:	McKinnon Prob-values with Trend	McKinnon Prob-values without Trend	McKinnon Prob-values with Trend	McKinnon Prob-values without Trend	**Test Result**
ASI	0.8899	0.8330	0.0000	0.0000	I(1)
BANKING	0.0492	0.0142	0.0000	0.0000	I(1)
EXR	0.0718	0.3020	0.0000	0.0000	I(1)
FOOD_BEV	0.9420	0.2890	0.0000	0.0000	I(1)
IBR	0.2956	0.1694	0.0000	0.0000	I(1)
INFLATION	0.3195	0.2020	0.0000	0.0000	I(1)
INSURANCE	0.0461	0.0001	0.0000	0.0000	I(1)
M2	0.0394	0.9605	0.0000	0.0000	I(1)
OIL	0.6532	0.1869	0.0000	0.0000	I(1)
OIL_GAS	0.0007	0.0031	0.0000	0.0000	I(0)
SPREAD	0.1311	0.1316	0.0000	0.0000	I(1)
TBR	0.6629	0.5965	0.0000	0.0000	I(1)
YLDCRV	0.2330	0.1477	0.0000	0.0000	I(1)

Phillips-Perron Tests

Null Hypothesis: Variable has a unit root

	Levels		**First Differences**		
Variable:	McKinnon Prob-values with Trend	McKinnon Prob-values without Trend	McKinnon Prob-values with Trend	McKinnon Prob-values without Trend	**Test Result**
ASI	0.9103	0.8632	0.0000	0.0000	I(1)
BANKING	0.0431	0.0121	0.0000	0.0000	I(1)
EXR	0.0613	0.3020	0.0000	0.0000	I(1)
FOOD_BEV	0.9316	0.2750	0.0000	0.0000	I(1)
IBR	0.3743	0.1694	0.0000	0.0000	I(1)
INFLATION	0.3814	0.3626	0.0000	0.0000	I(1)
INSURANCE	0.0023	0.0000	0.0000	0.0000	I(0)
M2	0.0400	0.9982	0.0000	0.0000	I(1)
OIL	0.8432	0.1904	0.0000	0.0000	I(1)
OIL_GAS	0.0006	0.0053	0.0000	0.0000	I(0)
SPREAD	0.1202	0.0191	0.0000	0.0000	I(1)
TBR	0.6088	0.5381	0.0000	0.0000	I(1)
YLDCRV	0.2158	0.1477	0.0000	0.0000	I(1)

IV.2 Regression Results

The regression results are shown in Table 4. The constant in the Banking sector's model was not significantly different from zero, as in the Food and Oil and Gas sectors' models and unlike in the Insurance sector and NSE 30 models, where they were significant at 5.0 per cent level. The Banking sector's beta was estimated at 1.0528 and was significant at the 1.0 per cent level. The Banking sector was found to be sensitive to oil prices, with a positive sign, but sensitive to the yield curve and M_2 with negative signs and all at 5.0 per cent level.We utilised ARMA (2,3) terms in the Banking sector model to obtain white noise error terms. The model seemed to explain the variation in the banking sector quite well, with anadjusted $R^2$of 0.7813.

The Food and Beverage sector's beta was estimated at 1.0577 and was significant at 1.0 per cent level. In addition, the Food and Beverage sector was found to be sensitive to inflation, the exchange rate and oil prices with elasticities of -0.1763, -2.7341 and -0.2558, respectively; the elasticities to inflation and exchange rates were significant at 1.0 per cent level, while the elasticity to oil prices was significant at 10.0 per cent level. The Food and Beverage sector was found to respond positively to a steepening of the yield curve and increases in M_2, with elasticities of 0.0252 and 0.4713, significant at the 5.0 per cent and one per cent levels, respectively. ARMA (1, 2) terms were used in the Food and Beverage sector model to obtain white noise error terms. The model had the second highest adjusted R^2 of 0.8823 among the estimated models.

