GLOBAL PORTFOLIO PERFORMANCE:
A COMPARATIVE ANALYSIS OF CONVENTIONAL AND ISLAMIC INDICES

BY

BELLO, ABBA AHMED
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(PhD/SOC-SCI/11511/11-12)

DEPARTMENT OF ECONOMICS,

FACULTY OF SOCIAL SCIENCE,

AHMADU BELLO UNIVERSITY,

ZARIA, NIGERIA

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A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES AHMADU BELLO UNIVERSITYIN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DOCTOR OF PHILOSOPHY IN ECONOMICS

DEPARTMENT OF ECONOMICS,

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ZARIA, NIGERIA

MAY, 2021

DECLARATION

IBello Abba Ahmedhereby solemnly declare that this research work titled "Global Portfolio Performance: A Comparative Analysis of Conventional and Islamic Indices" submitted for the award of Doctor of philosophy (PhD) Degree in Economics of the Ahmadu Bello University, Zaria is the result of my research work and has not previously been presented to any university for award of a degree. All references in the work have been duly acknowledged. All errors and omissions in this work are solely mine.

………………………	……………………	…………………..
Bello Abba Ahmed	**Signature**	**Date**

CERTIFICATION

I certify that this research work entitled "Global Portfolio Performance: A Comparative Analysis of Conventional and Islamic Indices" carried out by ABBA, Bello Ahmed has been carefully read and approved as meeting the requirement of Department of Economics, ABU Business School, Ahmadu Bello University, Zaria for the award of PhD in Economics.

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DEDICATION

I dedicate this work to my parents late Alh. Abba Ahmed and Haj. Amina Miko.

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ABSTRACT

The study examined the global portfolio performances of conventional and Islamic indices. This study used the 5-day weekly closing stock prices of 22 major global Islamic and conventional indices of Dow Jones and FTSE from 11 countries comprising, US, EU, Canada, Kuwait, Qatar, Malaysia, Japan, China, Turkey, India, and Taiwan. The other set of data used were the United States macroeconomic data comprising Brent oil price, Economic Uncertainty Index, Federal Funds Rate, Volatility Fear Index, three months T-bills, inflation rate, and broad money supply (M2). All the data were for the period 1st January 2006 to 31st December 2017. The analytical methods employed were Johansen Co-integration Test, VECM, ARCH, GARCH, EGARCH and TARCH models, Sharpe ratio and Treynor Index. The study found that there was a long run relationship between the conventional and Islamic indices, broad market index and US macroeconomic variables. The presence of leverage effect amongst all the indices suggests that bad news has greater influence on the price of the stocks than good news. However, the impact of the US macroeconomic variables on the volatility of the indices was not statistically significant. The ARCH in mean results suggests that the risk component was not significant in determining investment decisions for both the conventional and Islamic indices. In terms of risk-adjusted performance there was no clear result as to which index was less risky. The study recommends that Investors should be concerned with the movements of US macroeconomic variables as the yardstick for the expected returns of Dow Jones and FTSE in the selected countries. It is also important for investors to monitor changes in the monetary and fiscal policies in the respective countries as well as the corporate performances of the firms in each country.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The persistent crises in global equity markets in both developed and emerging markets necessitated the search for alternative portfolio investment assets. Crises have been witnessed in Asia in 1997, and the US and European stock markets have experienced declining equity markets. This planted the seed for flourishing Islamic financial assets as alternatives to the conventional ones. The Islamic financial assets have been floated in global stock markets including the UK, US, Canada, Malaysia, Taiwan, Qatar, China, Japan etc. (Yahya, Anis, Abdul, Hashim & Fakhzan, 2013). Prominent financial institutions in the developed countries such as HSBC, Citibank, and Morgan Stanley market Islamic assets. Similarly Islamic stocks are traded on the floors of New York Stock Exchange and London stock exchange to provide alternatives for diversification opportunities (Ho,Abd Rahman, Yusuf & Zamzamin, 2014).

