MACROECONOMIC VARIABLES AND STOCK MARKET RETURN IN NAIROBI SECURITIES EXCHANGE

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF ECONOMIC THEORY, SCHOOL OF ECONOMICS IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ECONOMICS (POLICY AND MANAGEMENT) OF KENYATTA UNIVERSITY.

NOVEMBER 2015

DECLARATION

This research project is my original work and has not been presented for a degree in any other University or any other award

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DEDICATION

I dedicate this work to my wife Anne and my daughters Victoria and Tracey who have been my constant source of inspiration.

ACKNOWLEDGEMENT

I would like to thank the Almighty God for His grace, strength and good health without which I would not have made it this far.

I wish to express my profound and inexhaustible appreciations to my supervisors Dr Julius Korir and Dr James Maingi for their invaluable and brilliant guidance. I would also like to thank my class mates Kiiru, Njugu, Gachara, Ndirangu and Evelyne for their moral support during the study period.

I acknowledge the support of my employer; The Ministry of Devolution and Planning for granting me leave to pursue my study. I wish to express my sincere gratitude to Director Economic Development and Coordination Department, Mr. Joseph Mukui, Chief Economists Ms Beatrice Manyonge and Ms Freshia Kamau for their support and motivation during my study.

Finally I wish to express my heartfelt thanks to my wife Anne and the entire family for their unfailing support during the period of developing this project.

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ACRONYMS AND ABBREVIATIONS

ADF	Augmented Dickey Fuller
APT	Arbitrage Pricing Theory
CAPM	Capital Asset Pricing Model
CBK	Central Bank of Kenya
EMH	Efficient Market Hypothesis
GDP	Gross Domestic Product
KIPPRA	Kenya Institute of Public Policy Research and Analysis
KNBS	Kenya National Bureau of Statistics
NSE	Nairobi Securities Exchange
VECM	Vector Error Correction Model

OPERATIONAL DEFINITION OF TERMS

Causality: Is the ability of past values of one variable to predict another variable.

Efficient capital market: a market for securities in which every security's price equals its investment value all time, implying that a specific set of information is fully and immediately reflected in the market prices.

Leverage effect: It is an asymmetric response of conditional variance to positive and negative shocks in errors.

Macroeconomic variables: Are measurable economic factors that allows for analysis of economic performance and the predictions of future performance.

Share index: the return on a security traded on a capital market based on the current market price of shares on a stock exchange.

Stock market: An organized market facilitating the purchase and sale of securities and operated by professional stock brokers according to fixed rules and regulations.

Stock market returns: are the returns that the investors generate out of trading in the stock market. This could be in the form of profit through trading or in the form of dividends given by the company to its shareholders

Volatility: refers to the amount of uncertainty or risk about the size of changes in a security's value.

ABSTRACT

Under the Kenya vision 2030, the financial services sector aims at creating a vibrant and globally competitive financial sector promoting high-levels of savings and financing for Kenya's investment needs. It also aims to ensure macroeconomic stability as well as reducing the volatility of returns in Nairobi securities exchange. This study aimed at investigating the macroeconomic variables and stock market return in Nairobi securities exchange limited. The study focused on exchange rate, inflation, government spending and the oil price as the macroeconomic variables under study. Arbitrage pricing theory was used to link the macroeconomic variables and the stock market return. Monthly Published time series data from January 2001 to December 2013 was sourced from CBK, KNBS and NSE. Regression analysis was done using ADF test for unit root and Johansen for co integration. Toda and Yamamoto Granger causality was applied to establish the causal relationship between the set of macroeconomic variables and the NSE 20 share index while Power Garch model was employed to determine the volatility. Diagnostic test showed that all the variables are integrated of order one. The co integration test confirmed presence of long run relationship between the NSE stock market 20 share index and the selected macroeconomic variables. The analysis revealed a uni-directional relationship which runs from the NSE stock market index to the inflation rate, a uni directional relationship from foreign exchange rate to NSE index and a bilateral causality between oil price and the stock market return. Presence of arch effects was noted and that the results of the power Garch model show that the magnitude of shocks has a significant impact on volatility of stocks. The study showed that exchange rate contributes greatly and significantly to volatility of stock returns at Nairobi securities exchange. The findings of this study provide evidence of a relationship between stock market return and macroeconomic variables in the economy. The government of Kenya should put proper and quality measures to ensure the stability of Kenya shilling against the dollar as well as increasing production of energy locally so as to reduce the cost of production as well as suppressing the rate of inflation in the economy. This study recommends that Policy makers, and investors, need to take the macroeconomic variables into consideration for proper decision making process to enhance economic growth and development.

CHAPTER ONE

INTRODUCTION

1.1: Background

Stock market plays a very crucial role in the modern economy because it acts as a mediator between lenders and borrowers. A well functioning stock market ensures that economic growth and development is accelerated through boosting savings as well as allowing for a more efficient allocation and distribution of the scarce resources. An efficient stock market enhances the savings to increase since the stock market provides households with assets that satisfies their risk preferences and liquidity needs (Leigh, 1997). Also, when a stock market becomes efficient, it promotes the diversification of domestic funds as well as the productive investment projects by enhancing liquidity and providing funds for industrialization and economic development. However, this is only realistic if the stock market has significant relationship with the macroeconomic variables.

According to Musilek (1997), any investor who wishes to be successful by increasing the returns must ensure that focus is given on the consideration of those macroeconomic variables that shape and influence the prices in an economy. The linkage between stock market and macroeconomic variables has been of primary focus in the research field between academics and practitioners (Kwon and Shin, 1999).

According to economic theory, the functioning of the stock market should be closely related with the behavior of the macroeconomic variables in an economy so as to necessitate forecasting for quality policy formulation. Stock exchange enables the firms to attain capital quickly due to the ease with which trading of securities in the stock market is executed. (Adjasi and Biekpe, 2006). Therefore, the efficiency of stock market returns and the volatility of stocks require to be investigated continuously to infer proper and quality formulation of policies geared towards attraction and retaining of potential investors.

Financial analysts and investors are interested in understanding the nature of volatility patterns of financial assets and what events can alter and determine persistence of volatility over time (Malik, 2004). Volatility can be considered as a measurement of the uncertainty of the risk that is associated with stock market investment decisions (Alexander, 2007). The opinion of Bekaert and Harvey (1997) is that the presence of and challenges emanating from volatility in various emerging stock exchanges is almost a common phenomenon. Binder and Merges (2001) are of the view that the volatility of the return on the market portfolio is inversely related to the ratio of expected profits to expected revenues of the economy.

According to United Nations (2013), most emerging markets are likely to continue experiencing volatility unless these economies formulate quality policies and implement them. Volatility of stocks has been witnessed in the Nairobi securities exchange which calls for an intervention. Enhancing macroeconomic stability as well as significantly reducing the volatility in the stock exchange indices is one of the main objectives of the Kenya capital market master plan 2014 to 2023 (CMA 2014). The vision 2030 financial sector aim in stimulating capital market growth is to formulate quality policies so as to raise stock market capitalization from 50% to 90% of GDP (KIPPRA, 2013)

1.1.1: Stock returns Volatility and stylized facts

Volatility is the amount of uncertainty or risk about the size of changes in a security's value. It measures the dispersion of returns for a given market index. Volatility reveals the riskiness associated with the asset since there is a relationship between them. The volatility in stock market return and macroeconomic variables is estimated by using the General Autoregressive Conditional Heteroscedasticity(Garch) models. The strength of these Garch models is anchored on their ability to capture the stylized facts that characterize the financial time series i.e. leverage effects and volatility clustering.

1.1.2: Macroeconomic Variables and Stock Returns

The following selected macroeconomic variables have been considered based on other scholars' findings, economic importance of the variables as well as the performance indicators of growth and development of the Kenyan economy.

Oil price is an important input in production where changes in oil prices affects real economic activity in all sectors which cause the stock returns to change. According to Basher Haug and Sadorsky (2011), changes of oil prices directly influence the rate of growth in the economy. The increase of the oil prices generates uncertainty in the financial markets which can induce a decrease in stock prices hence stock returns. (Kuwornu, 2011).

Government spending is one of the key macroeconomic variables that shape economic growth and development. Government spending has an impact on household income who may decide to invest part of their income in stock market depending on the rate of return on the alternative investment (Razni, 1987).

Exchange rates affect the competitive position of companies and their profitability. A rise in exchange rate (depreciation) causes a decrease in stock returns. Companies which rely heavily on imports suffer from higher costs due to a weaker domestic currency hence lower earnings. On the other hand, domestic products will become cheaper to foreign traders hence a benefit to the domestic exporters.

Inflation rate is a key macroeconomic variable in the Kenyan economy. Unexpected inflation triggers a rise in the living cost which will tend to shift the resources from the investment to consumption expenditure. As inflation goes up, discount rate used to determine intrinsic values of stocks will therefore increase which will reduce the present value of net income leading to lower stock prices (Talla, 2013).

1.1.3: Nairobi Securities Exchange Limited

In Kenya, dealing in shares and stocks started in 1920. However, trading of shares was done informally since rules and regulations to govern stock broking activities never existed. (Ngugi, 2003)

In 1954, NSE was constituted as a voluntary association of stock brokers registered under the societies act. In 1988, the first privatization at the NSE was successfully done with a sale of 20% government stake in Kenya commercial bank. (Ngugi, 2003).

In September 2006 live trading on the automated trading systems (ATS) of the Nairobi Stock Exchange was implemented. In July 2011, Nairobi stock exchange limited changed its name to Nairobi securities exchange to revolve into a full service securities exchange

The Nairobi securities exchange comprises of two market indices; NSE 20 share index based on market capitalization of twenty companies which are equally weighted, and all share index (NASI)

The NSE 20 share index has been fluctuating over time and hence affecting the volatility of share returns. Changes in the various macroeconomic variables like exchange rate government expenditure, inflation, and oil prices have been affecting the economic conditions hence influencing the performance of the securities.

The figure below shows the trend of percentage changes of macroeconomic variables and the Nairobi securities exchange index from January 2005 to January 2014

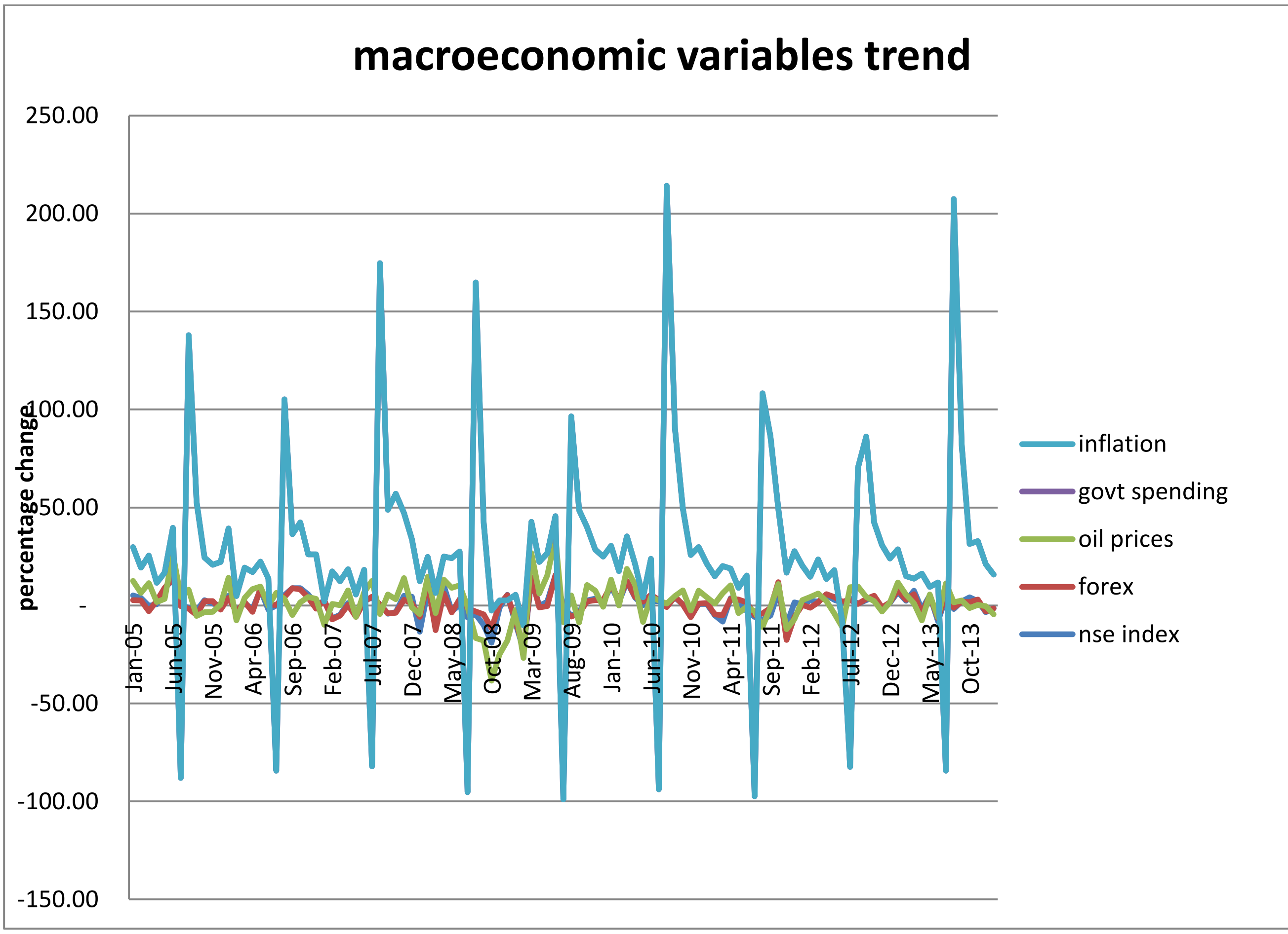

Figure 1.1 percentage changes of macroeconomic variables and NSE 20 share index from January 2005 to January 2014

Source: Nairobi Securities Exchange and Kenya National Bureau of Statistics

1.2: Statement of the problem

The Nairobi securities exchange market plays a very key role in creating potential investment opportunities for domestic and foreign investors and a leading economic growth indicator.

Quoted companies at the Nairobi securities exchange suffer from increasing stock return volatility. Since Stock prices influences investment decisions, excessive stock returns volatility undermines the usefulness of stock prices since stock prices shows the true intrinsic value of a firm (Karolyi, 2001). In order to inform quality policy making process, it is vital that factors causing volatility need to be established.

