A study of crude oil prices, exchange rate, interest rate and stock market volatility in Nigeria

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Abstract

This paper consideredtheproblem ofdeterminingtheimpact ofpriceofcrudeoil,exchangerate andinterest rate volatilityontheNigerian Stockexchangemarket.Themultifactormodelisusedtoevaluate theeffect ofthe selectedmacroeconomicvariables and thestock market volatilityusingdata fromJanuary2005to December2013. Thetest forstationaritywasperformed usingAugmentDickeyFuller(ADF) unitroottest andordinary leastsquarewasemployedtodeterminetheparametersofthemodel. Theresultofthisstudyrevealedthatthevolatilityoftheselectedmacroeconomic variables greatly affectstheNigerianstockmarket

Keywords: Macroeconomic Variables, Volatility,StockReturns,Liquidity, hedgeratio, factor betas, Nigerian StockExchange.

1. Introduction

Lack ofageneral agreementasto therelationship between price ofcrude oil,exchange rate, interest rateandstockmarket volatilityhascreated alotof conflictingbutinterestingfindingsbasedontheexisting literatures.Either stockmarket is affectedbymarket newsormarket newsis affectedbythestockmarket volatilitywhichinturn influencethedecisionofinvestors, financialandeconomicanalyst.Thishasresulted inconcurrentstudiesby different researchers'in theworldincludingNigeria. SinceNigeria isan importbasedcountry,almost alloftheimporters requireloanfacilitiestofinancetheir businessesandthisgreatly impact onreturnsoninvestmentasaresult ofthehighinterestrate. Besides,thetradingcommunityneeds foreignexchangeratetofacilitate tradeandexchangeratevolatilityaffectsthevolumeoftrade andliquidity ofthefirms. Nonetheless, crudeoilbeenthemainsourceofexport andrevenuegeneration fortheNigerian economy,fluctuationsincrudeoilpriceswillimpact greatlyonthegrowth ofthenation interms ofbudget andplanning.

Chen*etal*[1],studied economicforcesandthestockmarket usingArbitragepricingtheory (APT)frame- work. They foundasignificantrelationshipbetween theindustrialproduction,inflation rate, interestrate,bondyieldandtheUSstockexchange.

The effectofeconomic variables onthe USeconomy using S&P500 inorder to determinehowthe performance ofthe economy influencesthe success ofthe stock market and viceversa was examined by [2]. Hestudied howinterestrates, realGDP and the Fisher effectimpact the S&P 500and various industries including utilities, transport,financial,andtechnology index. Theresult

ofhisstudies showedthatthereal GDP isthe greatesteconomicdeterminantofstockmarket prices. Healsodiscovered thatunemployment ratesignificantly influencetheperformance oftheoverallstockmarket butdoesnotindicate whichindustry toinvest inandmoresoinflation andinterestrate affectsstockmarket significantly.

Thelongtermequilibrium relationshipbetweenselectedmacroeconomicvariablesand Singaporestock market aswellasthe hotel index was examined usingco-integrationanalysis [3]. They concluded thatSingapore's stock market and propertyindex formed co-integrationrelationshipwith changes inthe short and long-term interestrates, industrialproductionpricelevel,exchangerate andmoneysupply. The financeindexandHotelindexforminsignificantrelationshipwithmoneysupplyandlongterminterestrate.

Jechche[4] examined thearbitragepricetheory within avectorautoregressive(VAR) frameworktheory forthe caseofZimbabwe stockmarket and three macroeconomic variables; (CPI) inflation, exchange rate, andGrossdomesticproductusingGrangercausality testwithimpulseresponseandvariancedecomposition. Granger causality showthatthere isunidirectionalcausality fromconsumer priceindextostockprice,but nocausality between GDP, exchangerate andstockprice. Variance decomposition indicated thatGDP explainsdeviations inthestockpriceswhileimpulseresponsefunction revealasignificantrelationship between exchangerate andstockmarket priceofZimbabwe.

Humpe et al[5] examined the influenceofmacroeconomicvariablesonthe stock pricesinthe USand Japanusingstandarddiscounted valuemodel,they usedcointegrationanalysis tomodelthe longterm re- lationshipbetween industrialproduction,consumer priceindex,moneysupply, longterm interestrate and stock pricesinthe USand Japan. The stock pricespositively related toindustrialproductionindex and negatively related toboth theconsumerpriceindexandlongterminterestrate basedontheUSstockmarketdata. Whereas, theJapanesedata indicated that stockpricesareinfluencedpositively bytheindustrial productionindex and negatively bythe money supply and alsothe industrialproductionwasnegatively influencedbytheconsumer priceindexandlongterminterestrate.