Assets in the Islamic financial industry have been growing rapidly in the last decade. According to Hassan, Rabbani & Ali (2020) and the Islamic finance market grew to around US$ 2.4 trillion in 2018, an increase of 3% as compared to 2017. This was a radical surge from US$2.2 trillion in 2015 (Shahzad, Ferrer, Ballester & Umar 2017), US$2 trillion in 2014, 1.6 trillion in 2013, $1.46 trillion in 2012 and $1.3 trillion in 2011 respectively (Ajmi, Hammoudeh, Nguyen, and Sarafrazi, 2014; Hussain, Shahmoradi, & Turk, 2016; Nazlioglu, Hammoudeh & Gupta, 2013). About 75% of the industry concentrated in the Middle East. In a nutshell, the Islamic finance industry, including

Islamic capital markets, grew, on average, by 17.5% since the onset of the global financial crisis in 2008 (Hussain, Shahmoradi, & Turk 2016).

Since many stocks performed poorly during the Global Financial Crisis (GFC) period, many researchers have argued whether the GFC has had less impact on the Shariah complaint stocks compared to the conventional stocks. Some researchers (Abbes, 2012) have also argued that the difference in performance between conventional and Islamic stocks should be minimal and some have argued that conventional stocks should outperform the Islamic stocks McGowan and Junaina' study (as cited in Reddy & Fu, 2014). Arshad & Raza (2013) pointed that Islamic equity index seems to be more volatile with a slight lag to conventional indices during times of economic downturns. This can be related to the seminal work by Charles, Darne & Pop (2010) and Girard & Hassan (2008) and yet is in contrast to other researchers who found that Islamic stock indices seemed to appear less volatile during times of financial instability (Arshad & Rizvi, 2013, and Al-Zoubi & Maghyereh, 2007). In addition, it was discovered further that during the growth phase of a business cycle, Islamic indices appeared less volatile and more stable. This is a reiteration of several works such as Hakim & Rashidan (2002) and Al-Zoubi & Maghyereh, (2007).

Charles, Steak & Pop (2011) found Islamic indices to be affected in the same way as conventional indices during the US subprime crises. In terms of risk, Al-Zoubi & Maghyereh (2007) found that Islamic indices were less risky than conventional indices, perhaps due to the screening of highly risky indices. Regarding the correlation between the indices, Rizvi & Arshad (2012) found a weak correlation of movement between conventional and Islamic, which suggests this could provide a diversification benefit to investors in conventional indices. However, Kumar & Mukhopadhyay (2002), Wong, Agarwal & Du (2005) observed some correlation between different markets around the world with the possibility of the transmission of crises from one market to another. Similarly, for Islamic indices, Majid, Meera & Omar (2007), Rahman & Sidek (2011) and Siskawati, (as cited in Saadaoui & Boujelbene, 2015) found that volatility in all the major global markets is unlikely to affect Islamic indices. On the other hand, several other studies showed that there is no empirical co-integration between Islamic indices (Karim Kassim & Arip 2010).

Since Islamic indices are guided by the principles of the Islamic law there are strong reasons to expect them to behave differently from the conventional ones(Nazlioglu, Hammoudeh & Gupta, 2013).For instance, the principle of asset – backed paradigm excludes Islamic finance from excessive speculation on financial instruments such as derivatives and futures which have no direct linkage with physical assets. it also prohibits investing in industries that deal in alcohol, gambling, tobacco, arms etc. (Rehman, 2009). Based on this, there should be minimal contagion and volatility transmission or risk factor between conventional and Islamic indices because due to their fundamental difference (Dridi & Hassan, 2010; Dewi & Ferdian, 2010; Chapra, 2008)..

In examining Islamic and conventional stock indices for their volatilities in different countries Arshad & Raza (2013:8) revealed that throughout the twelve-year period, Islamic indices seemed to follow a similar pattern to that of its conventional counterpart. This indicates that the impact of business cycle movements affect the two indices in a similar manner. This allows policymakers the opportunity of clustering both stocks under the same umbrella when considering policies that may affect the financial markets. They also pointed that Islamic equity index seems to be more volatile with a slight lag to conventional indices during times of economic downturns.