Studies that have been conducted in developed and developing economies on the macroeconomic variables, stock market return and volatility realize a lot of conflicting findings in terms of the causality. Olweny and Omondi (2014) and kirui (2014), investigated the effect of macroeconomic variables on stock market return in Kenya where the former found inflation to be significant while the latter found it to be insignificant. Ouma and Muriu (2014) found inflation to be significant while Robert (2008) who investigated the effect of macroeconomic variables on stock market return for four economies; Brazil, China, Russia and India where found no relationship between exchange rate, oil prices and the stock market return.

If volatility of stock returns could be predicted by use of the available macroeconomic information, therefore information on rational portfolio selection and diversification geared towards increasing returns would be easily established. It is evident that there is no consensus in literature of the main factors causing volatility where factors vary from one study to another. There is need for an in-depth and an extensive evaluation to determine which factors that causes volatility of NSE index in Kenya.

1.3: Research Questions

The study aimed to addresses the following research questions

i. What type of relationship (long run or short run) exists between inflation, oil price, government spending and exchange rate and the NSE 20 share index?
ii. What is the direction of the causal relationship between inflation, oil price, government spending and exchange rat**e** and the NSE 20 share index?
iii. How do the inflation, oil price, government spending and exchange rate affect the Nairobi stock market return volatility?

1.4: Objectives of the study

1.4.1 General objective

To investigate macroeconomic variables and stock market return in Nairobi stock exchange limited.

1.4.2: Specific objectives

i. Determine whether inflation, oil price, government spending and exchange rate share a short run or a long run relationship with NSE 20 share index
ii. Determine whether there is a causal relationship, the direction of causality between inflation, oil price, government spending, exchange rate and the NSE 20 share index
iii. Determine how inflation, oil price, government spending and exchange rate affect the Nairobi stock market return volatility

1.5: Significance of the study

The findings of the study will extend the literature by examining the macroeconomic variables and stock market return. The study will also provide a platform for the government in the formulation of policies with regard to control of excessive stock return volatility and promotion of investment in the stock market.

By investigating the macroeconomic variables and the stock return, the study will be of great use to the investors since it will raise their returns predictability power and help them make quality and sound investment decisions.

The study is also geared towards enriching the school education curriculum as well as forming a basis for the academicians who would like to carry out further research on determining the effects of macroeconomic variables on stock market return.

1.6: Scope and organization of the study

The study focused on monthly time series data that spans from January 2001 to December 2013. This research project has three chapters; the first chapter gives the introduction. Chapter two entails the reviewing of the theoretical literature and the empirical literature on the relationship between the macroeconomic variables and stock market returns. Chapter 3 discusses the methodology, research design, theoretical framework, empirical model the type of data and data analysis.

CHAPTER TWO

LITERATURE REVIEW

2.1: Introduction

This chapter comprises of three sections. The first section is concerned with examining how the various theories and the macroeconomic variables are linked. The second section deals with the empirical review of the various studies on macroeconomic variables and stock return while the third section concludes by giving the overview of the literature.

2.2: Theoretical Literature

The linkage between the stock market returns and macroeconomic variables will be depicted using the following models: APT, CAPM and EMH. Any new information about the fundamental macroeconomic factors may influence the stock price, as well as stock return through the impact of expected dividends, the discount rates or both (Chen *et.al,* 1986).

2.2.1: Capital Asset Pricing Model (CAPM)

The capital asset pricing model was developed by Sharpe (1964), Lintner (1965) and Mosin (1966). It provides a theory that predicts an exact relation to hold for the expected returns of all securities in relation to the market portfolio expected return. CAPM operates under the concept of efficient markets where in an efficient market; the return of an asset includes a premium for risk that cannot be diversified away. CAPM comprises of only one independent variable which is the risk premium of the market. The risk premium should be fully explained by the covariance between asset returns and market return. (Takala and Pere, 1991). The CAPM is given as

$E(R_i) = R_f + [E(R_1) - R_f]\beta_i i = 1, \ldots N$……………………………2.1

$E(R_i) -$ Expected return on asset i

R_f −Risk-Free rate of return

$E(R_1) -$ Expected return of the market portfolio

$\beta_i -$ Beta of the asset market

$[E(R_1) - R_f] -$ Premium

Therefore, the expected return is given by the summation of the risk free rate of return and the premium. The main criticism of capital asset pricing model is particularly the use of betas in predicting the return of assets. Returns on high beta stocks will tend to be overestimated while the returns on low beta stocks are underestimated. (Groenewold and Fraser, 1997).Therefore, application of the capital asset pricing model may not be accurate.

2.2.2: Efficient market hypothesis

This model was developed by Fama (1970). The model states that in an efficient market, all the important information concerning the changes in macroeconomic variables is fully reflected in the current stock prices. Also, stock prices fully and rationally incorporate all the relevant information and therefore this theory supports the idea that the changes in any macroeconomic variables should not affect stock much, thereby discrediting its applicability in stock returns.

2.2.3: Arbitrage Pricing Theory (APT)

APT was established by Ross (1976). It builds on a multifactor model to develop a theory of asset pricing. It is based on the tenet that in a well functioning security market, no arbitrage should exist. APT is generally assumed to be an equilibrium pricing model that extends the original CAPM from a single factor to a multifactor model. It assumes that the return on an asset is a linear function of any number of macroeconomic factors such as exchange rate, industrial production inflation, government spending, foreign direct investment and changes in oil prices. These factors are denoted with factor specific coefficients that measure the sensitivity of the assets to each factor.

APT states that the realized return on an asset is composed of the expected return at the beginning of a time period and the unexpected realization of K risk factors during that time period plus firm specific risk. The model requires that the returns on any stock should be linearly related to a set of indexes as shown below.

$$R_{jt} = \eta_0 + \eta_1(F_1)_t + \cdots + \eta_n(F_n)_t + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots \quad 2.2$$

$$R_{jt} = \eta_0 + \beta_i \sum_{i=1}^{i=k} F_{it} + \mu_{it} \ldots\ldots\ldots\ldots\ldots\ldots \quad 2.3$$

$i = 1,2, \ldots \ldots k$

Where $R_{jt}$is the rate of return of security j at time t, η is a constant, $\beta_i s$ are the coefficients of the factor i in time t also called factor loading of a security or the sensitivity of a security, F_{it} is the value of factor i at period t. It measures the economic activity that affects the stock returns and μ_i is the random error term. It captures the unsystematic risks.

The empirical evidence that APT takes more than one factor to explain the systematic risk in securities discredits CAPM. By demonstrating that the risk premium of an asset depends only on its systematic factor loading, the APT provides investors with a result of great practical value that the CAPM.

2.3: Empirical Literature

There exists a lot of empirical literature regarding the impact of macroeconomic variables on stock market return volatility with a view of determining the causality.

Patel (2004) examined the effect of macroeconomic determinants on the performance of the Indian stock market using monthly data over the period of January 1991 to December 2011 for eight macroeconomic variables. Applying ADF unit root test, Johansen Co integration test, granger causality test and VECM, the study found that interest rate is 1(0), exchange rate, index of industrial production, gold price, silver price and oil price are 1(1), and inflation and money supply are 1 (2). The study found the long run relationship between macroeconomic variables and stock market indices. The study also revealed the causality run from exchange rate to stock market indices to industrial production index and oil price.

Acikalin*et.al*, (2008) investigated the relationship between the stock markets and macroeconomic variables in Istanbul stock exchange. The variables used in the study were GDP, nominal exchange rate (NER), interest rate (IR), and current account balance (CAB).Employing co integration tests and vector error correction model on a quarterly data set ranging from 1991-2006, the study found a long term stable relationship between the stock return and the macroeconomic variables.

Adam and Tweneboa (2008) examined the impact of macroeconomic variables on the stock return in Ghana using quarterly data from 1991 to 2007. The following macroeconomic variables were studied; Treasury bill rate, oil prices, foreign direct investment and the exchange rate. Applying the co integration test and vector error correction model, a long run relationship between the variables and stock return was realized

Ahmed (2008) investigated the relationship between the stock market return and macroeconomic variables in the Indian stock market using the following variables; money supply, interest rate, industrial production, exports foreign direct investments and exchange rate. In the analysis, Johansen co integration was employed. The study found a long run relationship between stock market return and money supply while no relationship was found with the interest rate.

Sakwa (2008) investigated the relationship between the stock market return and macroeconomic variables in Nairobi securities exchange using the following variables; interest rate, money supply, real exchange rate, inflation and GDP using annual time series data from 1976 to 2008 where ordinary least squares was used. The study found out that interest rate, money supply and exchange rate to be positively related with stock returns. However, there exists a negative relationship between inflation and stock returns and GDP with the stock returns.

Kuwornu (2011) examined the relationship between macroeconomic variables and stock returns using monthly data over period January 1992 to December 2008. The variables used in this study are consumer price index, crude oil price, exchange rate and 91 day Treasury bill rate. Full information maximum likelihood estimation procedure was used. The study found significant relationship between stock market returns and three macroeconomic variables; consumer price index, exchange rate and the 91 day Treasury bill rate. CPI had a positive significant effect. On the other hand exchange rate and Treasury bill rate had a negative significant influence on stock market returns. Crude oil prices did not appear to have any significant effect on stock market returns. The study notes that the macroeconomic variable set employed is not exhaustive and that more variables should be sought and used to determine the relationship with the stock return volatility while employing of vector error correction and the co integration analysis.

Olweny and Omondi (2011) investigated the effect interest rate, foreign exchange rate and inflation rate fluctuation on stock return volatility in the Nairobi stock exchange Kenya. The study used monthly time series data for a ten years period between January 2001and December 2010. The empirical analysis employed E-Garch and T-Garch models. The research findings showed that stock returns are symmetric but leptokurtic and not normally distributed. The results showed evidence that the three macroeconomic variables affect stock return volatility. In addition, the foreign exchange rate impact was found to be relatively low though significant as well as having low volatility persistence. The study also found presence of leverage effect implying that volatility rise more following a large price fall than following a price rise of the same magnitude. The research proposed further studies and identification of other macroeconomic variables that significantly affect stock returns like money supply, monetary policy, fiscal policy and industrial production.

Zakaria and Shamsuddin (2012), investigated the relationship between stock market returns volatility and macroeconomic variables in Malaysia with five selected macroeconomic variables; GDP, inflation, exchange rate, interest rate and money supply based on monthly data from January 200 to June 2012 where Garch (1,1) was used in estimation. The study found that only interest rate was found to granger cause the stock market return volatility and that the volatilities of the macroeconomic variables as a group are also not significantly related to stock market volatility.

Issahaku *et al.* (2013) examined the causality between the following macroeconomic variables and the stock market return in Ghana stock exchange; money supply, exchange rate, consumer price index, Treasury bill rate and the foreign direct investment. The study employed monthly time series data spanning the period January 1995 to December 2010. The analysis employed ADF, VECM and granger causality. The study revealed a long run relationship existed between the stock return and inflation, money supply and foreign direct investment.

Talla (2013) investigated the impact of changes in macroeconomic variables on stock prices of the Stockholm stock exchange. Interest rate, inflation and money supply were the variables under consideration. Unit root test, multivariate regression model computed using ordinary least squares method and granger causality test were carried out using monthly time series data ranging from 1993 to 2012. Inflation showed a significant negative influence on stock returns while money supply was found to be positively associated with stock returns although not significant.

Nasibu (2013) investigated the impact of the following macroeconomic variables on stock market return in Nairobi securities exchange; interest rate, inflation, government spending and GDP. Monthly time series data spanning from 2006 to 2012 was used and ordinary least squares used in analysis. The study found negative relationship between interest rate, inflation and stock return. However, GDP and government spending had no significant impact on stock market return volatility.

Gatebi (2013) investigated the effect of macroeconomic factors on the volatility of common stocks returns in Nairobi stock exchange focusing on the following variables; inflation rate, money supply, economic growth and interest rate fluctuations. Monthly time series data for a five year period between January 2007 and December 2011 was used. The study used E-Garch in the analysis. The results indicated that all the macroeconomic factors had a negative correlation against the common stock return volatility. The study recommended that analysis be carried out from time to time on macroeconomic factors affecting volatility of stock returns. However, the current study covers a longer period more than the five year period used by Gatebi (2013) so as to observe the changes on the variables within a longer period of time.

Kirui (2014) sought to evaluate the relationship between GDP, inflation, Treasury bill rate, exchange rate and stock market return in Kenya. The study determined the response of the stock returns to a shock in each of the macroeconomic variables. T – garch model was used to capture leverage effects and volatility persistence at the NSE where time series quarterly data from 2000 to 2012 was used. The study found that only exchange rate had an effect on stock returns which was a negative relationship where other macroeconomic variables were not important in explaining stock returns. The results contradicts what Gatebi (2013) found where inflation and interest rates were found to be significant and negatively correlated with the stock returns.

Ouma and Muriu (2014) investigated the impact of the macroeconomic variables on stock returns in Kenya during the period January 2003 to December 2013 using APT and CAPM framework for monthly data where the following variables were included in the ordinary least square model: money supply, exchange rates and inflation.

According to the findings, all the variables affect the stock market returns in Kenya where money supply and inflation are found to be significant determinants of the returns at NSE. Exchange rate was found to have a negative impact on stock returns while inflation showed a positive one. Interest rate was not important in determining long run returns in the NSE.

Umar (2014) analyzed the impact of macroeconomic variables on stock market return in Pakistan observing the following macroeconomic variables; inflation, GDP per capita, GDP savings, money supply and exchange rate. Annual time series data from 1991 to 2013 was used in correlation and granger causality analysis. The study realized positive insignificant relationship between the macroeconomic variables and stock return.

Ahmad (2015) investigated the causal relationship between stock market returns and the following macroeconomic variables in Nigeria; money supply, exchange rate, interest rate, foreign direct investment and gross domestic saving. Annual time series data ranging from 1984 to 2013 was used where ARDL method was employed in the data analysis. The study found a causal relationship between foreign direct investment, money supply and interest rate while no causal relationship was found between exchange rate and gross domestic saving.

2.4: Overview of the literature

According to the literature reviewed, a variety of theories have been applied as well as different macroeconomic variables used to show the impact of macroeconomic variables on stock market return volatility. Theories are silent on which and the number of macroeconomic variables to be included in the model. Studies that have been conducted in developed and developing economies realize a lot of conflicting findings on the relationship between macroeconomic variables and stock market return volatility.