Gay [6]studied theeffectofmacroeconomic variables onthe stock market returns for four emerging economies; Brazil, Russia, Indiaand China. Heinvestigatedthe time series relationshipbetween stock market indexpricesandthemacroeconomic variables ofoilpricesandexchangerate forthefourcountries using the Box-Jenkins ARIMA model. Heused the moving-averages at the one-month moving-averages (MA(1)), three-monthmoving-averages (MA(3)), six-month moving-averages (MA(6)), and twelve-month moving-averages (MA(12)) forthe lagged dependentofstock market price and the twointerveningvariablesofexchangerate andoilprice. Hehypothesizes apositive relation between theexchangerate andthe stockmarket andhypothesizes anegative relationshipbetween crude oilandthe stockprices. Heusedthe Dickey-Fuller test to confirm nonstationaritydata and transformedthe data to bestationaryusing first-order differencing. Hisstudies revealed thatthere exist arelationshipbetween the macroeconomic factors ofexchange rate and oilprice onthe stock market ofBrazil, Russia, and China. macroeconomic factors ofexchange rate and oilpriceonthe stock market exchange priceofBrazil, Russia, India, and China did not revealasignificantrelationship.Hehowever,statedthatthere wasnosignificantrelationshipbetween theselectedmacroeconomic variables andtheselectedcountries stockmarketdata basedontheparameter valuesfortheindependentvariables andtheircorresponding p-valuesandtheR^2 parameter

foreachmodel.

Rashid [7]studied macroeconomicsvariable and stock market performance with aviewoftesting fordynamic linkages with a known structuralbreak. Heinvestigatedthe dynamicsinteractionbetween four microeconomic variables(consumer priceindex, Industrialproduction,exchange rate and the market rate ofinterest)and stock prices inPakistan,usingco-integrationand Granger causality test thatare robust tostructuralbreaks. Thestudy revealed thatthereexistlongrunbidirectionalcausationbetween thefour macroeconomic variablesandthePakistanstockprices.

Pilinkus*et al*[8]studied theshort-runofrelationshipbetween stockmarket priceandmacroeconomic variables inLithuaniausingimpulse response function. Their result clearly indicated thatthe macroeconomic variables significantly affectsthestockmarketprice inLithuania. The macroeconomic variables used in the study wereas follows: seasonally adjustedgrossdomesticproduct(GDP) at previous year prices; harmonized consumer priceindex(HCPI)as compared to2005,the narrow moneysupply(M1), i.e.currency incirculation andovernightdeposits inLitasandforeigncurrencies;unemploymentrate(UR) reflecting tendencies inthe labour market; three monthsVilnius interbankofferedrate (VILIBOR3M) whichisbased onthe quotes ofnot lessthan five(5)localcommercial banks, designated bythe Bank of Lithuania,whicharemost active inLithuanianmoneymarket; and the exchange rate ofLitasagainst the USdollar.

Rahman*et al*[9]examined the interaction betweenstock market pricesand exchangeratein three emergingcountries ofsouth AsianamelyBangladesh, IndianandPakistanusingJohansenprocedure totest forco-integrationrelationshipandrevealedthatthereisnoco-integrationnorcausality relationshipbetween stockpricesandexchangerate inthecountries.

Another study bySingh [10]explored the relationship betweenstockmarket index and three Macroeconomic variables ofIndian economy using correlation,unit root stationarytest and Granger Causality test. He usedmonthly datafromApril, 1995toMarch, 2009forallthevariables,thatis,BSESensex,whole-salepriceindex(WPI),indexofindustrialproduction (IIP)andexchangerate (Rs/USD).Hisresults showedthatthestockmarket index,theindustrialproductionindex,exchangerate, andwholesalepriceindexcontained aunit rootandwereintegratedoforder one. The Granger causality test indicated thatIIP isthe onlyvariable having bilateral causal relationshipwith BSESensex,WPI ishaving strong correlationwith Sensexbut itishaving unilateralcausality withBSESensex. Hediscovered thatIndian stockmarket wasaffectedbyexchangerate andinflation.

Agrawal *et al*[11]studied therelationshipbetween Niftyreturnsand USDollar exchangerate. They applied unit root test and Granger causality toverifythe stationarityofexchange rate and Nifty returns andtherelationshipthatexistwithboth. Theyhighlighted Niftyreturnsandexchangeratewerestationary atthelevelformandunidirectionalrelationshipexistbetween them.

Abraham[12]studied the relationshipbetween the stock market and selected macroeconomicvariablesinNigeriaemploying ADF stationaritytest andtheerrorcorrectionmodel. He found thatexchange rate, inflation rate, andtheminimumre-discountingrate (MRR) affectedthe stockmarket. Heconcluded thatbyachieving stable exchange and alteringtheMRR monetarypolicy wouldbeeffectiveinimproving theperformance oftheNigeriastockmarket.

Benakovic*etal*[13]analyze stockmarket returnsoffourteen (14)stockslisted onthe CroatianCapital market from2004to2009usinginflation rate,

IndustrialProductionindex,interestrate, market indexand oilpricesasfactors. They discoveredthatthe marketindexhas the largeststatisticalsignificanceforall stocksandapositiverelationshiptoreturns.Interestrate, oilpricesandindexof industrialproductionalso showedapositive relationshiptothereturnswhileinflation affectedthereturnsnegatively.