Arshad and Raza (2013) discovered conventional indices perform better than Islamic ones. Quite a number of studies reported Islamic indices perform better than conventional indices (Ho *et al*, 2013; Shubbar, 2010 and Reddy and Fu, 2014). There were others that found no difference between both indices (Ajmi *et al* 2014, EL-Mosaid & Boutti, 2014, Miniaoui, Sayani & Chaibi, 2015).Hussein (2004) reported that Islamic index yields positive abnormal returns in bullish period and underperforms its conventional counterparts in bearish period. Ridwan (2009) came up with an inconclusive result as to which is riskier between Islamic and conventional indices.

Following the work of Ho *et al* (2013), Merdad (2012) and Albaity and Ahmad (2011) this study examined the risk and risk–adjusted return performances, volatility, and leverage effect, and the effect of US macroeconomic factors on 22 selected conventional and Islamic indices in 11 countries comprising US, EU, Canada, Japan, Taiwan, China, Qatar, India, Kuwait, Malaysia and Turkey. To ensure valid comparisons, the selected Islamic indices were matched with their conventional indices.

1.2 Statement of the Problem

The stock market crash during the subprime global crises of 2008 demonstrated the financial contagion of shocks and interconnectivity of world stock markets. Although the subprime crises emanated from real estate markets in the United States, it sporadically spread all over the world affecting both developed and developing nations including emerging stock markets like Turkey, India, Malaysia, Qatar, Kuwait, China, etc. (Saadaoui & Boujelbene, 2015). As the global crises escalated and took a global dimension, it devastated the real economy with a general downturn, the value of assets crashed in the global stock markets, inflicting substantial losses to investors running in to billions of dollars (Hussain, Shahmoradi & Turk, 2016). Given its financial strength and influence, volatility shocks from the US were easily transmitted to the rest part of the world as observed during the subprime crises. Ahlgren & Antell (2010) observed that one of the main features of globalization and swift transmission of information across markets is the extension of financial crises from one country to the other even if the macroeconomic fundamentals are different. Indeed, investors need a guide line to effective and less risky investment that can withstand market shocks.

Two decades ago investors in stock markets had limited choices as only conventional stocks were available but as time went by Islamic stocks were ushered in the market as alternative investments. The Dow Jones and FTSE were the first major conventional indices that created Islamic indices as alternative investment opportunities to investors. This ushered Islamic indices such as Dow Jones Islamic Market Index (DJMI) in 1999 and FTSE in 1998 as global Islamic Index Series that only incorporates stocks that comply with Islamic principles. Theoretically, Islamic stock indices were better positioned to be more resilient to shocks due to specific features such as ethical and ratio screenings, the exclusion of the financial sector and of highly-leveraged firms, the limit on interest-based leverage, and, finally, the exclusion of investing in complex excessively risky subprime and toxic assets, as well as zero-sum betting on derivatives (Ata & Bugan, 2015 and Saiti, Bacha & Masih, 2016). By promoting risk sharing (as opposed to risk transfer) and endorsing investment in wealth creating activities, the asset-based nature of Islamic financing naturally curbs excessive leverage. It also restricts Islamic banks from investing in highly leveraged assets and short selling, suggesting that they are likely to foster financial stability and render the global financial system less prone to financial distress. The direct link between the financial and the real or trade sectors may also prevent technical speculations and potential bubbles (Hussain, Shahmoradi & Turk, 2016).

However, the literature is loaded with contradictory opinions on the hypothesized resilience of the Islamic indices. On one hand, some argued that Islamic indices offered relatively more stability as they were less volatile and were able to adapt themselves with the market fluctuations and changes. Further, the screening and filtering process of Islamic indices, risk-sharing and asset-based financing, should presumably make them more resilient than the conventional ones during financial crisis (Arshad & Rizvi, 2013 and Pranata, 2015). While on the other hand, some scholars cast doubt on the ability of Islamic indices to perform as well as the conventional ones due to the smaller size of the investment pools relative to the conventional asset markets. In addition, giving its lower diversification potential as well as the higher costs of Islamic compliant portfolio selection, one may suggest that these investments would underperform the conventional ones (Bauer et al., 2005).