Various studies done in Kenya have yielded varying results. Ouma and Muriu (2014) and Kirui (2014) using OLS found insignificant relationship between interest rate and stock return while Gatebi (2013) and Olweny and Omondi (2014) concluded a negative relationship. Olweny and Omondi (2014), Ouma and Muriu (2014) found inflation to be significant while Kirui (2014) found it to be insignificant. Olweny and Omondi (2014), Sakwa (2008) concluded a positive relationship between exchange rate and the stock returns while Kirui (2014) found exchange rate to be insignificant. However Ouma and Muriu (2014) realized a negative relationship between the returns and the exchange rate. The varying results are attributable to differences in macroeconomic variables used, research methodology applied and the period covered. In addition the reviewed studies have not clearly shown the nature of causal relationship between the variables and stock returns in Kenya. The current study introduced oil prices and government spending due to their economic importance and further investigated their effect on stock return volatility.

It is evident that the list of macroeconomic variables data set is inexhaustible and a lot of research work need to be embarked on with a view to embracing the dynamics of stock market development in the economy; Olweny and Omondi (2011), Gatebi (2013), Kirui, (2014).

Also, the current study employed a power Garch (PGarch) methodological framework in investigating the macroeconomic variables and stock return volatility. Unlike other Garch models where variance is modeled, in this model, modeling is done on the standard deviation.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1: Introduction

This chapter presents the methodology to be used so as to realize the set objectives of the study. It comprises of the research design to be adopted, the theoretical framework, the model specification, the hypotheses, description and measurement of variable, target population, data type and source, research instruments, data collection and data analysis.

3.2: Research Design

The study sought to investigate the selected macro economic variables and stock market returns volatility at Nairobi securities exchange limited. Longitudinal time series research under causal relationship research design was adopted in the study. According to Cooper and Pamela (2006), this research design eases the understanding, explanation and prediction of any relationship between variables under study. Regression of NSE 20 share index on exchange rate, inflation government expenditure and oil prices was carried out to detect causality between the variables.

3.3: Theoretical Framework

The methodology that was adopted by this study is based on Arbitrage Pricing Theory (APT). Arbitrage Pricing Theory captures the explicit relationship between stock returns and the macroeconomic variables and it has a high forecasting power than the efficient market hypothesis, capital asset pricing model and the intertemporal capital pricing model.

The model is presented as follows.

$$R_{jt} = \eta_0 + \beta_i \sum_{i=1}^{i=k} F_{it} + \mu_{it} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. [3.1]$$

$i = 1,2, \dots\dots k$ and $j = 1,2, \dots m$

Where R_{jt} is the rate of return of security j at time t, η is a constant, $\beta_i s$ are the coefficients of the factor i in time t also called factor loading of a security or the sensitivity of a security, F_{it} is the value of factor i at period t

Arbitrage Pricing Theory (APT) is a multifactor model which can explain a larger share of variation among the securities used in the estimation process (Ross 1976). In the case of k macroeconomic variables $(F_1, F_2, \dots\dots F_k)$ each security has k sensitivities $(\beta_1, \beta_2, \dots \beta_k)$ in the following k factor model:

$$R_{it} = \alpha_{it} + \beta_{1t}F_{1t} + \beta_{2t}F_{2t} + \cdots \beta_{kt}F_{kt} + \varepsilon_{it} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots..\dots\dots\dots [3.2]$$

Where R_{it} is return on security i at period t

Therefore, according to the APT theory, the various factors included in the model (f_1, $f_2 \ldots f_k$) will generate the stock returns exhibiting a linear relationship.

3.4: Empirical Model

Following the theoretical framework, Exchange rate (ER), oil price (OP), inflation (INF) and Government spending (GS) were incorporated into a linear model as suggested by Chen, Roll and Ross (1986) as follows

R=f (f_1, f_2, f_3………………f_k)………………………………………………..3.3

Substituting f1, f2, f3, with the macroeconomic variables, equation 3.41 will be expressed as follows.

R=F ER, OP, INF, GS)…………………………………………………….……………….3.4

Where $R$is the market stock return

In order to perform partial elasticity analysis, logs of the variables in equation 3.4 are taken so as to assess the impact of a change in the independent variables on the dependent variable.

Expressing equation 3.4 in the form of log linear model, the following will be the result.

$R_t = \beta_{0t} + +\beta_1 lnER_t + \beta_2 lnOP_t + \beta_3 lnGS_t + \beta_4\, LnINF + \ \varepsilon_t$………………3.5

Where, $R_t = Ln(P_t) - Ln(P_{t-1})$. $P_t$and$P_{t-1}$are closing values of NSE-20 index for t and $t - 1$ respectively, where;

$\beta_0$is the intercept, $\beta_i s$ are the coefficient of the macroeconomic variables in the model while 'Ln' is the natural logarithm of each variable in the model.

3.5: Definition and the measurements of the selected variables

Stock market return**:** this is themonthly market capitalization weighted index of 20 companies measured by the monthly average of indices

Inflation: this Persistent rise in general prices of goods and services. Measured by monthly percentage change in consumer price index

Exchange rate: measured by monthly average rate at which Kenya shilling exchanges with a dollar

Oil price: this is measured by the monthly average retail crude oil price

Government spending: is the monthly total government expenditure in the economy measured in millions of Kenya shillings

3.6: Target Population

The study focused on all quoted companies in Nairobi securities exchangeKenya, for the period 2001 to 2013.

3.7: Data Type and Source

The type of data used is secondary. The NSE 20 share index returns was sourced from the NSE database, while data on government spending, inflation and oil prices data sourced from Kenya national bureau of statistic (KNBS) database. Data on exchange rate was sourced from the central bank of Kenya (CBK) database. This was through the published time series data and monthly abstracts.

3.8: Data Analysis

To realize objective one, unit root test for the time series data was done using the Augmented Dickey Fuller Test (Dickey and Fuller, 1979). This is essential so as to avoid spurious regression results. According to Engle and Granger (1987), the objective of the unit root test is to check whether the macroeconomic variables of interest are integrated of order one (I(1)) or otherwise before proceeding to the estimation procedure. Optimal lag selection was carried out using the Akaike Information Criterion (AIC). Co integration test using Johansen approach was conducted to assess changes in the long run equilibrium relationships between the variables and the NSE 20 share index. This was conducted using the two tests; maximum eigenvalue test and the trace test.

The Vector Error Correction Model was used to investigate the speed of adjustment towards the long run equilibrium.

$$\Delta Y = a_0 + \sum a_i \Delta InX_i + \pi e_{t-1} + v_t \qquad \text{..............................3.6}$$

π is the speed of adjustment to long run equilibrium.

To achieve objective two, Toda and Yamamoto (1995) Granger causality test was done to establish the causal relationship between the set of macroeconomic variables and the NSE 20 share index. This test is employed irrespective of whether y_t and x_t are 1(0), 1(1), or 1(2). This procedure provides the possibility of testing for causality between integrated variables based on asymptotic theory.

To achieve the third objective, first testing for the presence of arch effects was conducted to ascertain whether application of the Garch family models is appropriate. Volatility analysis of the macroeconomic variables using a Power Garch (PGarch) model was employed. This model was first introduced by Taylor (1986) and Schwert(1989) and later improved by Ding *et al*. (1993).PGarch provides an alternative way to model volatility with the long memory property.. This model offers an opportunity to estimate the power parameter λ instead of imposing it on the model (Ocran and Biekets, 2007). The provision for the switching of the power increases the flexibility of the model

$$h_t^{\lambda} = \omega + \sum_{i=1}^{q} \alpha_i(|\varepsilon_{t-i}| - \psi_i \varepsilon_{t-i})^{\lambda} + \sum_{j=1}^{p} \gamma_j h_{t-j}^{\lambda} \quad \ldots\ldots 3.7$$

where $\lambda > 0$ and $\psi_i \leq 1$,i = 1,…,q

$\omega>0$, $\alpha_i \geq 0$ $\gamma_j \geq 0$

CHAPTER FOUR

EMPIRICAL RESULTS AND DISCUSSION

4.0: Introduction

This chapter presents the findings of the analysis and highlights the various diagnostic tests conducted. These include unit root augmented dickey fuller test for stationarity, co integration analysis, granger causality and the Power garch results for analyzing volatility.

4.1: Descriptive statistics

Table 4.1 presents the summary of descriptive statistics for the dependent and independent variables under study

Table 4.1: Descriptive statistics

	Mean	Median	Maximum	Minimum	Std. dev
Stock market return	3373.223	3425.325	5774.24	1027	1272.003
Foreign exchange rate	77.20562	77.855	101.27	61.9	6.35636
Oil price	62.60236	60.969500	132.5500	18.02000	30.32726
Government spending	246866.1	246866.1	915888	16413	191688.8
Inflation	172.3953	146.09	355.36	104.39	61.77723
Observations	144	144	144	144	144

Source: author’s computation

Table 4.1 shows that the mean for NSE 20 share index over the period covered by the data averaged 3373.223with a standard deviation of 1272. The result showsthe presence of volatility of stock returns as indicated by the standard deviation.

4.2: Diagnostics Tests

4.2.1: Correlation matrix

Correlation analysis was conducted to ascertain whether the regressors were strongly correlated. The results are shown in Table 4.2.

Table 4.2: Correlation matrix results

	Foreign exchange rate	Government spending	Inflation	Oil price	Stock market return
Log of Foreign exchange rate	1				
Log of Government spending	0.18355	1			
Log of Inflation	-0.548460	0.0188222	1		
Log of Oil price	0.0747620	0.5157665	0.131227	1	
Log of Stock market return	-0.381544	0.282262	0.378365	0.708265	1

Source: own computation

The results in Table 4.2 show that the variables under study were not strongly correlated hence the problem of multicollinearity was minimal.

4.2.2: Unit root test.

Augmented Dickey Fuller unit root test was conducted to test for non stationarity of the variables. The results are shown in Table 4.3.

Table 4.3 unit root test results at levels

Variable	At Level form of test	ADF statistic	ADF critical values	conclusion
Log of inflation	intercept with trend	-1.582364	-3.441552	non stationary
	intercept	-1.600934	-2.881685	
	None	-0.054485	-1.943074	
Log of foreign exchange	intercept with trend	-2.198338	-3.441777	non stationary
	intercept	-1.974010	-2.881830	
Log of Government Spending	intercept with trend	-2.283040	-3.444487	non stationary
	intercept	1.397809	-2.883579	
	None	-4.974922	-1.943285	
Log of oil Price	intercept with trend	-3.054641	-3.441777	non stationary
	intercept	-1.354163	-2.881830	
	None	0.747843	-1.943090	
Log of Nse market return	intercept with trend	-1.062081	-3.441552	non stationary
	intercept	-1.065777	-2.881685	
	None	0.664705	-1.942896	
Variable	**At first difference** **form of test**	**ADF Statistic**	**ADF critical values**	**Conclusion**
Log of foreign exchange	intercept with trend	-8.440443	-3.442006	Stationary
	intercept	-8.424471	-2.881978	
	None	-8.444634	-1.943107	
Log of inflation	intercept with trend	-11.72082	-2.881830	Stationary
	intercept	-11.72082	-2.881830	
	None	-11.76235	-1.943090	
Log of government spending	intercept with trend	-7.407590	-3.444487	Stationary
	intercept	-7.148940	-2.883579	
	None	-3.151623	-1.943304	
Log of oil price	intercept with trend	-8.838937	-3.441777	Stationary
	intercept	-8.869738	-2.881830	
	None	-8.824242	-1.943090	
Log of Nse market return	intercept with trend	-10.15399	-3.441777	stationary
	intercept	-10.18087	-2.881830	
	None	-10.15899	-1.943090	

Source: own computation

The results in table 4.3 show that the variables were non-stationary at levels but stationary at first difference at 5% level of significance.

4.2.3: Lag length selection criteria

The lag length selection was conducted before carrying out co integration analysis. The results are shown in Table 4.4

Table 4.4: lag length selection statistics

VAR Lag Order Selection Criteria
Endogenous variables: LNRT LNGS LNOP LNFER LNINFL
Exogenous variables: C
Date: 09/19/15 Time: 14:19
Sample: 2001M01 2012M12
Included observations: 131

Lag	LogL	LR	FPE	AIC	SC	HQ
0	603.4157	NA	7.41e-11	-9.136118	-9.026378*	-9.091526
1	631.3085	53.23052	7.09e-11	-9.180283	-8.521841	-8.912728
2	648.9518	32.32362	7.95e-11	-9.067967	-7.860823	-8.577450
3	663.4500	25.45482	9.37e-11	-8.907634	-7.151788	-8.194155
4	682.7741	32.45261	1.03e-10	-8.820978	-6.516431	-7.884538
5	713.4080	49.10783	9.57e-11	-8.906992	-6.053743	-7.747590
6	728.5793	23.16222	1.13e-10	-8.756935	-5.354984	-7.374570
7	751.6119	33.40608	1.20e-10	-8.726899	-4.776246	-7.121572
8	770.3899	25.80187	1.37e-10	-8.631907	-4.132552	-6.803618
9	804.9267	44.81875	1.24e-10	-8.777507	-3.729450	-6.726256
10	828.5297	28.82806	1.35e-10	-8.756178	-3.159420	-6.481965
11	1059.409	264.3652	6.27e-12	-11.89937	-5.753909	-9.402194
12	1124.687	69.76292*	3.73e-12*	-12.51430*	-5.820141	-9.794165*

* 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
HQ: Hannan-Quinn information criterion

Source: own computation

Table 4.4 shows the optimal lag length of twelve as indicated by the four lag order selection criteria at 5% level of significance.

4.3: Co-integration test

Johansen test was conducted to test for no co integration of the variables. The results are shown in the Table 4.5

Table 4.5: Johansen co integration test results

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.378115	154.1867	69.81889	0.0000
At most 1 *	0.274118	92.43674	47.85613	0.0000
At most 2 *	0.231681	50.78885	29.79707	0.0001
At most 3 *	0.072392	16.52725	15.49471	0.0349
At most 4 *	0.050658	6.758229	3.841466	0.0093

Trace test indicates 5 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.378115	61.74998	33.87687	0.0000
At most 1 *	0.274118	41.64789	27.58434	0.0004
At most 2 *	0.231681	34.26160	21.13162	0.0004
At most 3	0.072392	9.769024	14.26460	0.2275
At most 4 *	0.050658	6.758229	3.841466	0.0093

Max-eigenvalue test indicates 3 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: own computation

The results in Table 4.5 show that at 5%, in both trace and maximum eigenvalue tests, the null hypothesis of no co-integration was rejected and therefore there existed a long run relationship between the macroeconomic variables.