Kuwornu*etal*[14]examined therelationshipbetween macroeconomic variablesandthestockexchange returns inGhana usingthefullinformationmaximum likelihoodestimationprocedure. Theyusedconsumer priceindex,crudeoilprice,exchangerate and91dayTreasurybillrate. Their resultrevealedthatthereisa significantrelationshipbetween stockmarket returnsand three ofthe macroeconomic variables; consumer priceindex, exchange rate, Treasurybillrate, whilethe priceofcrude oilhavenosignificanteffectonthe stockmarket

Alvan[15] examines the causal relationshipsamong stockmarket pricesrealGDP and the Index ofIndustrial productioninNigeriausingquarterlydata fromthe firstquarterof1984tothe fourth quarterof
2008.Granger causalitytestindicateabidirectionalcausality betweenstockpricesandGDP.

Oseni*etal*[16]employed AR(K)-EGARCH(p,q) technique to examine the volatilityin stock market andmacroeconomic variablesandusedLA-VARGranger causality testtoanalyzetherelationshipbetween stockmarketvolatilityandmacroeconomic variables volatilityinNigeriafortheperiod1986to2010using time seriesdata. They discovered thatabi-causal relationshipexistsbetween realGDP whileinterestrate andinflation ratehadnocausalrelationship.

Afzal*et al*[17]investigatedthe casual relationshipbetween four macroeconomic variables (M1,M2, Inflation rateandexchange rate) andDhakastockexchange(DSE)pricesusingcointegrationandGranger causality test. Theydiscovered thatcointegrationexists betweenstockpricesandthemacroeconomicvariables andviceversa. They didnot supportthe hypothesisofinformationefficiencyinthe caseofthe DSEmarketofBangladesh.

Herve*etal*[18]examined thecausalrelationshipbetween stockmarket andmacroeconomic variablesinCoteD'IvoireusingError correction modelsandGranger causalitytest. TheyinvestigatedtheCoteD'Ivoire stock market and the followingselected macroeconomic variables; Industrialproductionindex, consumer priceindex,domestic interestrate, realexchangerate andrealmoneysupplyusingJohannsen'smultivariate co-integrationtest techniques. The study revealedthatthere isco-integrationbetween macroeconomicvariables andstockpricesinCote D'Ivoire. The result ofthe impulse responsefunction and forecast error variance decomposition indicated thatonlythe consumer priceindexand the domestic interestrate out of the five(5) macroeconomic variables have asignificantrelationshipwith the stock market. The Grangercausality testbased onthe vector autoregressive(VAR) analyticalframework wasemployed and itempiricallyrevealedthatthereisastrongbi-directionalrelationshipbetweenthestockpriceanddomesticinterest rate.

Ali [19]investigatedthe impact ofchanges in selected microeconomic and macroeconomic variables namely; market dividend yield, market price earnings multiples, monthly average market capitalization andaveragetradingvolumeonthereturnsonDhaka stockexchangemarket usingamultivariateregression modelevaluatedonastandardOLSformula toestimate therelationshipanddiscovered thatbasedonthe regression coefficient,inflation and foreignremittancehave negative influencewhileindustrialproduction index,market P/Esand

monthly percentaverage growth inmarket capitalizationhavepositive influence withthestockmarket returns. The study revealedthatusingthemethods ofroottest, cointegrationtestand long-run granger causalitytest proposed microeconomic variables havealong-run equilibrium relationship amongthemselves andwiththestockprice.

Izedonmietal[20],examined theperformance ofArbitragePricing theory (APT)ontheNigerian stock market usingthree(3)macroeconomic variables(inflation, exchange rate and market capitalization).They investigated60stocksusingordinary leastsquare(OLS)andobservedtherearenosignificanteffectsofthose variables ontheNigerian stockmarket.

Patel [21]studied the effectofmacroeconomicdeterminants ontheperformance oftheIndian stockmarketusingmonthly data from1991to2011 foreightmacroeconomic variables namely;interestrate, inflation rate, exchange rate, index ofIndustrialproduction,money supply, Gold price, silverprice and oilprice. Heusedtwo stockmarket indices,theSENSEXandNXNiftyusingJohansencointegrationtest, Grangercausality testandvectorerrorcorrection model(VECM). Hisstudiesrevealedthat alongrunrelationship existbetween macroeconomicvariablesandthestockmarket indices.

Sadia [22]examined the impactofmacroeconomic variablesonthe stockreturnsbyapplying theAPTframework. Heused fivemacroeconomic variables (moneysupply, exchange rate, industrial production, short term interestrateand oilprices) andthestockdata fromninesectors(oilandgas,textile, composite, jute, cement, cableandelectronics, automobile,chemicalandpharmaceutical,leasingandglass,andceramics. Hisstudies revealed thatthemacroeconomic variables haveasignificantimpact onthereturnsstating thatthe contributionofthe macroeconomic variables indeterminingthe valueofanasset wasverysmall. Hediscovered thatshort terminterestrate hasasignificantimpact onreturnsofvarious sectors whereasexchangerateandoilpriceshavesignificantimpact onspecificsectorsliketheoilandgas,automobile,cable andelectronics.

Zhu[23]studied the impact ofinflation rate, moneysupply(m2),exchange rate, industrialproduction, bond, exports, imports, foreignreserveand unemploymentrate onthe returnofenergysectorinShanghai stockexchangemarket.Thestudy applied theAugmentedDickeyFuller (ADF) modelinordertest aunit auto regressive root and APT model to investigaterelationshipbetween stock returnofenergy sector in Shanghai stockmarket andthesevenmacroeconomic variables. Thestudy revealed thatexchangerate, exports, foreignreserve,andunemploymentrate haveeffectsinthestockreturnofenergysectorinShanghai stockmarket.