Even though the focus of this study is not the global financial crises or its effect on both indices, but its occurrence and aftermath intensified the debate on which of the indices outperforms the other in terms of risk, volatility and response to macroeconomic shocks from the US. A preview of information and data available on the official website of the Wall street journal indicated that both conventional and Islamic indices were affected terribly by the crises. For instance, the data revealed that the major stock market crash of 2008 occurred on 29th September, 2008 corresponding to when the Lehman Brothers declared bankruptcy. The Dow Jones Industrial Average index (DJIA) fell 777.68 points in intraday trading which was its largest point drop in history, closing around 10, 000 points for the first time since 2004. By the end of December 2008, Dow further crashed to 8, 776.39 down almost 34% for the year. On March 5th 2009, Dow dropped by more than 50% to its bottom of 6,594.44 point. (The Balance.com and www.wsj.com). Similarly Dow's Islamic counterpart, Dow Jones Islamic Market Index (DJIMI) was increasing since 2004 until it suddenly declined in a dramatic way in 2008 due to the financial crisis. Though it began to rise again by the beginning of 2009, however the level of recovery was low in comparison with the index level just before the crisis began. Since both indices declined drastically during the crises, it could suggest a strong correlation between them and the US macroeconomic fundamentals.

The behaviour of FTSE 250 GBP during the subprime crises wasn't much different from that of the Dow Jones. It lost about 24% of its value for the year on 29th September 2008 by dropping to 10, 365.45 points as against 12, 800 points on January 1st, 2008. This suggests the possibility of contagion between the US based Dow Jones and the British FTSE index. The Shariah compliant product of the FTSE, FTSE Shariah All-World index, fluctuated in the first 6 months until it reached its peak in the mid of May 2008. Then, it suddenly declined sharply till the end of Febreuary 2009 due to the 2008 subprime crisis and its impacts. However, the index rose steadily at the beginning of March 2009, but the recovery rate was slow relative to the pre-crisis period. This also suggests some level of correlation between the conventional indices and its Islamic counterpart, since they both responded to the shock in a similar manner.

The problematic here is, once there is evidence of correlation between conventional and Islamic indices then it undermines the benefit of diversification as postulated by the Markowitz theory. Meaning that, there is no incentive for investors to combine both conventional and Islamic indices in the same portfolio as it would not guarantee hedging against risk or higher returns. Secondly, the information from the wall street journal, suggests that both conventional and Islamic indices were affected by the subprime crises in the US and with the possibility of contagion from the US to other countries as observed in the FTSE. Therefore, the ongoing debate as to which of the indices amongst the two is more resilient to volatility shocks can only be settled through more empirical works of this manner. Thirdly, since the focus of this study is on Dow Jones and FTSE which were the first major global indices to float Islamic counterparts and have wider global presence in many countries, it's important to investigate how the US macroeconomic variables affect their volatilities because their basis point is measured in US dollars. There could be the possibility of linkage between US macroeconomic factors and the price fluctuations of these indices. Fourthly, since it appears from the available information, that the recovery rate of both indices after the crises was slow, it gives reasons to investigate leverage effect. The presence of leverage effect will suggests that bad news has greater influence on the price of the stocks than good news. When a substantial decline in an equity price is not matched by a decline in the value of debt, the firm's debt to equity ratio will increase alongside with the financial risk of the firm's investors.

Markowitz theory suggests that the benefit of diversification of portfolio improves hedging against risk. The debate over whether Islamic and conventional indices are substitutes or complementary in terms of portfolio diversification benefits is ongoing. That is, whether Islamic indices represent an alternative class of investment with distinctive characteristics that allow investors to obtain effective diversification benefits and downside risk reductions. Giving fresh perspective to this debate is the central thesis in this study. The motivation of this study is to report findings from a comparative study of both types of investments since this issue has yet been bedded down.

Thus, the following research questions were designed to guide this study:

i. What is the nature of the long-run relationship between conventional and Islamic indices, and the US macroeconomic variables?

ii. Is there leverage effect (asymmetry), volatility reaction to the market and volatility persistence amongst conventional and Islamic indices?

iii. What is the effect of US macroeconomic variables on the volatility of conventional and Islamic indices?

iv. What are the risk-adjusted return performances of conventional and Islamic indices?