The VECM was estimated since the variables were co integrated. The coefficient of error correction model tells the speed with which the model returns to equilibrium following an exogenous shock. The coefficient of error correction model was negative and statistically significant indicating a move back towards equilibrium which was consistent with economic theory. It suggests that adjustment process is quite fast and 57 percent of the previous month disequilibrium in returns is corrected in the current month. (Appendix c)

4.4: Residual diagnostics of the vector error correction model.

The residual diagnostics of the vector error correction model were carried out which included; correlogram test, Breusch-Godfrey serial correlation lm test, heteroskedasticity test, normality test and the stability test. On correlogramtest, the null hypothesis of no autocorrelation, and null hypothesis no heteroskedasticity in the residuals could not be rejected implying that in all the tests the null hypothesis was not rejected. The Histogram of residuals and JarqueBera test showed that the residuals were normally distributed since the p-value was greater than the critical value at the 5% level of significance. On the stability test The CUSUM and CUSUM of squares results showed the model was stable at 5% significance level. The null hypothesis (i.e. that the regression equation is correctly specified) could not be rejected since the plot of the statistics remained within the critical bounds of the 5% significance level (Appendix D)

4.5: Granger causality results

Table 4.6 shows the Toda and Yamamoto (1995) granger causality test results

Table 4.6: Granger causality results

Hypothesis	*K +d*	*Wald statistics*	*Probability value*	*Decision*
Stock return does not granger cause foreign exchange rate	13	8.784571	0.7212	Insignificant
foreign exchange rate does not granger cause stock return	13	19.05050	0.0873	significant
Stock return does not granger cause inflation	13	45.32769	0.0000	significant
Inflation does not granger cause stock return	13	10.70672	0.5542	Insignificant
stock return does not granger cause government spending	13	8.618384	0.7351	Insignificant
Government spending does not granger cause stock return	13	11.15389	0.5158	Insignificant
stock return does not granger cause oil price	13	24.54291	0.0171	Significant
Oil price does not granger cause stock return	13	24.38085	0.0180	Significant

Source: own computation

Table 4.6 shows that the null hypothesis of no causality from foreign exchange rate to stock market return cannot be rejected. Therefore, there exists a unidirectional relationship.

There is a unidirectional relationship between inflation rate and stock market return since we reject the null hypothesis that stock market return does not Granger cause inflation (the p-value (0.0000<5%). There is also a bi-directional relationship between oil price and stock market return since the null hypothesis that stock market return does not Granger cause oil price is rejected at 5% level of significance. Also null hypothesis that oil price does not granger cause stock market return was rejected at 5% level of significance.

4.6: Volatility analysis

4.6.1: Testing for ARCH effects

Before estimating a GARCH-type model Engle (1982) test for ARCH effects was computed to make sure that this class of models is appropriate for the data as shown in table 4.7. The results in Table 4.7 show that the null hypothesis of no arch effects is rejected

Table 4.7: ARCH effects

Heteroskedasticity Test: ARCH			
F-statistic	2.513333	Prob. F(12,118)	0.0056
Obs*R-squared	26.66684	Prob. Chi-Square(12)	0.0086

Source: own computation

Volatility analysis of the macroeconomic variables was conducted using a Power Garch (PGarch) model. The provision for the switching of the power increases the flexibility of this model.

Results of the power garch model on the effect of foreign exchange rate, inflation, oil price and government spending on stock market return volatility. (Mean equation)

4.6.2: Mean equation

Table 4.8 mean equation

Variable	Coefficient	Std. Error	z-Statistic	Prob.
LNFER	-0.469493	0.179053	-2.622088	0.0087
LNGS	-0.000456	0.000923	-0.494391	0.6210
LNOP	-0.03961	0.047258	-0.838155	0.4019
LNINFL	-0.048357	0.056248	-0.859702	0.3900

Source: own computation

Table 4.8 shows that there exists a negative relationship between exchange rate and the stock returns. It has a coefficient of-0.469493 which is significant. This confirms the premise that an increase in exchange rate (depreciation) causes a decrease in the stock returns. The coefficient of exchange rate is negative and statistically significant indicating that increases in exchange rate dampens stock market returns. The results are similar to those of Kirui (2014), Olweny and Omondi (2011), and Ouma and Muriu (2014. However, the results contradict those of Sakwa (2008) who found a positive impact of exchange rate on the stock market return.

There is also a negative relationship between inflation and stock market return volatility although insignificant in explaining the volatility while increases in oil prices generate uncertainty in the stock market inducing a decrease in stock returns.

Results of the Power Garch model on the effect of foreign exchange rate, inflation, oil price and government spending on stock market return volatility. (Variance equation)

4.6.3: Variance equation

Table 4.9: Variance Equation

Variance Equation				
	coefficient	Std error	Z statistic	prob
ω	0.012143	0.044519	0.272753	0.7850
α	0.112265	0.095042	1.181218	0.2375
ψ	0.302055	0.332842	0.907503	0.3641
γ	0.880906	0.07229	12.18573	0.0000

Source: own computation

Table 4.9 shows that γ is found to be positive and significant. Therefore, this implies that the magnitude of shocks has a significant impact on volatility. It is therefore evident that positive shocks are associated with higher volatility than negative shocks.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1: Summary

This study investigated monthly data on macroeconomic variables and stock market return in Nairobi securities exchange from 2001 to 2013. Diagnostic tests showed inflation rate 1(1) exchange rate 1(1) government spending 1(1) oil price1(1) and NSE 20 index 1(1).

The first objective of this study was to determine the relationship between the NSE 20 share index and inflation rate, exchange rate, government spending, and oil price. Co integration test confirmed presence of long run relationship between the NSE 20 share index and the selected macroeconomic variables. The error correction term showed that the adjustment process is quite fast and 57% of the previous month disequilibrium in returns is corrected in the current month.

The second objective of the study was to determine the causal relationship between inflation rate, exchange rate, government spending, and oil price and the NSE stock market return index. The study employed Toda and Yamamoto granger causality model in determination of the presence of and direction of causality on the variables. The analysis revealed a uni-directional relationship which runs from the NSE stock market index to the inflation rate, a uni-directional relationship from foreign exchange rate to NSE index and a bilateral directional causality between oil price and the stock market return.

In determining how inflation rate, exchange rate, government spending, and oil price affect the stock market return volatility, the power garch model revealed a negative relationship between the macroeconomic variables and the stock return. However, the study showed that exchange rate contributes greatly and significantly to the volatility of stocks in Nairobi securities exchange. There is evidence that positive shocks are associated with higher volatility than negative shocks

5.2: Conclusion

Based on the study findings, there is evidence of a long run relationship between stock market return and macroeconomic variables in the economy. There exists a uni-directional relationship which runs from the NSE stock market index to the inflation rate, a uni-directional relationship from foreign exchange rate to NSE index and a bi-directional causality between oil price and the stock market return.

Among the variables under study (oil price, inflation, government spending and exchange rate), only exchange rate is significant in explaining the volatility in stock returns in Nairobi securities exchange. Positive shocks are associated with higher volatility than negative shocks. Policy makers should enhance exchange rate stability as well as making sure that inflation is suppressed so as to spur growth in the economy.

5.3: Policy implications

The government of Kenya should put proper and quality measures to ensure the stability of Kenya shilling against the dollar. The government should put more emphasis on stabilizing the exchange rate since this will prevent significant fluctuation of stock market return attributed to unexpected changes in the exchange rate.

The government should also increase production of energy locally so as to reduce over reliance on imported oil, reduce the cost of production as well as suppressing the rate of inflation in the economy.

This study recommends that Policy makers, and investors, need to take the macroeconomic variables into account when formulating financial and economic policies which are necessary to encourage investment as anchored in the Kenya vision 2030.

5.4: Areas of further research

Future research can be extended in this field by considering macroeconomic variables and stock market return based on sector analysis using a different methodological framework (e.g. Q Garch, which has not been extensively applied) in Kenya considering the various sector characteristics in the economy. This is since as a result of data transformation by the power term, the effect of outliers to capture volatility may change.

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APPENDICES

APPENDIX A

Table A1**:** 2001 TO 2013 DATA FOR NSE 20 SHARE INDEX, INFLATION GOVERNMENT SPENDING, OIL PRICE AND EXCHANGE RATE

Year/month	LNOP	LNFER	LNGS	LNINFL	LNRT
2001M01	3.256172	4.364499	11.68134	4.854605	7.548029
2001M02	3.304686	4.359909	11.81881	4.842611	7.566828
2001M03	3.219676	4.353499	11.98163	4.836123	7.512618
2001M04	3.218876	4.347694	12.10022	4.844187	7.477604
2001M05	3.316003	4.363608	12.24452	4.841427	7.40001
2001M06	3.217675	4.364626	12.345	4.839214	7.412764
2001M07	3.178054	4.369701	9.705829	4.848508	7.390799
2001M08	3.250762	4.368308	10.63564	4.844266	7.317212
2001M09	3.220075	4.368815	10.92029	4.846861	7.244849
2001M10	3.031582	4.369068	11.20887	4.845761	7.295056
2001M11	2.927989	4.368941	11.44769	4.843321	7.258412
2001M12	2.891482	4.365516	11.58839	4.846154	7.211557
2002M01	2.952303	4.364372	11.76844	4.840479	7.202966
2002M02	2.994732	4.359909	11.87209	4.842059	7.180504
2002M03	3.16294	4.357478	12.00219	4.84403	7.075893
2002M04	3.23593	4.360164	12.11977	4.843321	7.02938
2002M05	3.246102	4.360803	12.23934	4.863681	6.976413
2002M06	3.181797	4.365262	12.3512	4.881589	6.990827
2002M07	3.248435	4.366913	9.9487	4.90253	7.001
2002M08	3.287655	4.36399	10.62547	4.90149	6.950221
2002M09	3.342155	4.36704	10.94712	4.898138	6.934397
2002M10	3.315276	4.37349	11.24874	4.900597	7.017829
2002M11	3.313822	4.376637	11.51523	4.905201	7.057579
2002M12	3.328268	4.376134	11.7156	4.917642	7.217333
2003M01	3.42654	4.353113	11.87368	4.935265	7.320282
2003M02	3.492865	4.341725	12.00549	4.94663	7.350991
2003M03	3.413126	4.338336	12.12915	4.972933	7.382958
2003M04	3.238286	4.32625	12.21098	4.990297	7.521118
2003M05	3.260402	4.271235	12.34301	5.034222	7.638039
2003M06	3.328985	4.300274	12.47404	5.036498	7.567842
2003M07	3.353057	4.314149	9.947361	5.006092	7.603424
2003M08	3.390473	4.330207	10.59796	4.980932	7.653224
2003M09	3.291383	4.355426	11.0077	4.97411	7.774818
2003M10	3.367641	4.353756	11.30914	4.987503	7.806778
2003M11	3.529884	4.340423	11.51627	4.991113	7.91461
2003M12	3.399529	4.330996	11.73306	4.99782	7.9148

2004M01	3.446808	4.334542	11.88952	4.881286	8.057663
2004M02	3.553346	4.335852	12.03596	5.040841	8.063189
2004M03	3.516607	4.347176	12.15096	5.052864	7.926819
2004M04	3.517795	4.355554	12.27274	5.063354	7.903818
2004M05	3.627802	4.372481	12.3777	5.079726	7.896962
2004M06	3.570659	4.37286	12.5522	5.094364	7.77054
2004M07	3.635742	4.381902	10.02624	5.088213	7.903977
2004M08	3.739573	4.392348	10.74503	5.127529	7.904283
2004M09	3.729301	4.390986	11.15372	5.147494	7.890092
2004M10	3.847378	4.396915	11.41711	5.155601	7.947908
2004M11	3.743131	4.396915	11.65157	5.145166	7.97877
2004M12	3.665867	4.379147	11.86831	5.148424	7.988061
2005M01	3.758639	4.355811	12.02851	5.15986	8.037317
2005M02	3.796837	4.343026	12.14924	5.171052	8.074898
2005M03	3.930452	4.314818	12.28103	5.185149	8.073715
2005M04	3.924742	4.332705	12.37363	5.21167	8.079491
2005M05	3.867235	4.335983	12.49895	5.217649	8.162057
2005M06	3.986945	4.339641	12.62254	5.206805	8.287025
2005M07	4.031937	4.333755	10.0628	5.19927	8.289539
2005M08	4.125035	4.32823	10.89479	5.204556	8.278428
2005M09	4.111693	4.305416	11.3524	5.189506	8.251403
2005M10	4.063714	4.300138	11.59804	5.192012	8.278796
2005M11	4.006969	4.314015	11.81293	5.203787	8.287559
2005M12	4.03371	4.291965	12.0088	5.221328	8.287277
2006M01	4.132924	4.279579	12.23327	5.304548	8.336103
2006M02	4.0895	4.273884	12.35019	5.343912	8.308108
2006M03	4.109726	4.280547	12.49385	5.360353	8.319142
2006M04	4.219508	4.266896	12.57702	5.350388	8.300332
2006M05	4.228438	4.273327	12.69752	5.340514	8.377874
2006M06	4.223763	4.29606	12.82891	5.310493	8.357139
2006M07	4.283587	4.29946	10.43992	5.295914	8.356682
2006M08	4.274024	4.288677	11.14269	5.303006	8.408732
2006M09	4.12665	4.288677	11.48847	5.319198	8.492872
2006M10	4.059581	4.280686	11.83046	5.33773	8.578168
2006M11	4.062682	4.264509	12.02689	5.340419	8.633232
2006M12	4.110874	4.243196	12.23121	5.366256	8.638641
2007M01	3.977811	4.246779	12.34363	5.306881	8.661162
2007M02	4.053175	4.243052	12.49726	5.409814	8.591796
2007M03	4.104295	4.238301	12.61347	5.417433	8.543576
2007M04	4.175925	4.228001	12.71597	5.405421	8.556306
2007M05	4.175925	4.207524	12.82494	5.401911	8.517547
2007M06	4.222298	4.198254	12.93362	5.415789	8.546117