Rasaq [24]analyzethe impact ofexchange rate volatilityonmacroeconomicvariables usingcorrelation matrix ordinary leastsquare and granger causality test. The study reviewedexchange ratevolatilityasa positiveinfluenceonGDP, foreigndirect investmentandtrade opennessbut withnegative influenceonthe inflationaryrate inthecountry.

Chandni*etal*[25]studied the effectsofmacroeconomic variables onstockmarket usingthe Indian perspectiveinordertoinvestigatetherelationshipbetween Indian stockmarketandseven(7)macroeconomic variables namely the Index ofIndustrialProduction(IIP),Consumer Price Index (CPI),Callmoneyrate (CMR), Dollar price(DP),Foreign InstitutionalInvestment(FII), crude oilprices(CO),Gold prices(GP). Theyusedsectoralanalysisoffivesectorsnamelymetal, auto, capital goods,FMCGandconsumerdurables, and employed the Granger causality test, regression analysis and correlationanalysis toexamine the relationship between the stockmarket and the

macroeconomic variables. They discoveredthatexchange rate, foreigninstitutionalinvestmentand callrate wererelatively moresignificantand likelytoinfluenceIndian stock market. Also,FII andSENSEX, callrate and SENSEX had positive relationshipwhereas exchange rate andSENSEXshowedanegative relation. Theyconcluded thatinthelongruntheIndian stockmarket ismoredriven bydomestic macroeconomicfactorsratherthan theglobalfactors.

Talla [26]researched onthe impact ofmacroeconomic variables onthe stockmarket pricesofthe Stock- holm stock exchange using multivariateregression model, unit root test and Granger causality test. He discovered thatinflation and currency depreciationhave asignificantnegative influenceonstock market priceswhileinterestrate negatively influencethestockpricesbut itwasnotsignificant. Healsostatedthat money supply waspositively associated to stock pricesalthoughnot significantand thatnobidirectional Grange causality wasfoundbetweenstockpricesandallthevariables under study exceptttheunidirectional causalrelation fromstockpricetoinflation.

Emenike*et al* [27]examined stock market returnvolatilityand the macroeconomic variables inNigeria usingGARCH-X modelandfive(5)macroeconomic variables namelybroad moneysupply, consumer price index, credit tothe private sector, USDollar/Nairaexchange rate and the net foreignassets. They used the all share index from January1996to March 2013and discovered thatthe Nigerian stock exchange market returnvolatilityispositively influencedbychangesinexchangerate andcredit toprivate sectorbut negatively influencedbychangesinbroad moneysupply and inflation. Onthe other hand, changesinnet foreignassets had anegative relationshipbutnot significantto influencechanges instock market return volatility.

Ourstudydisagreewiththeopinionsof[4], [9], [16], [17], [18], [20] and [22]. The existing models and approachusedarebased onperfect market asinthe developed countries and they failtoconsiderthe micro-macro volatilityand liquidity.The objectives ofthis paper istodeterminethe relationshipbetween the macroeconomic variables and the stockmarket volatilityusingmultifactormodeland the approachof microfoundationofthemacroeconomic variables.

2.1 Assets and Returns

Asset refers to a resource with economic value that an individual, corporation, state or country owns or controls with the expectation that it will provide future benefit. We shall be investigating equity oriented assets that's the stock market; a type of security that signifies ownership in a corporation and represents a claim on part of the corporation's assets and earnings which may either be a gain or loss of a security in a given period. Most investors are concerned with financial risk. The return on an investment is expressed as a fraction of its revenue and the initial investment. If an investor buy an asset at the end of a holding period t_1 with price P_{t_1} and later sold the asset at P_{t_2} at the end of the holding period t_2 , then the net return over the holding period from t_1 to t_2 is given by;

$$R_t = \frac{P_{t_2} - P_{t_1}}{P_{t_1}} = \%\Delta P_t$$

2.2 Assets Pricing Models

This refers to any of the several models used to determine the expected or appropriate price or return on an asset at a given time and level of risk. Two of the prominent assets pricing models are the capital asset pricing model (CAPM) by Sharpe (1964) and the arbitrage pricing theory (ATP) by Ross (1976).

2.2.1 Capital Assets Pricing Models (CAPM)

The capital assets pricing model (CAPM) was developed by Sharpe (1964), the works by the Black *et al* (1972) and Fama and Macbeth (1973) showed the importance of the model in determining the relationship between risk and return in asset pricing. The principle of CAPM is based on building an efficient market portfolio that maximizes the returns at a given level of risk. The expected return of an individual asset is a function of the covariance of the risk with the stock market; that is the expected return on a stock depends on the risk free rate and the risk free premium which is evaluated by the stocks receptive to the news in the market (beta coefficient).