1.3 Objectives of the Study

The broad objective of this study is to examine the portfolio performance of conventional and Islamic indices. However, other specific objectives include the following:

i. To determine the long-run relationship between conventional and Islamic indices, and the US macroeconomic variables

ii. To analyze the leverage effect (asymmetry), volatility reaction to the market and volatility persistence of conventional and Islamic indices

iii. To determine the effect of US macroeconomic variables on the volatility of the conventional and Islamic indices.

iv. To examine the risk and risk-adjusted return performance of conventional and Islamic indices.

1.4 Research Hypothesis

The study tested the following hypotheses:

H_{01}: There is no long-run relationship between conventional and Islamic indices, and the US macroeconomic variables

H_{02}: There is no leverage effect, volatility reaction, volatility persistence of conventional and Islamic indices

H_{03}: There is no significant effect of US macroeconomic variables on the volatility of the conventional and Islamic indices.

H_{04}: There is no significant difference in the risk and risk-adjusted return performances of conventional and Islamic indices.

1.5 Justification of the Study

The motivation of this study arises from the growing interest in Islamic finance and the increasing innovation and introduction of Islamic financial assets in the global stock markets. Investors and policymakers would be interested in factual information to serve as their guide in investment decisions and portfolio management. This is especially important given the uncertainty of the financial market with looming crises surfacing not only in emerging but also in developed markets. The study developed a conceptual framework that could be used to analyze portfolio investment choices containing conventional and Islamic stock given the nature of their stochastic properties, volatilities and effects of macroeconomic variables.

The selection of the macroeconomic variables for inclusion in the analysis was governed by the time series that are commonly included in studies of stock return predictability. It is assumed that stock market behavior is related to macroeconomic conditions as postulated by the Arbitrage Pricing Theory (APT). It will be quite tedious to consider all possible macroeconomic variables, therefore, this study is limited to the following US factors: Brent oil price as a measure of oil market influence on stock prices, US Economic Uncertainty Index (EUI) to measure US policy response to economic and political news (Nazlioghu, Hammoudeh and Gupta, 2013), Federal Funds Rate (FFR) as proxy for monetary policy influence on stock markets and, volatility and fear index (VLF) to capture anxiety on US stock market. These four variables were all used in Nazlioghu, Hammoudeh and Gupta (2013:7). To build on their work, this study reasoned with Ejaz and Akhtar (2015) and included US three months Treasury bill to measure short-term interest rate. In addition, as in Khositkulporn (2013), Abugri (2002), Caner and Onder (2005), and Granger, Huang and Yang (2000) the study added US inflation rate, and money supply.

From the reviews done so far by the researcher, it seems only limited researches have been undertaken that examined the volatilities of conventional indices with Islamic indices using global cross-country data. Most of the studies encountered in the literature that studied the nexus between Islamic and conventional indices used performances measures of Sharpe ratio, Treynor index and Jensen alpha as their methodologies of comparison (e.g. Ho *et al* 2013, Shubbar 2010, Ajmi *et al* 2014, Hussein 2004, Hussein 2005, Hoepner *et al* 2011, and Hassan and Girard 2011). The methods employed in these studies were only ratios that give idea on the risk – adjusted returns of the two indices. It does not give a detail account of the effect of volatilities typically associated with the stylized facts of financial data.

However, a number of studies improved on this by employing GARCH models to study the volatilities of conventional and Islamic indices and the relationships therein, for instance Arshad and Raza 2013, Miniaoui, sayani and Chabi 2015, Albaity and Ahmad 2011, Al-Zoubi and Maghyereh 2007 and Reddy and Fu 2014. Even though these studies employed the GARCH models including GARCH-M, EGARCH and the TARCH models which are considered sufficient in capturing volatility, and leverage effect of stock market indices none of these studies used the cross-country data and the period covered in this study. Again none of these studies used the conceptual framework developed in this study that related the combine effects of volatility, macroeconomic variables, and leverage effect on the stock returns volatility of conventional and Islamic indices using cross country data.