2007M07	4.299596	4.205737	10.00951	5.423054	8.582996
2007M08	4.250351	4.203946	11.03603	5.419605	8.588903
2007M09	4.342636	4.204991	11.39523	5.421198	8.546064
2007M10	4.408547	4.202451	11.82596	5.438036	8.511384
2007M11	4.513822	4.181897	12.11257	5.534417	8.559363
2007M12	4.493456	4.147885	12.41122	5.559951	8.602422
2008M01	4.50888	4.220683	12.56593	5.56314	8.458018
2008M02	4.540632	4.257313	12.66304	5.584886	8.531571
2008M03	4.623403	4.173156	12.76124	5.614915	8.485325
2008M04	4.691806	4.131319	12.87206	5.641481	8.582237
2008M05	4.810313	4.12552	13.01341	5.676034	8.551755
2008M06	4.879159	4.15544	13.17214	5.672464	8.553633
2008M07	4.88696	4.200205	10.27949	5.658157	8.490494
2008M08	4.741186	4.214791	11.31407	5.663169	8.44436
2008M09	4.598045	4.268438	11.786	5.664972	8.338162
2008M10	4.286204	4.33938	12.09203	5.688263	8.127597
2008M11	3.989725	4.359014	12.33495	5.709731	8.114025
2008M12	3.726416	4.357222	12.52162	5.724434	8.166551
2009M01	3.782142	4.368815	12.59508	5.762114	8.070562
2009M02	3.731939	4.376134	12.74877	5.808773	7.813915
2009M03	3.849083	4.385271	12.89679	5.818004	7.939159
2009M04	3.917607	4.377391	13.04623	5.873131	7.93741
2009M05	4.062166	4.354912	13.15384	5.854384	7.955986
2009M06	4.235989	4.354784	13.25889	5.835921	8.10004
2009M07	4.168988	4.340553	10.91494	4.935696	8.093493
2009M08	4.271514	4.33559	11.56396	4.941214	8.040028
2009M09	4.22508	4.325456	12.01663	4.945279	8.008199
2009M10	4.305146	4.320683	12.27522	4.950248	8.033853
2009M11	4.351052	4.314015	12.46542	4.9523	8.067651
2009M12	4.315887	4.323205	12.69447	4.954982	8.08561
2010M01	4.345363	4.327966	12.85228	4.648134	8.179003
2010M02	4.313748	4.340293	13.01421	4.654532	8.196823
2010M03	4.373238	4.343156	13.16748	4.653579	8.312111
2010M04	4.432482	4.347047	13.2682	4.658711	8.350713
2010M05	4.324662	4.363608	13.38568	4.660605	8.352743
2010M06	4.313882	4.394696	13.56339	4.660132	8.375468
2010M07	4.311068	4.399744	10.26123	4.663062	8.398094
2010M08	4.329153	4.387512	11.40311	4.665795	8.401693
2010M09	4.33218	4.393337	12.02121	4.670396	8.440269
2010M10	4.403299	4.390862	12.36942	4.671894	8.446685
2010M11	4.437107	4.38776	12.61919	4.681761	8.388268
2010M12	4.500587	4.389102	12.81995	4.694828	8.396742

2011M01	4.522441	4.394807	12.97787	4.705739	8.404024
2011M02	4.582209	4.400272	13.10934	4.719034	8.352319
2011M03	4.682594	4.433266	13.23944	4.741622	8.265393
2011M04	4.753763	4.429506	13.32029	4.756087	8.301273
2011M05	4.683797	4.447732	13.44193	4.780803	8.313362
2011M06	4.662023	4.489187	13.58907	4.795046	8.286017
2011M07	4.673576	4.498676	10.68554	4.804922	8.226306
2011M08	4.60567	4.530296	11.47086	4.82004	8.150179
2011M09	4.60547	4.56806	12.09863	4.830152	8.096817
2011M10	4.60437	4.61779	12.4224	4.845761	8.162516
2011M11	4.654532	4.539885	12.6755	4.86082	8.056744
2011M12	4.646888	4.461992	12.97285	4.868227	8.072467
2012M01	4.664288	4.458293	13.13429	4.873822	8.078378
2012M02	4.724729	4.421007	13.23289	4.873364	8.102889
2012M03	4.762943	4.417635	13.39294	4.886658	8.121777
2012M04	4.727476	4.421127	13.49923	4.895898	8.173857
2012M05	4.645352	4.43533	13.69933	4.898511	8.202756
2012M06	4.499921	4.440178	13.72765	4.8908	8.217169
2012M07	4.57213	4.432482	11.23333	4.882196	8.251142
2012M08	4.654722	4.431769	11.70806	4.879083	8.259976
2012M09	4.663628	4.438052	12.30613	4.882726	8.287025
2012M10	4.638508	4.443945	12.64313	4.886281	8.33014
2012M11	4.616209	4.450036	12.93412	4.892827	8.314587
2012M12	4.616209	4.454231	13.13572	4.900448	8.326759

APPENDIX B: UNIT ROOT TEST

Table A2**:** Unit Root Test

Null Hypothesis: LNINFL has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.600934	0.4795
Test critical values:	1% level	-3.476472	
	5% level	-2.881685	
	10% level	-2.577591	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNINFL)
Method: Least Squares
Date: 08/25/15 Time: 12:24
Sample (adjusted): 2001M02 2012M12
Included observations: 143 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINFL(-1)	-0.035008	0.021867	-1.600934	0.1116
C	0.178735	0.111664	1.600650	0.1117

R-squared	0.017853	Mean dependent var	0.000321
Adjusted R-squared	0.010887	S.D. dependent var	0.084243
S.E. of regression	0.083783	Akaike info criterion	-2.107284
Sum squared resid	0.989764	Schwarz criterion	-2.065846
Log likelihood	152.6708	Hannan-Quinn criter.	-2.090445
F-statistic	2.562988	Durbin-Watson stat	1.947438
Prob(F-statistic)	0.111630		

Null Hypothesis: LNINFL has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.582364	0.7953
Test critical values:	1% level	-4.023506	
	5% level	-3.441552	
	10% level	-3.145341	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNINFL)
Method: Least Squares
Date: 08/25/15 Time: 12:25
Sample (adjusted): 2001M02 2012M12
Included observations: 143 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINFL(-1)	-0.034669	0.021909	-1.582364	0.1158
C	0.185846	0.112287	1.655107	0.1001
@TREND("2001M01")	-0.000123	0.000170	-0.722024	0.4715

R-squared	0.021496	Mean dependent var	0.000321
Adjusted R-squared	0.007518	S.D. dependent var	0.084243
S.E. of regression	0.083926	Akaike info criterion	-2.097015
Sum squared resid	0.986092	Schwarz criterion	-2.034857
Log likelihood	152.9366	Hannan-Quinn criter.	-2.071757
F-statistic	1.537803	Durbin-Watson stat	1.955360
Prob(F-statistic)	0.218460		

Null Hypothesis: LNINFL has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.054485	0.6630
Test critical values:	1% level	-2.581233	
	5% level	-1.943074	
	10% level	-1.615231	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNINFL)
Method: Least Squares
Date: 08/25/15 Time: 12:26
Sample (adjusted): 2001M02 2012M12
Included observations: 143 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINFL(-1)	-7.52E-05	0.001380	-0.054485	0.9566

R-squared	0.000006	Mean dependent var	0.000321
Adjusted R-squared	0.000006	S.D. dependent var	0.084243
S.E. of regression	0.084243	Akaike info criterion	-2.103262

Sum squared resid	1.007749	Schwarz criterion	-2.082543
Log likelihood	151.3833	Hannan-Quinn criter.	-2.094843
Durbin-Watson stat	1.980655		

Null Hypothesis: LNFER has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.974010	0.2980
Test critical values:	1% level	-3.476805	
	5% level	-2.881830	
	10% level	-2.577668	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNFER)
Method: Least Squares
Date: 08/25/15 Time: 12:27
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNFER(-1)	-0.042139	0.021347	-1.974010	0.0504
D(LNFER(-1))	0.329457	0.080630	4.086010	0.0001
C	0.183440	0.092700	1.978850	0.0498

R-squared	0.117699	Mean dependent var	0.000664
Adjusted R-squared	0.105004	S.D. dependent var	0.021788
S.E. of regression	0.020612	Akaike info criterion	-4.904939
Sum squared resid	0.059058	Schwarz criterion	-4.842492
Log likelihood	351.2507	Hannan-Quinn criter.	-4.879563
F-statistic	9.271280	Durbin-Watson stat	1.891035
Prob(F-statistic)	0.000166		

Null Hypothesis: LNFER has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.198338	0.4865
Test critical values:	1% level	-4.023975	
	5% level	-3.441777	
	10% level	-3.145474	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNFER)
Method: Least Squares
Date: 08/25/15 Time: 12:28
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNFER(-1)	-0.048349	0.021993	-2.198338	0.0296
D(LNFER(-1))	0.326119	0.080588	4.046729	0.0001
C	0.206767	0.094782	2.181497	0.0308
@TREND("2001M01")	5.02E-05	4.36E-05	1.151501	0.2515

R-squared	0.126096	Mean dependent var	0.000664
Adjusted R-squared	0.107098	S.D. dependent var	0.021788
S.E. of regression	0.020588	Akaike info criterion	-4.900417
Sum squared resid	0.058496	Schwarz criterion	-4.817155
Log likelihood	351.9296	Hannan-Quinn criter.	-4.866583
F-statistic	6.637333	Durbin-Watson stat	1.891115
Prob(F-statistic)	0.000320		

Null Hypothesis: LNFER has a unit root
Exogenous: None
Lag Length: 2 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.312315	0.7746
Test critical values:	1% level	-2.581466	
	5% level	-1.943107	
	10% level	-1.615210	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNFER)
Method: Least Squares
Date: 08/25/15 Time: 12:29
Sample (adjusted): 2001M04 2012M12
Included observations: 141 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNFER(-1)	0.000125	0.000399	0.312315	0.7553
D(LNFER(-1))	0.363198	0.083518	4.348734	0.0000
D(LNFER(-2))	-0.192866	0.083523	-2.309136	0.0224

R-squared	0.126359	Mean dependent var	0.000714
Adjusted R-squared	0.113698	S.D. dependent var	0.021858
S.E. of regression	0.020577	Akaike info criterion	-4.908190
Sum squared resid	0.058434	Schwarz criterion	-4.845451
Log likelihood	349.0274	Hannan-Quinn criter.	-4.882695
Durbin-Watson stat	1.950389		

Null Hypothesis: LNOP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.354163	0.6031
Test critical values:	1% level	-3.476805	
	5% level	-2.881830	
	10% level	-2.577668	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNOP)
Method: Least Squares
Date: 09/21/15 Time: 09:59
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNOP(-1)	-0.017638	0.013025	-1.354163	0.1779
D(LNOP(-1))	0.288477	0.080987	3.562034	0.0005
C	0.077125	0.052586	1.466644	0.1447

R-squared	0.091143	Mean dependent var	0.009236
Adjusted R-squared	0.078065	S.D. dependent var	0.085975
S.E. of regression	0.082551	Akaike info criterion	-2.129895
Sum squared resid	0.947244	Schwarz criterion	-2.067448
Log likelihood	154.2226	Hannan-Quinn criter.	-2.104519
F-statistic	6.969634	Durbin-Watson stat	1.996914
Prob(F-statistic)	0.001305		

Null Hypothesis: LNOP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.054641	0.1215
Test critical values:	1% level	-4.023975	
	5% level	-3.441777	

	10% level	-3.145474	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNOP)
Method: Least Squares
Date: 09/21/15 Time: 09:59
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNOP(-1)	-0.092719	0.030354	-3.054641	0.0027
D(LNOP(-1))	0.329139	0.080571	4.085072	0.0001
C	0.299670	0.096504	3.105262	0.0023
@TREND("2001M01")	0.001073	0.000394	2.724949	0.0073

R-squared	0.137548	Mean dependent var	0.009236
Adjusted R-squared	0.118799	S.D. dependent var	0.085975
S.E. of regression	0.080707	Akaike info criterion	-2.168220
Sum squared resid	0.898878	Schwarz criterion	-2.084957
Log likelihood	157.9436	Hannan-Quinn criter.	-2.134385
F-statistic	7.336321	Durbin-Watson stat	2.038953
Prob(F-statistic)	0.000134		

Null Hypothesis: LNOP has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.747843	0.8747
Test critical values:	1% level	-2.581349	
	5% level	-1.943090	
	10% level	-1.615220	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNOP)
Method: Least Squares
Date: 09/21/15 Time: 10:00
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

LNOP(-1)	0.001296	0.001734	0.747843	0.4558
D(LNOP(-1))	0.282351	0.081211	3.476781	0.0007

R-squared	0.077078	Mean dependent var	0.009236
Adjusted R-squared	0.070486	S.D. dependent var	0.085975
S.E. of regression	0.082890	Akaike info criterion	-2.128623
Sum squared resid	0.961903	Schwarz criterion	-2.086992
Log likelihood	153.1322	Hannan-Quinn criter.	-2.111706
Durbin-Watson stat	1.991437		

Null Hypothesis: LNRT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.065777	0.7282
Test critical values:	1% level	-3.476472	
	5% level	-2.881685	
	10% level	-2.577591	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRT)
Method: Least Squares
Date: 08/25/15 Time: 12:38
Sample (adjusted): 2001M02 2012M12
Included observations: 143 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRT(-1)	-0.012832	0.012040	-1.065777	0.2883
C	0.108504	0.096854	1.120284	0.2645

R-squared	0.007992	Mean dependent var	0.005446
Adjusted R-squared	0.000956	S.D. dependent var	0.065770
S.E. of regression	0.065739	Akaike info criterion	-2.592372
Sum squared resid	0.609341	Schwarz criterion	-2.550934
Log likelihood	187.3546	Hannan-Quinn criter.	-2.575534
F-statistic	1.135880	Durbin-Watson stat	1.692923
Prob(F-statistic)	0.288346		

Null Hypothesis: LNRT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.062081	0.9308
Test critical values:	1% level	-4.023506	

	5% level	-3.441552	
	10% level	-3.145341	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRT)
Method: Least Squares
Date: 08/25/15 Time: 12:39
Sample (adjusted): 2001M02 2012M12
Included observations: 143 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRT(-1)	-0.017707	0.016672	-1.062081	0.2900
C	0.142029	0.125238	1.134073	0.2587
@TREND("2001M01")	7.82E-05	0.000184	0.424099	0.6721