The CAPM states that in equilibrium, only the systematic (market) risk is priced and not the total risk, thus investors do not require to be compensated for unique risk since the market beta are determined by the expected return of an asset simply by using an economic argument that all investors hold the same tangent portfolio. The CAPM are based on the Capital Market Line (CML) and is only valid for efficient portfolios which combines risk free asset and market portfolio and assume that all risk comes from market portfolio. The question now is, how we handle inefficient portfolios or individual stocks which don't lie on the CML hence the need for a different model. The CAPM is stated as follows;

$$E(r_i) = r_f + \beta_i E(r_m - r_f)$$

Where,

- $E(r_i)$ is the expected return on a asset i,
- r_f is the risk free rate of return,
- $r_m$is the expected market return(portfolio return),
- β_i is the beta coefficient of asset i which is a function of market news and the stock movements; that is, it measures volatility or risk and
- $E(r_m - r_f)$is the clear price of the risk.

2.2.2 Arbitrage Pricing Theory (APT)

In 1976, an economist Stephen Ross developed the Arbitrage Pricing Theory (APT) as an alternative to the CAPM. The APT has the potential to overcome CAPM weakness, it requires less and more realistic assumptions to be generated by a simple arbitrage argument and it's explanatory power is potentially better since it is a multifactor model in which every investor believes that the stochastic properties of returns of capital as- sets are consistent with a factor structure.

Ross (1976) argues that the expected returns of an asset can be expressed as a linear function of the macroeconomic variables or theoretical market indices with the factor specific beta coefficient. That is, if equilibrium prices offer no arbitrage opportunities over static portfolios of the assets, then the expected returns on the assets are approximately linearly related to factor loadings which

are proportional to the returns' covariance with the factors. APT assumes that two otherwise identical assets cannot sell at different prices and that assets returns are linearly related to a set of indexes each representing a factor that influences the return of an asset.

$$E(r_i) = r_i + \sum_{k=1}^{K} \beta_{ik} (f_k - E[f_k]) + \varepsilon_i$$

Where,

- $E[f_k]$ is the expected return of stock i,
- β_{ik} is the sensitivity of stock i to factor k,
- f_k is the return of factor k, with $E[f_k - E[f_k]] = 0$,
- ε_i is the idiosyncratic return stock I and
- $E[\varepsilon_i] = 0$

2.2.3 Macroeconomic Variables Description

Macroeconomic variables are generally referred to as statistical indicators that reflect the economic, situation of a country during a period of time. Economic theories such as classical, Keynesian monetary among others allocate unequal power to various economic variables. Therefore it is difficult to select a set of macroeconomic variables that would be most valuable in establishing the relationship between macroeconomic variables and stock market price. Thus, we shall be selecting the following macroeconomic variables because they are popular and reflect the situation in the country's economy and the financial status of the country ; Foreign Exchange Rate (FER), Interest rate (IR) and price of crude oil (OP).

2.2.3.1 ForeignExchange Rate

Stockpricescanbeinfluencedbyexchangerate fluctuations asthe currency devaluation may lead to inflationary processesin the country sinceit reduces consumer expenditure and profitsearned bylocal companies. Thisstudyemploysforeignexchangerateasendofmonth USdollar toNairaexchangerateandhypothesizedthat alossinvalueofthehomecurrency isnegatively relatedtostockprice. Sincethe economyofNigeria isimport-demand drivenchangesintheexchangerate thereforeaffectsbusinesscashflow andprofitability asthecostofimportingrawmaterials andotherimportswillbe affectedbysuchfluctuations.

2.2.3.2 Interest Rate

The rate of interest is a rate of return promised by a borrower to a lender. This is important because it governs the redistribution of purchasing power across time; many different interest rates in the economy vary by duration and degree of risk and very often move up and down together. Interest rates are determined by the collective borrowing and lending decisions of thousands of participants in the money and capital markets and are also impacted by changing perceptions of risk by participants in the money and capital markets, especially the risk of borrower default, liquidity risk, price risk, reinvestment risk, inflation risk, term or maturity risk, marketability risk, and call risk.

Low interest rate increase the present value of future cash flow, thus increasing the attractiveness of investment. We hypothesize a negative relationship between interest rates and stock prices.

2.2.3..3 PriceofCrudeOil

Crudeoilisanessentialinput forproduction andsothe priceofoilisincludedasaproxyforrealeconomicactivity. Increaseintheprice ofoilinthenationaland/orinternationalmarketaugmentthecostsofproduction forcompaniesandeventually, reducetheirprofitswhichwillcausestockreturns to fall. We hypothesized a negative relationshipbetween oilprice andstockprices.

2.2.3.4 Data Source

We collected monthly stock market data from January 2005 to May 2013 from the Nigerian stock exchange of one hundred fourteen (114) companies listed on the stock exchange market for empirical analysis and the monthly macroeconomic variables were obtained from the Central Bank of Nigeria (CBN) and the Nation Bureau of Statistics (NBS). We transformed the variables using natural logarithm since most statistical methods work best when the data are normally distributed or at least symmetrically distributed and have a constant variance, and the transformed data will often exhibit less skewness and a more constant variable compared to the original variables. This will mitigate correlation between the macroeconomic variables and also help in reducing heteroscedasticity as it compresses the scale in which the variables are being measured. The table (3.1) below shows data description and data source of the selected macroeconomic variables;