Drawing from the literature reviewed, undoubtedly there is a growing focus on the linkages between Islamic and conventional finance markets but the empirical conclusions seems to be inconclusive. These mixed results could be attributed to time periods, data sets, frequencies, methodologies and model descriptions. Thus, this study attempted to fill the literature gap in that respect.

Notably, the study extended the findings of Caner and Onder (2005) on factors affecting volatility in stock market, the works of Koutmos (1996), Koutmos and Booth (1995), and Booth, Martikainen and Tse (1997) on leverage effects, and the work of Khositkulporn (2013) on the factors affecting stock market volatility , the findings of Papapetron (2001), Sadorsky (2001), Chen (2009), Brouwer (2003), Wang and Lin (2009), Diebold and Yilmaz (2008) and Longstaff (2010), Basher and Sadorsky (2006) and Nandha and Faff (2008) on oil price fluctuation and the equity market.

The study has potential to benefit regulators, fund managers, investment analysts, and general investors in terms of gaining better understanding of the effect of volatility on the risk and returns of conventional and Islamic stock indices, as well as the factors determining their volatilities. The findings from this study will provide investors some valuable guidelines regarding optimal portfolio investment choices between conventional and Islamic stocks. It's also hoped that this study will serve as a springboard for more researches in the area of portfolio management.

1.6 Scope and limitations of the Study

The study examined the effects of volatility, leverage effects, and macroeconomic variables on the risk and returns of conventional and Islamic indices for the period 2006 to 2017. Data was obtained from 11 countries for both Islamic and conventional indices. It was discovered that most countries do not have Islamic indices or do not have data on it before 2006; therefore, the study was constrained to begin its analysis from 2006 that was two years before the US mortgage financial crises. Emphasis was given to the Dow Jones index for two reasons. First it has the widest global coverage across countries and secondly, it's the index that has the Islamic counterpart in most countries. Dow Jones launched its first Islamic market index in 1999 which includes stocks from 34 countries and covers 10 economic sectors, 18 market sectors, 51 industry groups and 89 subgroups defined by the Dow Jones Global Classification Standard. It's only when data on Dow Jones was not available that a substitute preferably FTSE was used. FTSE is another index that also has a global representation in 29 countries and has 15 Islamic indices. It was in 1998 that the FTSE, launched FTSE Global Islamic Index Series (GIIS) which is a subset of the FTSE All-World Index group.

In this regard search through the data base of the Wall Street Journal for countries that have a pair of conventional and Islamic indices led to the selection of the following countries as the sample: United States, European Union, France, Japan, Canada, Turkey, Kuwait, India, Qatar, Taiwan and Malaysia. All these countries have robust economies and flourishing stock markets; therefore they provide strong bases for making empirical comparison of the performances of conventional and Islamic indices that covers the period 2006 – 2017.

1.7 Organization of Chapters

The work is organized into five chapters; chapter one contains the general introduction comprising the statement of problem, the research objectives, the hypotheses and the scope and limitations of the study. Chapter two gives the conceptual literature explaining the key concepts related to the study; the theoretical literature reviewed four theories relevant to the study comprising modern portfolio theory (MPT), capital asset pricing model (CAPT), arbitrage pricing model (APT) and market efficiency theory (MET); the empirical literature was grouped into studies diversification, studies on risk-return of conventional and Islamic indices, studies on risk-return of conventional and Islamic indices, studies on volatility of conventional and Islamic indices, and studies on macroeconomic variables. This chapter also contains the theoretical framework. Chapter three outlined the conceptual framework, data sources, variables measurement and models specification. Chapter four presents results and discussions and finally, chapter five contains the summary, conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introducguretion

This chapter gives the conceptual literature explaining the key concepts related to the study; the theoretical literature reviewed four theories relevant to the study comprising modern portfolio theory (MPT), capital asset pricing model (CAPT), arbitrage pricing model (APT) and market efficiency theory (MET); the empirical literature was grouped into studies diversification, studies on risk-return of conventional and Islamic indices, studies on risk-return of conventional and Islamic indices, studies on volatility of conventional and Islamic indices, and studies on macroeconomic variables. This chapter also contains the theoretical framework.