R-squared	0.009264	Mean dependent var	0.005446
Adjusted R-squared	-0.004889	S.D. dependent var	0.065770
S.E. of regression	0.065931	Akaike info criterion	-2.579670
Sum squared resid	0.608559	Schwarz criterion	-2.517513
Log likelihood	187.4464	Hannan-Quinn criter.	-2.554412
F-statistic	0.654566	Durbin-Watson stat	1.686876
Prob(F-statistic)	0.521250		

Null Hypothesis: LNRT has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.927677	0.9053
Test critical values:	1% level	-2.581233	
	5% level	-1.943074	
	10% level	-1.615231	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRT)
Method: Least Squares
Date: 08/25/15 Time: 12:40
Sample (adjusted): 2001M02 2012M12
Included observations: 143 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

LNRT(-1)	0.000635	0.000684	0.927677	0.3551

R-squared	-0.000838	Mean dependent var	0.005446
Adjusted R-squared	-0.000838	S.D. dependent var	0.065770
S.E. of regression	0.065798	Akaike info criterion	-2.597497
Sum squared resid	0.614765	Schwarz criterion	-2.576778
Log likelihood	186.7210	Hannan-Quinn criter.	-2.589077
Durbin-Watson stat	1.700714		

Null Hypothesis: D(LNINFL) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.72082	0.0000
Test critical values:	1% level	-3.476805	
	5% level	-2.881830	
	10% level	-2.577668	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNINFL,2)
Method: Least Squares
Date: 08/25/15 Time: 12:41
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINFL(-1))	-0.990496	0.084507	-11.72082	0.0000
C	0.000405	0.007119	0.056854	0.9547

R-squared	0.495273	Mean dependent var	0.000138
Adjusted R-squared	0.491668	S.D. dependent var	0.118984
S.E. of regression	0.084832	Akaike info criterion	-2.082297
Sum squared resid	1.007512	Schwarz criterion	-2.040666
Log likelihood	149.8431	Hannan-Quinn criter.	-2.065380
F-statistic	137.3776	Durbin-Watson stat	2.000601
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNINFL) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.72912	0.0000
Test critical values:	1% level	-4.023975	

	5% level	-3.441777	
	10% level	-3.145474	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNINFL,2)
Method: Least Squares
Date: 08/25/15 Time: 12:42
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINFL(-1))	-0.994740	0.084809	-11.72912	0.0000
C	0.010141	0.014510	0.698901	0.4858
@TREND("2001M01")	-0.000134	0.000174	-0.770416	0.4424

R-squared	0.497419	Mean dependent var	0.000138
Adjusted R-squared	0.490187	S.D. dependent var	0.118984
S.E. of regression	0.084956	Akaike info criterion	-2.072474
Sum squared resid	1.003228	Schwarz criterion	-2.010027
Log likelihood	150.1456	Hannan-Quinn criter.	-2.047098
F-statistic	68.78613	Durbin-Watson stat	2.000424
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNINFL) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.76235	0.0000
Test critical values:	1% level	-2.581349	
	5% level	-1.943090	
	10% level	-1.615220	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNINFL,2)
Method: Least Squares
Date: 08/25/15 Time: 12:42
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINFL(-1))	-0.990481	0.084208	-11.76235	0.0000

R-squared	0.495261	Mean dependent var	0.000138
Adjusted R-squared	0.495261	S.D. dependent var	0.118984
S.E. of regression	0.084532	Akaike info criterion	-2.096359
Sum squared resid	1.007535	Schwarz criterion	-2.075543
Log likelihood	149.8415	Hannan-Quinn criter.	-2.087900
Durbin-Watson stat	2.000587		

Null Hypothesis: D(LNFER) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.424471	0.0000
Test critical values:	1% level	-3.477144	
	5% level	-2.881978	
	10% level	-2.577747	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNFER,2)
Method: Least Squares
Date: 08/25/15 Time: 12:43
Sample (adjusted): 2001M04 2012M12
Included observations: 141 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNFER(-1))	-0.829624	0.098478	-8.424471	0.0000
D(LNFER(-1),2)	0.192811	0.083511	2.308810	0.0224
C	0.000591	0.001734	0.340807	0.7338

R-squared	0.372174	Mean dependent var	7.52E-05
Adjusted R-squared	0.363075	S.D. dependent var	0.025782
S.E. of regression	0.020576	Akaike info criterion	-4.908325
Sum squared resid	0.058426	Schwarz criterion	-4.845585
Log likelihood	349.0369	Hannan-Quinn criter.	-4.882830
F-statistic	40.90301	Durbin-Watson stat	1.950396
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNFER) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=13)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-8.440443	0.0000

Test critical values:	1% level	-4.024452	
	5% level	-3.442006	
	10% level	-3.145608	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNFER,2)
Method: Least Squares
Date: 08/25/15 Time: 12:44
Sample (adjusted): 2001M04 2012M12
Included observations: 141 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNFER(-1))	-0.835909	0.099036	-8.440443	0.0000
D(LNFER(-1),2)	0.195947	0.083771	2.339087	0.0208
C	-0.001655	0.003571	-0.463331	0.6439
@TREND("2001M01")	3.08E-05	4.28E-05	0.719658	0.4730

R-squared	0.374538	Mean dependent var	7.52E-05
Adjusted R-squared	0.360842	S.D. dependent var	0.025782
S.E. of regression	0.020612	Akaike info criterion	-4.897914
Sum squared resid	0.058206	Schwarz criterion	-4.814261
Log likelihood	349.3029	Hannan-Quinn criter.	-4.863920
F-statistic	27.34605	Durbin-Watson stat	1.950645
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNFER) has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.444634	0.0000
Test critical values:	1% level	-2.581466	
	5% level	-1.943107	
	10% level	-1.615210	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNFER,2)
Method: Least Squares
Date: 08/25/15 Time: 12:45
Sample (adjusted): 2001M04 2012M12
Included observations: 141 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNFER(-1))	-0.828477	0.098107	-8.444634	0.0000
D(LNFER(-1),2)	0.192306	0.083232	2.310479	0.0223

R-squared	0.371645	Mean dependent var	7.52E-05
Adjusted R-squared	0.367125	S.D. dependent var	0.025782
S.E. of regression	0.020511	Akaike info criterion	-4.921668
Sum squared resid	0.058475	Schwarz criterion	-4.879842
Log likelihood	348.9776	Hannan-Quinn criter.	-4.904671
Durbin-Watson stat	1.950169		

Null Hypothesis: D(LNGS) has a unit root
Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.148940	0.0000
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGS,2)
Method: Least Squares
Date: 08/25/15 Time: 12:46
Sample (adjusted): 2002M02 2012M12
Included observations: 131 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGS(-1))	-7.218341	1.009708	-7.148940	0.0000
D(LNGS(-1),2)	5.625920	0.925910	6.076095	0.0000
D(LNGS(-2),2)	5.023454	0.842805	5.960402	0.0000
D(LNGS(-3),2)	4.422262	0.758994	5.826481	0.0000
D(LNGS(-4),2)	3.819388	0.674935	5.658894	0.0000
D(LNGS(-5),2)	3.214533	0.590610	5.442733	0.0000
D(LNGS(-6),2)	2.611740	0.506003	5.161508	0.0000
D(LNGS(-7),2)	2.010989	0.421549	4.770472	0.0000
D(LNGS(-8),2)	1.411201	0.337222	4.184779	0.0001
D(LNGS(-9),2)	0.811363	0.253005	3.206910	0.0017
D(LNGS(-10),2)	0.210856	0.168815	1.249034	0.2141
D(LNGS(-11),2)	-0.384701	0.084587	-4.547983	0.0000
C	0.077746	0.015859	4.902313	0.0000

R-squared	0.990632	Mean dependent var	0.000164
Adjusted R-squared	0.989679	S.D. dependent var	1.307334
S.E. of regression	0.132815	Akaike info criterion	-1.105759

Sum squared resid	2.081499	Schwarz criterion	-0.820434
Log likelihood	85.42719	Hannan-Quinn criter.	-0.989818
F-statistic	1039.808	Durbin-Watson stat	2.114957
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNGS) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 11 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.407590	0.0000
Test critical values:	1% level	-4.029595	
	5% level	-3.444487	
	10% level	-3.147063	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGS,2)
Method: Least Squares
Date: 08/25/15 Time: 12:47
Sample (adjusted): 2002M02 2012M12
Included observations: 131 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGS(-1))	-7.632873	1.030412	-7.407590	0.0000
D(LNGS(-1),2)	6.006021	0.944893	6.356298	0.0000
D(LNGS(-2),2)	5.369671	0.860115	6.242968	0.0000
D(LNGS(-3),2)	4.734612	0.774660	6.111858	0.0000
D(LNGS(-4),2)	4.098125	0.689002	5.947916	0.0000
D(LNGS(-5),2)	3.459734	0.603097	5.736608	0.0000
D(LNGS(-6),2)	2.822581	0.516808	5.461564	0.0000
D(LNGS(-7),2)	2.186459	0.430526	5.078580	0.0000
D(LNGS(-8),2)	1.551260	0.344360	4.504763	0.0000
D(LNGS(-9),2)	0.916104	0.258313	3.546492	0.0006
D(LNGS(-10),2)	0.280425	0.172313	1.627416	0.1063
D(LNGS(-11),2)	-0.350134	0.086300	-4.057189	0.0001
C	0.040241	0.026973	1.491901	0.1384
@TREND("2001M01")	0.000538	0.000314	1.711732	0.0896

R-squared	0.990861	Mean dependent var	0.000164
Adjusted R-squared	0.989845	S.D. dependent var	1.307334
S.E. of regression	0.131742	Akaike info criterion	-1.115226
Sum squared resid	2.030646	Schwarz criterion	-0.807953
Log likelihood	87.04730	Hannan-Quinn criter.	-0.990367
F-statistic	975.7476	Durbin-Watson stat	2.088555
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNGS) has a unit root
Exogenous: None
Lag Length: 12 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.151623	0.0018
Test critical values:	1% level	-2.582872	
	5% level	-1.943304	
	10% level	-1.615087	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGS,2)
Method: Least Squares
Date: 08/25/15 Time: 12:48
Sample (adjusted): 2002M03 2012M12
Included observations: 130 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGS(-1))	-2.693360	0.854595	-3.151623	0.0021
D(LNGS(-1),2)	1.188191	0.823503	1.442850	0.1517
D(LNGS(-2),2)	0.961360	0.753100	1.276538	0.2043
D(LNGS(-3),2)	0.733780	0.682967	1.074401	0.2849
D(LNGS(-4),2)	0.507010	0.612504	0.827766	0.4095
D(LNGS(-5),2)	0.279166	0.542039	0.515030	0.6075
D(LNGS(-6),2)	0.054530	0.472030	0.115523	0.9082
D(LNGS(-7),2)	-0.168076	0.402144	-0.417950	0.6768
D(LNGS(-8),2)	-0.389727	0.332630	-1.171654	0.2437
D(LNGS(-9),2)	-0.611961	0.264091	-2.317240	0.0222
D(LNGS(-10),2)	-0.835277	0.197484	-4.229593	0.0000
D(LNGS(-11),2)	-1.053673	0.135623	-7.769141	0.0000
D(LNGS(-12),2)	-0.292022	0.088743	-3.290664	0.0013

R-squared	0.989679	Mean dependent var	0.000753
Adjusted R-squared	0.988620	S.D. dependent var	1.312374
S.E. of regression	0.140000	Akaike info criterion	-0.999712
Sum squared resid	2.293194	Schwarz criterion	-0.712958
Log likelihood	77.98128	Hannan-Quinn criter.	-0.883194
Durbin-Watson stat	2.077406		

Null Hypothesis: D(LNOP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-8.869738	0.0000
Test critical values:	1% level	-3.476805	
	5% level	-2.881830	
	10% level	-2.577668	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNOP,2)
Method: Least Squares
Date: 09/21/15 Time: 10:02
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNOP(-1))	-0.718854	0.081046	-8.869738	0.0000
C	0.006543	0.006991	0.935916	0.3509

R-squared	0.359772	Mean dependent var	-0.000342
Adjusted R-squared	0.355199	S.D. dependent var	0.103110
S.E. of regression	0.082797	Akaike info criterion	-2.130873
Sum squared resid	0.959740	Schwarz criterion	-2.089242
Log likelihood	153.2920	Hannan-Quinn criter.	-2.113956
F-statistic	78.67225	Durbin-Watson stat	1.990890
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNOP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.838937	0.0000
Test critical values:	1% level	-4.023975	
	5% level	-3.441777	
	10% level	-3.145474	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNOP,2)
Method: Least Squares
Date: 09/21/15 Time: 10:03
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

D(LNOP(-1))	-0.719020	0.081347	-8.838937	0.0000
C	0.007913	0.014203	0.557120	0.5783
@TREND("2001M01")	-1.89E-05	0.000170	-0.110897	0.9119

R-squared	0.359829	Mean dependent var	-0.000342
Adjusted R-squared	0.350618	S.D. dependent var	0.103110
S.E. of regression	0.083090	Akaike info criterion	-2.116877
Sum squared resid	0.959656	Schwarz criterion	-2.054430
Log likelihood	153.2983	Hannan-Quinn criter.	-2.091501
F-statistic	39.06476	Durbin-Watson stat	1.990732
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNOP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.824242	0.0000
Test critical values:	1% level	-2.581349	
	5% level	-1.943090	
	10% level	-1.615220	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNOP,2)
Method: Least Squares
Date: 09/21/15 Time: 10:04
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNOP(-1))	-0.710432	0.080509	-8.824242	0.0000

R-squared	0.355767	Mean dependent var	-0.000342
Adjusted R-squared	0.355767	S.D. dependent var	0.103110
S.E. of regression	0.082760	Akaike info criterion	-2.138721
Sum squared resid	0.965745	Schwarz criterion	-2.117905
Log likelihood	152.8492	Hannan-Quinn criter.	-2.130262
Durbin-Watson stat	1.995616		

Null Hypothesis: D(LNRT) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-10.18087	0.0000
Test critical values: 1% level	-3.476805	
5% level	-2.881830	
10% level	-2.577668	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRT,2)
Method: Least Squares
Date: 08/25/15 Time: 12:51
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNRT(-1))	-0.850702	0.083559	-10.18087	0.0000
C	0.004546	0.005514	0.824394	0.4111