Variable	Concept	Description	Units	Source
lnFER	Natural logarithm of FER	IFEM Dollar Foreign ExchangeRate	NGNperUSD	CBN
lnIR	Natural logarithm of IR	Interest Rate	percentage	CBN
lnOP	Natural logarithm of OP	Price of Crude Oil	USDper Barrel	CBN

Table3.1:Data DescriptionandData Source

2.3 Method

According tothe postulateofAPT, the differencebetween the actual orrealized returnand the expected returnforanyassetisequaltothesumofoverallriskfactors oftheriskexposure(thatis,thebeta forthat riskfactor) multiplied bythe realization forthe riskfactor plusanasset specific(idiosyncraticrisk) error term. Wethen have thefollowingmodel;

$$lnR_{it} = \beta_0 + lnOP\beta_{1t} + lnFER\beta_{2t} + lnIR\beta_{3t} + \varepsilon_{it} \quad (1)$$

Where,
ln isthenaturallogarithm,
R_{it} isthereturnofstock (i=1,⋯,114)
IRistheInterestrate,
OP istheCrude OilPrice,
β_0 is theriskfreerate (the interceptoftheregression),
β_{1t} is the estimationoftheloadingofasecurityi,on crude oil price.
β_{2t} is the estimationoftheloadingofasecurityi,on Foreign Exchange Rate.

β_{3t} is the estimation of the loading of a security i, on Interest Rate.
ε_{it} is the error term for i=1,⋯,114 and
t is time.

Also, the stock expected returns vector is orthogonal to the weights vector, therefore, the stocks expected return vector must be a linear combination of the unit beta coefficients vector and unique risk components vector (though, the unique risk components has an expected value of zero). Thus, we state that;

$$E[r_i] = \delta_0 + \delta_1\beta_{1t} + \cdots + \delta_i\beta_{it}$$

where,
$E[r_i]=\hat{\mu}$, is the estimated average return of each stock,
$\delta_0=r_f$ is the risk-less return rate and
$\delta_i=r_i-r_f$ is the factor risk premia or coefficients relating the betas to expected returns.
Equation (1) is a multivariate raw return model in which all the variables are entered into the model as total shocks (that is the shock contains both the expected and unexpected components). We estimate the factor loadings β_{it} for each security i=1,⋯,114 using the individual stocks as well as the average return of each security in the sample, $\hat{\mu}_i$.

We collected monthly stock market data from January 2005 to May 2013 from the Nigerian stock exchange of one hundred and fourteen (114) companies listed on the stock exchange market for empirical analysis and the monthly macroeconomic variables were obtained from the Central Bank of Nigeria (CBN). We transformed the variables using natural logarithms since most statistical methods work best when the data are normally distributed or at least symmetrically distributed and have a constant variance, and the transformed data will often exhibit less skewness and a more constant variable compared to the original variables. This will mitigate correlation between the macroeconomic variables and also help in reducing heteroscedasticity as it compresses the scale in which the variables are being measured. We used R Statistical package to estimate the parameters macroeconomic factor model and to test for the stationarity of the data using Augmented Dickey Fuller test.

3. Results and Discussions

We performed the unit root test on the stock data and the macroeconomic variables using the Augmented Dickey-Fuller (ADF) method and discovered that the series are stationary. This study showed that all the stock are affected by the selected macroeconomic variables also their hedge ratio is not constant or evenly distributed across the stocks of the 114 companies.
In view of the above, we briefly discuss the hedge ratios and the factor loadings of the stocks as it relates to the macroeconomic variables understudy as follows (see Appendix A);

3.1.1. Discussion of the Hedge Ratio (β_0)

The Hedge ratio (β_0) of seven companies was negative meaning as the underlying security increases the value of the option will decrease. The remaining 107 have positive hedge ratio which implies the underlying security return increases with a corresponding increase in the value of the option.

3.1.2. Effects of Price of Crude Oil (β_1)

Fifty five companies have negative beta loadings for crude oil which mean increase in price of crude oil will result in the decrease in return of the affected companies.

3.1.3. EffectsofExchangeRate (β_2)

The factor loadings for exchange rate of 100 companieswerenegative indicatingthatthehighertheexchangerate thestock returnofthecompanieswilldecreasewhereascompanies with positive factor loadings for exchange rate will enjoy anincrease in their stock returns.

3.1.4. EffectsofInterestRate (β_3)

Sixty three (63) companies have anegative factor beta for interest rate which means increase ininterestrate willreduce the stock returnofthe aforementionedcompanies whilethosewithpositive beta loadingswillenjoyincreasing stockreturn.

4. Conclusion

Weconcluded thattheimpact ofmacroeconomic variablesonthestockdata wassignificant and explained betterwiththemultifactormodelandusingthemicrofundation.Thisapproachcanbeusedin selecting adiverseportfolio werethe factor betas foreachmacroeconomic variable canbemaximize using theavailable data.