Table 4
Estimated Sensitivities to Macroeconomic Risk Factors

	Banking		Food and Beverage		Insurance		Oil and Gas		NSE 30	
Variable	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
C	0.0013	0.8255	0.0148	0.1892	-0.0263	0.0232 **	-0.0100	0.4635	0.0042	0.0109 **
DLOG(ASI)	1.0528	0.0000 ***	1.0577	0.0000 ***	0.6745	0.0000 ***	0.6210	0.0000 ***	0.9398	0.0000 ***
DLOG(INFLATION)	0.1398	0.2141	-0.1763	0.0001 ***	-0.3233	0.0000 ***	-0.0605	0.5798	-0.0232	0.2321
DLOG(IBR)	-0.0239	0.2013	-0.0322	0.1339	-0.0190	0.2512	-0.0188	0.4765	-0.0013	0.8044
DLOG(TBR)	0.0752	0.2114	0.0751	0.2827	0.0397	0.5771	0.0644	0.6127	-0.0277	0.0432 **
DLOG(EXR)	0.2559	0.7078	-2.7341	0.0002 ***	0.0652	0.9398	-1.3610	0.3036	0.0947	0.6578
DLOG(OIL)	0.2059	0.0297 **	-0.2558	0.0631 *	-0.0145	0.8933	0.1101	0.3766	-0.0155	0.6332
DLOG(SPREAD)	0.0812	0.7888	-0.0074	0.9641	0.5947	0.0573 *	-0.1825	0.5767	-0.0364	0.5682
DLOG(YLDCRV)	-0.0200	0.0293 **	0.0252	0.0304 **	0.0213	0.0003 ***	0.0174	0.0259 **	-0.0010	0.4347
DLOG(M2)	-1.0451	0.0185 **	0.4713	0.0072 ***	-0.1571	0.5170	-0.7823	0.1537	-0.0175	0.8402
AR(1)	-0.0506	0.6833	0.3981	0.0480	-0.4232	0.0839	-0.7041	0.0000	0.8348	0.0000
AR(2)	-0.3483	0.0891	-	-	-	-	0.1977	0.0405	-	-
MA(1)	-0.4797	0.0000	0.5118	0.0224	0.7669	0.0008	0.7417	0.0000	-0.9700	0.0000
MA(2)	0.4799	0.0000	-0.4881	0.0196	0.6637	0.0000	-	-	-	-
MA(3)	-0.9449	0.0000	-	-	0.3852	0.1267	-	-	-	-
MA(4)	-	-			-0.4681	0.0008	-	-	-	-
Adjusted R-squared	0.7813	-	0.8823	-	0.5977	-	0.4003	-	0.9716	-
F-statistic	13.7597	0.0000	21.6234	0.0000	6.4116	0.0000	3.7808	0.0008	159.8812	0.0000
Akaike info criterion	-2.8706	-	-3.5975	-	-3.0104	-	-2.4829	-	-5.7550	-
Schwarz criterion	-2.3024	-	-3.0139	-	-2.4475	-	-1.9905	-	-5.3047	-
Durbin-Watson statistic	1.9698	-	1.7122	-	1.9415	-	1.9139	-	2.1457	-

*** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

Models were estimated with White heteroskedasticity-consistent standard errors and covariance.

The Insurance sector's beta, at 0.6745, was significantly less than those of the Banking and Food and Beverage sectors and the NSE 30. However, like the other betas, it was significant at 1.0 per cent level. The Insurance sector was sensitive to inflation, with an elasticity of -0.3233; this was significant at 1.0 per cent level. However, the Insurance sector responded positively to increases in the spread between deposit and lending rates and the slope of the yield curve, with elasticities of 0.5947 and 0.0213, respectively; the elasticity to spread was significant at 10.0 per cent level while the elasticity to the yield curve was significant at 1.0 per cent level. ARMA (1,4) terms were used in the Insurance sector model to ensure white noise error terms. In terms of goodness of fit, the adjusted R^2 of 0.5977 indicates that the Insurance model did not perform as well as the Banking, Food and Beverage and NSE 30 equations.

The Oil and Gas sector's beta was estimated at 0.6210 (significant at 1.0 per cent level), the lowest beta among the estimated models. Moreover, this index is only sensitive to the yield curve, among the macroeconomic risk factors, with an estimated elasticity of 0.0174, which was significant at 5.0 per cent level. Again, ARMA (2,1) terms were used in the Oil and Gas sector model to ensure white noise error terms. The adjusted R^2 of 0.4003 was the lowest among the models.

The NSE 30 beta was estimated at 0.9398 and was significant at the one per cent level. Since this index is made of the thirty largest firms in terms of market capitalization on the Nigerian Stock Exchange, it is not surprising that the beta is close to one. Besides the market index, the NSE 30 was found to be sensitive to the Treasury bond yield, with an elasticity of -0.0277 (significant at 1.0 per cent level). ARMA (1,1) terms were used in the NSE 30 model to ensure white noise error terms. Incidentally, the adjusted R^2 of 0.9716 was the highest among the models estimated.