R-squared	0.425406	Mean dependent var	-4.67E-05
Adjusted R-squared	0.421301	S.D. dependent var	0.086084
S.E. of regression	0.065486	Akaike info criterion	-2.599974
Sum squared resid	0.600380	Schwarz criterion	-2.558342
Log likelihood	186.5981	Hannan-Quinn criter.	-2.583056
F-statistic	103.6501	Durbin-Watson stat	2.011858
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNRT) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-10.15399	0.0000
Test critical values: 1% level	-4.023975	
5% level	-3.441777	
10% level	-3.145474	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRT,2)
Method: Least Squares
Date: 08/25/15 Time: 12:52
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

D(LNRT(-1))	-0.851755	0.083884	-10.15399	0.0000
C	0.007824	0.011231	0.696662	0.4872
@TREND("2001M01")	-4.51E-05	0.000135	-0.335429	0.7378

R-squared	0.425870	Mean dependent var	-4.67E-05
Adjusted R-squared	0.417609	S.D. dependent var	0.086084
S.E. of regression	0.065695	Akaike info criterion	-2.586698
Sum squared resid	0.599894	Schwarz criterion	-2.524251
Log likelihood	186.6556	Hannan-Quinn criter.	-2.561322
F-statistic	51.55278	Durbin-Watson stat	2.011247
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNRT) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.15899	0.0000
Test critical values:	1% level	-2.581349	
	5% level	-1.943090	
	10% level	-1.615220	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRT,2)
Method: Least Squares
Date: 08/25/15 Time: 12:53
Sample (adjusted): 2001M03 2012M12
Included observations: 142 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNRT(-1))	-0.845067	0.083184	-10.15899	0.0000

R-squared	0.422616	Mean dependent var	-4.67E-05
Adjusted R-squared	0.422616	S.D. dependent var	0.086084
S.E. of regression	0.065412	Akaike info criterion	-2.609215
Sum squared resid	0.603294	Schwarz criterion	-2.588400
Log likelihood	186.2543	Hannan-Quinn criter.	-2.600757
Durbin-Watson stat	2.014182		

APPENDIX C: VECTOR ERROR CORRECTION MODEL

Table A3: Vector error correction model

Dependent Variable: D(LNRT)
Method: Least Squares
Date: 11/13/15 Time: 09:43
Sample (adjusted): 2002M03 2012M12
Included observations: 130 after adjustments
D(LNRT) = C(1)*(LNRT(-1) + 1.52695685666*LNOP(-1) - 0.0280948770386) + C(2)*(LNFER(-1) + 1.22694451646*LNOP(-1) - 0.016362959398) + C(3)*(LNGS(-1) + 0.00306293876419*LNOP(-1) - 0.00900593759888) + C(4)*(LNINFL(-1) - 5.36145867622*LNOP(-1) + 0.0682201318333) + C(5)*D(LNRT(-1)) + C(6)*D(LNRT(-2)) + C(7)*D(LNRT(-3)) + C(8)*D(LNRT(-4)) + C(9)*D(LNRT(-5)) + C(10)*D(LNRT(-6)) + C(11)*D(LNRT(-7)) + C(12)*D(LNRT(-8)) + C(13)*D(LNRT(-9)) + C(14)*D(LNRT(-10)) + C(15)*D(LNRT(-11)) + C(16)*D(LNRT(-12)) + C(17)*D(LNFER(-1)) + C(18)*D(LNFER(-2)) + C(19)*D(LNFER(-3)) + C(20)*D(LNFER(-4)) + C(21)*D(LNFER(-5)) + C(22)*D(LNFER(-6)) + C(23)*D(LNFER(-7)) + C(24)*D(LNFER(-8)) + C(25)*D(LNFER(-9)) + C(26)*D(LNFER(-10)) + C(27)*D(LNFER(-11)) + C(28)*D(LNFER(-12)) + C(29)*D(LNGS(-1)) + C(30)*D(LNGS(-2)) + C(31)*D(LNGS(-3)) + C(32)*D(LNGS(-4)) + C(33)*D(LNGS(-5)) + C(34)*D(LNGS(-6)) + C(35)*D(LNGS(-7)) + C(36)*D(LNGS(-8)) + C(37)*D(LNGS(-9)) + C(38)*D(LNGS(-10)) + C(39)*D(LNGS(-11)) + C(40)*D(LNGS(-12)) + C(41)*D(LNINFL(-1)) + C(42)*D(LNINFL(-2)) + C(43)*D(LNINFL(-3)) + C(44)*D(LNINFL(-4)) + C(45)*D(LNINFL(-5)) + C(46)*D(LNINFL(-6)) + C(47)*D(LNINFL(-7)) + C(48)*D(LNINFL(-8)) + C(49)*D(LNINFL(-9)) + C(50)*D(LNINFL(-10)) + C(51)*D(LNINFL(-11)) + C(52)*D(LNINFL(-12)) + C(53)*D(LNOP(-1)) + C(54)*D(LNOP(-2)) + C(55)*D(LNOP(-3)) + C(56)*D(LNOP(-4)) + C(57)*D(LNOP(-5)) + C(58)*D(LNOP(-6)) + C(59)*D(LNOP(-7)) + C(60)*D(LNOP(-8)) + C(61)*D(LNOP(-9)) + C(62)*D(LNOP(-10)) + C(63)*D(LNOP(-11)) + C(64)*D(LNOP(-12)) + C(65)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.565884	0.261455	-2.164366	0.0341
C(2)	0.151088	1.024795	0.147433	0.8832
C(3)	-0.201485	0.877832	-0.229525	0.8192
C(4)	-0.132836	0.268453	-0.494819	0.6224
C(5)	-0.264876	0.250647	-1.056769	0.2945
C(6)	-0.099368	0.246911	-0.402443	0.6887
C(7)	0.130061	0.243403	0.534345	0.5949
C(8)	0.219326	0.239189	0.916956	0.3626
C(9)	-0.001850	0.239935	-0.007709	0.9939
C(10)	0.057408	0.225206	0.254913	0.7996
C(11)	-0.026716	0.212906	-0.125480	0.9005
C(12)	-0.030803	0.205222	-0.150096	0.8812
C(13)	0.026026	0.206638	0.125949	0.9002
C(14)	0.096157	0.200735	0.479024	0.6335

C(15)	0.116030	0.182898	0.634398	0.5280
C(16)	-0.040627	0.136778	-0.297032	0.7674
C(17)	-0.604169	0.982667	-0.614826	0.5408
C(18)	-0.244072	0.935074	-0.261019	0.7949
C(19)	-0.397091	0.885707	-0.448332	0.6554
C(20)	-0.957166	0.830260	-1.152851	0.2532
C(21)	-0.447779	0.772713	-0.579489	0.5643
C(22)	-0.626702	0.747608	-0.838276	0.4049
C(23)	-0.192392	0.705894	-0.272551	0.7861
C(24)	-1.109250	0.653192	-1.698199	0.0943
C(25)	-1.063620	0.606355	-1.754122	0.0841
C(26)	-0.728529	0.593498	-1.227518	0.2241
C(27)	0.196312	0.470384	0.417344	0.6778
C(28)	-0.410893	0.436017	-0.942379	0.3495
C(29)	0.137817	0.837742	0.164510	0.8698
C(30)	0.121780	0.766036	0.158974	0.8742
C(31)	0.091481	0.694248	0.131770	0.8956
C(32)	0.069041	0.621404	0.111105	0.9119
C(33)	0.045475	0.548455	0.082914	0.9342
C(34)	0.031011	0.476315	0.065105	0.9483
C(35)	0.015403	0.403908	0.038135	0.9697
C(36)	0.013247	0.331428	0.039970	0.9682
C(37)	-0.004029	0.259323	-0.015537	0.9877
C(38)	-0.028028	0.188605	-0.148606	0.8823
C(39)	-0.048333	0.121347	-0.398303	0.6917
C(40)	-0.063622	0.068849	-0.924090	0.3589
C(41)	0.172475	0.239731	0.719453	0.4744
C(42)	0.272460	0.220274	1.236914	0.2206
C(43)	0.181827	0.220084	0.826169	0.4117
C(44)	0.096153	0.226799	0.423958	0.6730
C(45)	0.082215	0.231997	0.354379	0.7242
C(46)	0.092258	0.236702	0.389763	0.6980
C(47)	0.112275	0.223531	0.502278	0.6172
C(48)	-0.069828	0.200551	-0.348178	0.7288
C(49)	-0.000520	0.178496	-0.002913	0.9977
C(50)	0.115261	0.149388	0.771556	0.4432
C(51)	0.069205	0.127743	0.541749	0.5898
C(52)	0.022760	0.099433	0.228894	0.8197
C(53)	-0.171963	0.325104	-0.528947	0.5986
C(54)	-0.046576	0.319816	-0.145634	0.8847
C(55)	0.066492	0.309579	0.214781	0.8306
C(56)	-0.042809	0.289939	-0.147646	0.8831
C(57)	0.004920	0.281531	0.017477	0.9861
C(58)	-0.070954	0.278378	-0.254885	0.7996
C(59)	-0.131705	0.266015	-0.495105	0.6222
C(60)	-0.160598	0.244296	-0.657391	0.5133
C(61)	-0.140589	0.223392	-0.629339	0.5313
C(62)	-0.065099	0.195198	-0.333500	0.7398
C(63)	-0.026702	0.154037	-0.173351	0.8629
C(64)	0.134012	0.112095	1.195517	0.2362

C(65)	-0.000130	0.006024	-0.021522	0.9829

R-squared	0.719129	Mean dependent var	0.000266
Adjusted R-squared	0.442579	S.D. dependent var	0.088089
S.E. of regression	0.065768	Akaike info criterion	-2.298525
Sum squared resid	0.281150	Schwarz criterion	-0.864758
Log likelihood	214.4041	Hannan-Quinn criter.	-1.715938
F-statistic	2.600358	Durbin-Watson stat	2.014843
Prob(F-statistic)	0.000085		

APPENDIX D: RESIDUAL DIAGNOSTICS

Table A4**:** serial correlation test

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.561692	Prob. F(12,53)		0.8625
Obs*R-squared	14.66748	Prob. Chi-Square(12)		0.2601

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 11/14/15 Time: 20:20
Sample: 2002M03 2012M12
Included observations: 130
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.308173	1.013493	0.304070	0.7623
C(2)	0.254805	1.396847	0.182414	0.8560
C(3)	0.272616	1.339316	0.203549	0.8395
C(4)	0.131640	0.486278	0.270709	0.7877
C(5)	-0.074501	0.646334	-0.115267	0.9087
C(6)	-0.113358	0.701143	-0.161675	0.8722
C(7)	-0.139018	0.676254	-0.205571	0.8379
C(8)	-0.118118	0.550125	-0.214711	0.8308
C(9)	-0.204666	0.541200	-0.378171	0.7068
C(10)	0.104924	0.481701	0.217820	0.8284
C(11)	0.127517	0.440701	0.289350	0.7734
C(12)	0.200758	0.379189	0.529440	0.5987
C(13)	0.213806	0.345204	0.619362	0.5383
C(14)	-0.002682	0.321722	-0.008338	0.9934
C(15)	-0.187456	0.299444	-0.626014	0.5340
C(16)	-9.43E-05	0.224293	-0.000420	0.9997
C(17)	-0.139485	1.362225	-0.102395	0.9188
C(18)	0.141037	1.226513	0.114990	0.9089
C(19)	-0.164299	1.135445	-0.144700	0.8855
C(20)	-0.011904	1.037991	-0.011469	0.9909
C(21)	0.245137	1.086062	0.225712	0.8223
C(22)	-0.045549	1.086490	-0.041923	0.9667
C(23)	0.193845	0.968276	0.200196	0.8421
C(24)	0.074131	0.817317	0.090700	0.9281
C(25)	0.128248	1.014236	0.126448	0.8999
C(26)	0.396926	1.404444	0.282621	0.7786
C(27)	0.139928	1.223689	0.114349	0.9094
C(28)	0.080258	0.770712	0.104135	0.9175
C(29)	-0.280949	1.306012	-0.215120	0.8305
C(30)	-0.264403	1.204483	-0.219516	0.8271

C(31)	-0.241104	1.100578	-0.219070	0.8274
C(32)	-0.217373	0.982900	-0.221155	0.8258
C(33)	-0.193401	0.862857	-0.224140	0.8235
C(34)	-0.168350	0.744984	-0.225978	0.8221
C(35)	-0.148159	0.633100	-0.234021	0.8159
C(36)	-0.128288	0.523848	-0.244896	0.8075
C(37)	-0.107936	0.424100	-0.254507	0.8001
C(38)	-0.086595	0.321719	-0.269163	0.7888
C(39)	-0.056551	0.212422	-0.266218	0.7911
C(40)	-0.030545	0.111700	-0.273456	0.7856
C(41)	-0.055412	0.470316	-0.117818	0.9067
C(42)	-0.070211	0.444837	-0.157836	0.8752
C(43)	-0.107009	0.491309	-0.217803	0.8284
C(44)	-0.140556	0.458016	-0.306880	0.7601
C(45)	-0.044485	0.393883	-0.112939	0.9105
C(46)	-0.086149	0.350075	-0.246086	0.8066
C(47)	-0.108102	0.319086	-0.338787	0.7361
C(48)	-0.103632	0.288614	-0.359068	0.7210
C(49)	-0.076974	0.303570	-0.253563	0.8008
C(50)	-0.021956	0.272611	-0.080539	0.9361
C(51)	-0.093049	0.182087	-0.511015	0.6115
C(52)	-0.021392	0.125266	-0.170776	0.8650
C(53)	-0.073274	0.476423	-0.153800	0.8784
C(54)	0.021715	0.541071	0.040133	0.9681
C(55)	-0.041486	0.489693	-0.084718	0.9328
C(56)	-0.034696	0.387586	-0.089517	0.9290
C(57)	0.010291	0.403599	0.025499	0.9798
C(58)	-0.027177	0.383283	-0.070905	0.9437
C(59)	0.053579	0.420152	0.127523	0.8990
C(60)	0.012446	0.455888	0.027301	0.9783
C(61)	-0.036919	0.506689	-0.072862	0.9422
C(62)	-0.065790	0.470002	-0.139977	0.8892
C(63)	-0.036986	0.357909	-0.103338	0.9181
C(64)	-0.054074	0.252712	-0.213974	0.8314
C(65)	0.000105	0.006702	0.015654	0.9876
RESID(-1)	-0.236734	0.925271	-0.255854	0.7991
RESID(-2)	0.035076	0.731977	0.047920	0.9620
RESID(-3)	0.035260	0.458624	0.076883	0.9390
RESID(-4)	-0.085841	0.371778	-0.230894	0.8183
RESID(-5)	0.151540	0.347567	0.436001	0.6646
RESID(-6)	-0.391103	0.333375	-1.173163	0.2460
RESID(-7)	-0.165260	0.338409	-0.488344	0.6273
RESID(-8)	-0.174284	0.312413	-0.557863	0.5793
RESID(-9)	0.002886	0.318558	0.009059	0.9928
RESID(-10)	0.092314	0.325335	0.283750	0.7777
RESID(-11)	0.428442	0.319411	1.341350	0.1855
RESID(-12)	-0.302641	0.333308	-0.907990	0.3680