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APPENDIX 1

CMP	β_0	β_1	β_2	β_3	DF	P-VALUE	REMARK
1	218.147	0.0808	-45.947	-10.047	-36.3	0.01	Mean-reverting
2	296.671	-8.626	-46.865	-19.65	-39.54	0.01	Mean-reverting
3	217.38	-7.04	-68.42	43.54	-28.26	0.01	Mean-reverting
4	106.282	-6.826	-0.207	11.565	-37.79	0.01	Mean-reverting
5	129.623	-2.803	-25.449	-1.884	-36.75	0.01	Mean-reverting
6	346	7.84	-143.61	42.92	-21	0.01	Mean-reverting
7	362.832	3.227	141.692	101.986	-38.65	0.01	Mean-reverting
8	941.19	-19.01	-176.78	16.02	-38.78	0.01	Mean-reverting
9	128.27	-2.74	-19.82	-2.94	-37.92	0.01	Mean-reverting
10	81.302	3.321	-19.546	-11.307	-17.76	0.01	Mean-reverting
11	9.514	0.637	-0.656	0.633	-8.092	0.01	Mean-reverting
12	341.48	-7.326	-66.689	-7.741	-36.81	0.01	Mean-reverting
13	77.036	-1.6936	-23.084	8.145	-17.11	0.01	Mean-reverting
14	236.73	26.74	-15.15	-186.2	-5.6	0.01	Mean-reverting
15	180	4.52	-46.66	-9.68	-6.257	0.01	Mean-reverting
16	8.442	1.473	-6.798	4.784	-7.557	0.01	Mean-reverting
17	87.321	1.889	-17.945	2.586	-27.88	0.01	Mean-reverting
18	457.686	8.4052	-96.592	-9.5409	-13.5	0.01	Mean-reverting
19	714.85	-15.14	-135.72	-3.66	-33.5	0.01	Mean-reverting
20	132.93	-4.61	-32.3	12.08	-23.47	0.01	Mean-reverting
21	221.769	-6.717	-36.445	-8.128	-34	0.01	Mean-reverting
22	555.65	5.21	-120.67	-5.42	-32.52	0.01	Mean-reverting
23	22.46	-1.39	3.46	3.23	-3.81	0.0185	Mean-reverting
24	438.57	1.76	-98.56	-33.33	-6.538	0.01	Mean-reverting
25	738.6	-11.2	-22.9	102.1	-30.39	0.01	Mean-reverting
26	118.72	2.18	-31.87	-1.37	-7.363	0.01	Mean-reverting
27	66.945	0.435	-13.179	-3.197	-17.84	0.01	Mean-reverting
28	47.776	0.308	-11.169	-4.75	-28.58	0.01	Mean-reverting
29	77.0006	-1.6981	-23.037	8.0813	-17.12	0.01	Mean-reverting
30	-74.895	1.981	0.982	13.82	-18.37	0.01	Mean-reverting
31	19.933	0.409	1.526	8.608	-35.3	0.01	Mean-reverting
32	96.22	1.17	-37.17	-4.57	-10.37	0.01	Mean-reverting
33	217.968	0.0828	-45.862	-10.109	-36.36	0.01	Mean-reverting
34	366.19	-11.38	-79.75	-5.03	-27.72	0.01	Mean-reverting
35	225.41	-3.89	-47.44	-6.43	-34.81	0.01	Mean-reverting
36	240.61	-4.61	-45.57	-1.64	-3.922	0.0129	Mean-reverting

37	922.36	-26.06	-170.6	82.92	-39.53	0.01	Mean-reverting
38	710.2	-29.3	-121.4	-28.5	-39.61	0.01	Mean-reverting
39	-3.219	2.253	-2.376	2.552	-19.81	0.01	Mean-reverting
40	13.765	8.957	-35.085	26.644	-2.159	0.01	Mean-reverting
41	509.24	-7.29	-145.32	51.54	-37.45	0.01	Mean-reverting
42	1896.56	-58.206	-281.54	-45.489	-39.29	0.01	Mean-reverting
43	3.714	3.486	2.01	2.059	-36.03	0.01	Mean-reverting
44	91.396	-0.358	-17.488	-3.384	-35.69	0.01	Mean-reverting
45	348.172	9.663	-85.04	-25.488	-19.55	0.01	Mean-reverting
46	12.826	1.987	0.305	-3.615	-5.326	0.01	Mean-reverting
47	185.97	-3.06	-39.32	-2.84	-35.6	0.01	Mean-reverting
48	200.8	3.6	-5.18	-12.77	-24.47	0.01	Mean-reverting
49	84.7322	-1.5809	-7.2549	0.0635	-3.829	0.0175	Mean-reverting
50	221.382	-6.2577	-47.535	10.8142	-32.01	0.01	Mean-reverting
51	148.89	-5.7	-21.32	-1.49	-36.7	0.01	Mean-reverting
52	155.335	-5.084	-29.19	8.866	-24.94	0.01	Mean-reverting
53	62.052	-1.133	-7.14	-0.284	-3.523	0.0401	Mean-reverting
54	429.84	-10.29	-87.59	-29.02	-36.38	0.01	Mean-reverting
55	222.15	-6.86	-37.04	-3.64	-37.88	0.01	Mean-reverting
56	219.311	-2.858	-44.852	-8.989	-38.36	0.01	Mean-reverting
57	98.986	-1.625	-19.274	-2.385	-29.97	0.01	Mean-reverting
58	281.88	-1.51	-58.49	-24.51	-38.84	0.01	Mean-reverting
59	1159.9	14.5	-249.3	-75.9	-7.219	0.01	Mean-reverting
60	245.82	4.96	-122.97	81	-18.96	0.01	Mean-reverting
61	109.29	-4.25	-6.52	-15.03	-25.91	0.01	Mean-reverting
62	0.448	3.827	-12.662	-7.768	-7.8	0.01	Mean-reverting
63	248.287	1.902	-80.853	24.786	21.47	0.01	Mean-reverting
64	17.917	0.571	2.146	5.227	-30.92	0.01	Mean-reverting
65	-120.5	55.7	-117.3	238.4	-24.42	0.01	Mean-reverting
66	234.319	-4.883	-42.201	-3.904	-38.18	0.01	Mean-reverting
67	-56.095	1.5773	6.3368	2.3782	-5.626	0.01	Mean-reverting
68	218.83	1.41	-94.56	50.98	-21.95	0.01	Mean-reverting
69	19.121	1.326	0.331	4.987	-14.99	0.01	Mean-reverting
70	81.204	0.311	-19.633	-1.33	-16.26	0.01	Mean-reverting
71	118.693	2.0892	-24.661	-7.8802	-32.65	0.01	Mean-reverting
72	51.409	-0.849	-9.989	-20.661	-27.83	0.01	Mean-reverting
73	61.438	-1.008	-5.562	-10.364	-5.401	0.01	Mean-reverting
74	1232.02	20.14	-289.16	-93.65	-15.35	0.01	Mean-reverting
75	1232.02	0.429	-215.37	81.073	-21.74	0.01	Mean-reverting
76	794.925	-0.161	-7.269	2.383	-35	0.01	Mean-reverting