V. Conclusions and Policy Implications

This study investigated the sensitivity of index returns to selected macroeconomic risk factors, i.e., inflation, the interbank rate, Treasury bond yields, the exchange rates, oil prices, the spread between consolidated deposit and lending rates, the slope of the yield curve,broad money supply or M_2, the spread between deposit and lending rates of banks, the spread between ten year and 3-month Treasury securities, and M_2. Rather than examine sensitivities to macroeconomic variables of the entire stock market, we investigated sensitivities by sector/industry, with the full expectation that these sensitivities should differ by industry. Thus, the paper highlighted the differing reactions of sectors to changes in macroeconomic variables.

Judging by the estimated betas, as shown by the coefficients of DLOG(ASI) in the sector equations, the Food and Beverage sector is the most risky, closely followed by the Banking sector. On the other hand, the estimated betas for the NSE 30 group and the Insurance and Oil and Gas sectors suggest less than average exposures to systematic risk since they are below 1.0.

The Banking sector elasticity of 0.2059 to oil prices could be explained by the concentration of lending to the oil and gas industry. More than 25.0 per cent of loans are routinely issued to this industry. Contrary to expectation, the elasticity to the interest rate spread was not significant. The elasticity to the slope of the yield curve is negative and significant, which may be due to the duration of banks' asset holdings. The greatest sensitivity of the Banking sector was to M_2, estimated at -1.0451. The estimated elasticities suggest that banks' exposure to the oil and gas industry should be closely monitored. A fall in oil prices could lead to an increase in non-performing loans in this sector. Stress tests should be used to gauge the effectiveness of banks' risk management efforts. Banks should also be encouraged to hedge their exposure to the yield curve, even though complete hedging of risk in this area would also eliminate the possibility of profiting from yield curve dynamics.

The Food and Beverage sector elasticities to exchange rates and inflation are strongly negative; in fact, the estimated elasticity to exchange rates of -2.7341 is the greatest number we have among the models, suggesting that a 1.0 per cent depreciation of the exchange rate would lead to a 2.7 per cent reduction in returns in this sector. Given that most of the inputs to these sectors' output are imported, deterioration in the exchange rate would affect profits and stock returns negatively. The same reasoning applies to inflation. However, inflation applies to this sector's input as well as its output and a negative elasticity to inflation implies that the prices of output rise less than those of input, thereby constraining profits. This suggests a measure of competition in this sector and a relative lack of market power. Given the ease with which food and beverage products can be substituted for one another, this would seem to be borne out by reality in Nigeria. The Food and Beverage sector is really a proxy for Nigerian manufacturing and the sensitivity to exchange rates suggests that the manufacturing sector will be negatively impacted by the recent devaluation of the naira. This may be compounded by the sensitivity to inflation as the naira devaluation is likely to increase observed rates of inflation. Thus, the food and beverage (and wider manufacturing) sector may be a candidate for targeted interventions in terms of subsidised credit facilities.

The Insurance sector also has a negative elasticity to inflation. The negative elasticity may be due to the composition of balance sheets in this sector. The lack of sensitivity to short - term or long-term interest rates suggests immunisation against interest rates risk, as in the Banking sector. However, this sector has positive elasticities to spread and the slope of the yield curve. The substantial negative elasticity to inflation would suggest investing in real assets or alternative assets (including farmland, timber, real estate, and some equity securities), which are likely to keep up with inflation.

The lack of sensitivity to most macroeconomic risk factors in the Oil and Gas sector and the relatively low goodness of fit indicate that we could do a better job at identifying the factors driving this sector through further research. This sector may be more sensitive to political risk than the other sectors, especially as it is more heavily regulated (with administratively determined prices and subsidies) than other sectors. However, the Oil and Gas sector was sensitive to the slope of the yield curve. This suggests a better hedging strategy for firms in this sector.

As with the Oil and Gas sector, the NSE 30 was largely insensitive to the macroeconomics risk factors with the exception of the Treasury bond yield, to which it had a negative elasticity. The negative elasticity to the Treasury bond yield may be due to the fact that these firms, due to their size and other characteristics, are more likely to issue bonds in the Nigerian capital market. The risk they bear could of course, be hedged, and so would the profits.

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