R-squared	0.112827	Mean dependent var	-1.80E-18
Adjusted R-squared	-1.159346	S.D. dependent var	0.046685

S.E. of regression	0.068602	Akaike info criterion	-2.233625
Sum squared resid	0.249429	Schwarz criterion	-0.535162
Log likelihood	222.1856	Hannan-Quinn criter.	-1.543483
F-statistic	0.088688	Durbin-Watson stat	1.961623
Prob(F-statistic)	1.000000		

Table A5: Heteroskedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.176396	Prob. F(65,64)	0.2583
Obs*R-squared	70.76848	Prob. Chi-Square(65)	0.2912
Scaled explained SS	17.73156	Prob. Chi-Square(65)	1.0000

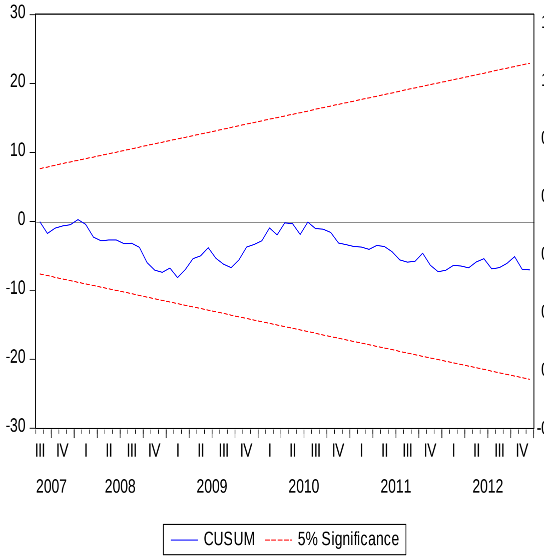
Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/14/15 Time: 20:27
Sample: 2002M03 2012M12
Included observations: 130

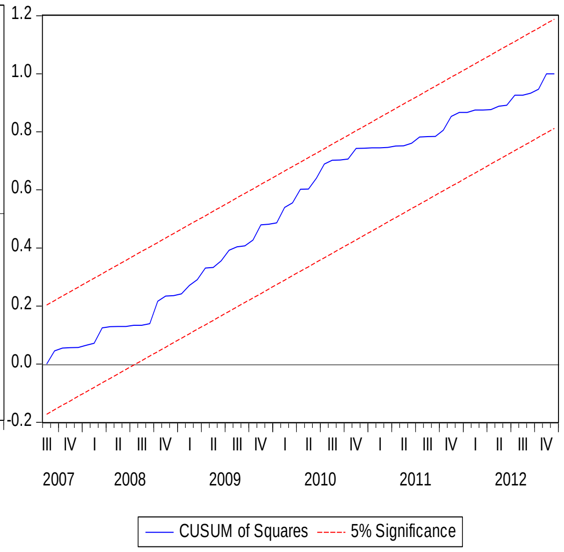
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002466	0.000531	4.644724	0.0000
LNRT(-1)	-0.008227	0.005598	-1.469710	0.1465
LNOP(-1)	0.001263	0.004695	0.269005	0.7888
LNFER(-1)	-0.003849	0.016936	-0.227292	0.8209
LNGS(-1)	-0.001492	0.003399	-0.438867	0.6622
LNINFL(-1)	-0.003031	0.005816	-0.521152	0.6041
LNRT(-2)	0.000320	0.005723	0.055889	0.9556
LNRT(-3)	0.002372	0.005807	0.408432	0.6843
LNRT(-4)	-0.007314	0.005859	-1.248340	0.2165
LNRT(-5)	-0.000398	0.006586	-0.060410	0.9520
LNRT(-6)	0.007427	0.006417	1.157402	0.2514
LNRT(-7)	0.006852	0.006315	1.084964	0.2820
LNRT(-8)	-0.010829	0.006386	-1.695684	0.0948
LNRT(-9)	-0.010316	0.006608	-1.561246	0.1234
LNRT(-10)	0.004368	0.006640	0.657872	0.5130
LNRT(-11)	-0.008237	0.006300	-1.307504	0.1957
LNRT(-12)	-0.001398	0.006293	-0.222129	0.8249
LNRT(-13)	-0.003980	0.006155	-0.646651	0.5202
LNFER(-2)	0.015556	0.017394	0.894321	0.3745
LNFER(-3)	0.028147	0.017692	1.590911	0.1166
LNFER(-4)	-0.034537	0.017908	-1.928556	0.0582
LNFER(-5)	0.013179	0.018091	0.728482	0.4690
LNFER(-6)	-0.007727	0.017941	-0.430685	0.6681
LNFER(-7)	-0.014948	0.017726	-0.843299	0.4022
LNFER(-8)	-0.011434	0.017642	-0.648110	0.5192

LNFER(-9)	0.019441	0.017871	1.087841	0.2807
LNFER(-10)	-0.023451	0.017520	-1.338511	0.1855
LNFER(-11)	-0.000288	0.018341	-0.015716	0.9875
LNFER(-12)	-0.040158	0.018614	-2.157361	0.0347
LNFER(-13)	0.027904	0.019962	1.397869	0.1670
LNGS(-2)	-0.001071	0.003260	-0.328498	0.7436
LNGS(-3)	-0.000827	0.003273	-0.252552	0.8014
LNGS(-4)	-0.000861	0.003320	-0.259455	0.7961
LNGS(-5)	-0.000579	0.003322	-0.174150	0.8623
LNGS(-6)	-0.001602	0.003301	-0.485194	0.6292
LNGS(-7)	-0.001946	0.003327	-0.584786	0.5607
LNGS(-8)	-0.000568	0.003331	-0.170590	0.8651
LNGS(-9)	-0.000466	0.003336	-0.139665	0.8894
LNGS(-10)	-0.000732	0.003331	-0.219808	0.8267
LNGS(-11)	-0.001230	0.003310	-0.371697	0.7113
LNGS(-12)	-0.001155	0.003293	-0.350886	0.7268
LNGS(-13)	0.000411	0.003088	0.132978	0.8946
LNINFL(-2)	0.000249	0.005502	0.045243	0.9641
LNINFL(-3)	0.007755	0.005167	1.500980	0.1383
LNINFL(-4)	0.002927	0.005253	0.557239	0.5793
LNINFL(-5)	0.006494	0.004508	1.440422	0.1546
LNINFL(-6)	0.005797	0.004509	1.285722	0.2032
LNINFL(-7)	0.004945	0.004685	1.055328	0.2952
LNINFL(-8)	0.000136	0.004547	0.029836	0.9763
LNINFL(-9)	-0.003154	0.004017	-0.785189	0.4352
LNINFL(-10)	0.002219	0.004023	0.551706	0.5831
LNINFL(-11)	-0.001738	0.004050	-0.429083	0.6693
LNINFL(-12)	0.002171	0.003962	0.547831	0.5857
LNINFL(-13)	0.001698	0.004488	0.378275	0.7065
LNOP(-2)	0.009541	0.004813	1.982329	0.0517
LNOP(-3)	-0.002747	0.004822	-0.569758	0.5708
LNOP(-4)	-0.001047	0.004912	-0.213178	0.8319
LNOP(-5)	-0.007698	0.004782	-1.609869	0.1123
LNOP(-6)	-0.006351	0.004863	-1.306076	0.1962
LNOP(-7)	0.001353	0.004862	0.278228	0.7817
LNOP(-8)	0.006093	0.004951	1.230606	0.2230
LNOP(-9)	0.007211	0.004899	1.472025	0.1459
LNOP(-10)	-0.007112	0.004751	-1.496853	0.1393
LNOP(-11)	0.005901	0.004902	1.203859	0.2331
LNOP(-12)	-0.009803	0.004938	-1.984940	0.0514
LNOP(-13)	0.002272	0.005022	0.452403	0.6525

R-squared	0.544373	Mean dependent var	0.002163
Adjusted R-squared	0.081627	S.D. dependent var	0.003074
S.E. of regression	0.002946	Akaike info criterion	-8.510250
Sum squared resid	0.000555	Schwarz criterion	-7.054424
Log likelihood	619.1662	Hannan-Quinn criter.	-7.918699
F-statistic	1.176396	Durbin-Watson stat	2.009350
Prob(F-statistic)	0.258274		

Figure A1: CUSUM resultsFigure A2: Cusum of squares





APPENDIX E: GRANGER CAUSALITY RESULTS

Table A6: Granger causality results

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 09/21/15 Time: 08:54
Sample: 2001M01 2012M12
Included observations: 130

Dependent variable: LNOP

Excluded	Chi-sq	df	Prob.
LNRT	24.54291	12	0.0171
All	24.54291	12	0.0171

Dependent variable: LNRT

Excluded	Chi-sq	df	Prob.
LNOP	24.38085	12	0.0180
All	24.38085	12	0.0180

Foreign exchange

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 09/21/15 Time: 09:12
Sample: 2001M01 2012M12
Included observations: 130

Dependent variable: LNRT

Excluded	Chi-sq	df	Prob.
LNFER	19.05050	12	0.0873
All	19.05050	12	0.0873

Dependent variable: LNFER

Excluded	Chi-sq	df	Prob.
LNRT	8.784571	12	0.7212
All	8.784571	12	0.7212

Government expenditure

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 09/21/15 Time: 09:14
Sample: 2001M01 2012M12
Included observations: 130

Dependent variable: LNRT

Excluded	Chi-sq	df	Prob.
LNGS	11.15389	12	0.5158
All	11.15389	12	0.5158

Dependent variable: LNGS

Excluded	Chi-sq	df	Prob.
LNRT	8.618384	12	0.7351
All	8.618384	12	0.7351

Inflation

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 09/21/15 Time: 09:16
Sample: 2001M01 2012M12
Included observations: 130

Dependent variable: LNRT

Excluded	Chi-sq	df	Prob.
LNINFL	10.70672	12	0.5542
All	10.70672	12	0.5542

Dependent variable: LNINFL

Excluded	Chi-sq	df	Prob.
LNRT	48.32769	12	0.0000
All	48.32769	12	0.0000

APPENDIX F:ARCH EFFECTS

Table A7: ARCH effects

Heteroskedasticity Test: ARCH			
F-statistic	2.513333	Prob. F(12,118)	0.0056
Obs*R-squared	26.66684	Prob. Chi-Square(12)	0.0086

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 09/19/15 Time: 19:41
Sample (adjusted): 2002M02 2012M12
Included observations: 131 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002590	0.001200	2.158703	0.0329
RESID^2(-1)	0.221228	0.091933	2.406406	0.0177
RESID^2(-2)	-0.061842	0.093497	-0.661431	0.5096
RESID^2(-3)	-0.106742	0.093125	-1.146222	0.2540
RESID^2(-4)	0.429507	0.092777	4.629452	0.0000
RESID^2(-5)	-0.139166	0.099343	-1.400862	0.1639
RESID^2(-6)	0.042689	0.100038	0.426725	0.6704
RESID^2(-7)	-0.020339	0.100028	-0.203336	0.8392
RESID^2(-8)	-0.188217	0.099137	-1.898555	0.0601
RESID^2(-9)	0.143459	0.092775	1.546307	0.1247
RESID^2(-10)	-0.105572	0.093055	-1.134509	0.2589
RESID^2(-11)	0.125167	0.093389	1.340270	0.1827
RESID^2(-12)	0.043466	0.092126	0.471813	0.6379

R-squared	0.203564	Mean dependent var	0.004223
Adjusted R-squared	0.122570	S.D. dependent var	0.007511
S.E. of regression	0.007036	Akaike info criterion	-6.981662
Sum squared resid	0.005841	Schwarz criterion	-6.696338
Log likelihood	470.2989	Hannan-Quinn criter.	-6.865722
F-statistic	2.513333	Durbin-Watson stat	2.004385
Prob(F-statistic)	0.005601		

APPENDIX G: VOLATILITY ANALYSIS

Table A8: volatility analysis

Dependent Variable: LNRT
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 12/07/15 Time: 12:23
Sample (adjusted): 2001M02 2012M12
Included observations: 143 after adjustments
Convergence achieved after 35 iterations
Presample variance: backcast (parameter = 0.7)
@SQRT(GARCH)^C(9) = C(5) + C(6)*(ABS(RESID(-1)) - C(7)*RESID(
-1))^C(9) + C(8)*@SQRT(GARCH(-1))^C(9)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
LNFER	-0.469493	0.179053	-2.622088	0.0087
LNGS	-0.000456	0.000923	-0.494391	0.6210
LNOP	-0.039610	0.047258	-0.838155	0.4019
LNINFL	-0.048357	0.056248	-0.859702	0.3900
		Variance Equation		
C(5)	0.012143	0.044519	0.272753	0.7850
C(6)	0.112265	0.095042	1.181218	0.2375
C(7)	0.302055	0.332842	0.907503	0.3641
C(8)	0.880906	0.072290	12.18573	0.0000
C(9)	0.185305	0.827963	0.223808	0.8229

R-squared	0.028523	Mean dependent var	0.005446
Adjusted R-squared	0.007556	S.D. dependent var	0.065770
S.E. of regression	0.065521	Akaike info criterion	-2.647817
Sum squared resid	0.596729	Schwarz criterion	-2.461344
Log likelihood	198.3189	Hannan-Quinn criter.	-2.572043
Durbin-Watson stat	1.785546		