77	47.009	-2.6872	-15.585	-8.6106	-35.15	0.01	Mean-reverting
78	115.517	-8.92	-99.27	-25.11	-34.18	0.01	Mean-reverting
79	492.14	-0.88	-3.64	2.19	-31.27	0.01	Mean-reverting
80	48.85	0.802	-20.58	5.428	-33.82	0.01	Mean-reverting
81	88.642	-123.28	-680.11	-113.68	-20.33	0.01	Mean-reverting
82	3764	34.8	-818.6	-100.3	-5.052	0.01	Mean-reverting
83	70.174	-0.741	-11.959	1.249	-35.17	0.01	Mean-reverting
84	52.036	-0.139	-8.528	1.356	-36.34	0.01	Mean-reverting
85	237.76	1.27	-53.79	-4.98	-7.191	0.01	Mean-reverting
86	219.28	-7.07	-69.35	44.27	-28.33	0.01	Mean-reverting
87	147.68	0.348	-26.71	-6.731	-36.93	0.01	Mean-reverting
88	5957	-105	-2154	1795	-38.62	0.01	Mean-reverting
89	171.273	-2.566	-32.908	1.273	-37.72	0.01	Mean-reverting
90	-827.42	48.32	93.4	-6.35	-3.749	0.0218	Mean-reverting
91	294.02	-5.9	-26.46	-14.03	-27.39	0.01	Mean-reverting
92	463.15	8.04	-280.47	327.93	-38.77	0.01	Mean-reverting
93	235.66	-8.462	-56.067	15.064	-15.32	0.01	Mean-reverting
94	88.581	2.295	-22.6	1.997	-25.39	0.01	Mean-reverting
95	287.117	-1.396	-80.811	-4.958	-10.87	0.01	Mean-reverting
96	847.98	-36.52	-120.03	-78.04	-31.7	0.01	Mean-reverting
97	19.2404	0.0591	-1.1662	4.9326	-9.44	0.01	Mean-reverting
98	596.95	-8.13	-232.06	221.62	-6.386	0.01	Mean-reverting
99	68.73	1.95	-12.65	-6.91	-11.61	0.01	Mean-reverting
100	7.2787	-0.1758	0.1617	-2.7835	-8.288	0.01	Mean-reverting
101	132.13	5.56	-51.16	15.34	-26.14	0.01	Mean-reverting
102	315.96	2.38	-91.49	65.34	-38.21	0.01	Mean-reverting
103	131.225	-1.943	-26.427	-6.235	-36.88	0.01	Mean-reverting
104	642.97	-23.27	-110.66	-17.87	-39.47	0.01	Mean-reverting
105	-16.546	3.131	-18.331	34.788	-4.135	0.01	Mean-reverting
106	70.111	1.168	-10.016	4.536	-6.656	0.01	Mean-reverting
107	21.11	1.96	-14.06	-7.08	-17.55	0.01	Mean-reverting
108	122.612	-3.775	-20.824	-0.38	-36.82	0.01	Mean-reverting
109	27.075	1.462	-1.072	3.936	-32.99	0.01	Mean-reverting
110	89.157	-1.934	-13.089	-4.851	-34.58	0.01	Mean-reverting
111	119.743	-0.0361	-24.008	-5.4593	-32.51	0.01	Mean-reverting
112	24.049	3.333	-11.622	18.737	-23.09	0.01	Mean-reverting
113	1274.4	13.8	-115.9	-420.2	-8.91	0.01	Mean-reverting
114	-45.35	7.92	6.49	-3.98	-16.52	0.01	Mean-reverting