2.1.1 Risk

Coleman (2021) defines investment risk as the probability or likelihood of occurrence of losses relative to the expected return on any particular investment, it is a measure of the level of uncertainty of achieving the returns as per the expectations of the investor, and it is the extent of unexpected results to be realized. Risk is an important component in assessment of the prospects of an investment. Most investors while making an investment consider less risk as favourable. The lesser the investment risk, more lucrative is the investment. However, the thumb rule is the higher the risk, the better the return.

Investment in stocks is risky as stock prices are affected by changes in domestic and world economy. The growth of stock is equally susceptible to a number of risks (Harvey *et al*, 2005). The risks include changes in returns for different stocks because of changes in interest rates, inflation rates, political factors, environmental factors and economic policies. As stocks growth is determined by the overall market movement which leads to changes in the firm's stock prices. The sensitivity of a stock to market movements is measured by Beta (β) thus, a stock with Beta that is equal to one moves with the market, while a stock with a Beta that is higher than one has higher volatility than the market. A stock of a beta of less than one has a lower volatility than the market. Betas are important to investors as they enable them to establish the market risk of a stock (Sharpe, 1964).

In describing securities, Elton and Gruber (2006:20) mentioned several factors that affect risk. These included: the maturity of an instrument (in general the longer the maturity the more risky it is), the risk characteristics and the creditworthiness of the issuer or guarantor of the investment, the nature and priority of claims the investment has on income and assets, and the liquidity of the instrument and the type of market in which it is traded. If risk is related to these elements, then measures of risk such as the variability of returns should be related to these same factors. A widely accepted measure of risk is called the standard deviation. Most scholars are of the view that returns (over long periods of time) should be consistent with risk. Numerous historical facts from various financial series alluded to this speculation.

The terminology used for risk or uncertainty in Arabic form is *Gharar*(Hashim, (2008). It was explained by ArsalanTariq (2004), as any form of transaction that is shady or illegal in nature, for instance, if the exact price or the nature of the good is hidden or undefined. This is the reason why gambling and speculation are disallowed in Islamic finance (Fleifel, 2009 and Kamali 2000). Another conventional transaction that is considered unlawful in Islam, are dealings in speculative derivatives such as futures and options as well as short selling (Fleifel, 2009).

Islamic indices which adhere to the Islamic rulings avoid dealing with *Riba* and *Gharar*. According to the *Shariah*, *Riba* technically refers to the "premium" that must be paid by the borrower to the lender along with the principal amount as a condition for the loan or for an extension in the duration of loan" (Iqbal & Mirakhor 2007). *Riba* or interest creates wealth for one party at the expense of another which is unjustified in Islam for it conflicts with the general interest and welfare of the society Robertson (as cited in Hashim, 2008).

In addition, Islamic equity funds possess some specific risks that are usually not present in conventional investments such as: changing Sharia rules, the lack of sufficient track record, high exposure to companies that might be sub-optimally levered, and companies with low working capital (Hayat & Kraeussl 2011; Listyaningsih &Krishnamurti 2014:5). Additionally, Girard and Hassan (2008) argued that Islamic indices comprise smaller firms than conventional indices. In sum, Islamic indices are growth and small-cap oriented while conventional indices are relatively more value and mid-cap focused. Al-Zoubi and Maghyereh (2007) found that Islamic index presents unique risk characteristics that is significantly less than the broad market basket of stocks. In addition, Hakim and Rashidian (2002) indicate that Islamic index is influenced by factors independent from the broad market or interest rates.

The definition of risk by Coleman (2021) is the working definition adopted in this study.

2.1.2 Return on Investment

Elton and Gruber (2006) used return to indicate the return on an investment over a particular span of time called holding period return. They measured it by the sum of the change in the market price of a security plus any income received over a holding period divided by the price of a security at the beginning of the holding period. Studies of return on investment are based on Markowitz Model of finance, which enable an investor to form a portfolio in the beginning of the period (Markowitz, 1952). Investors maximize the expected returns from the portfolios subject to a tolerable degree of risk or minimize risk depending on expected return that is acceptable. The investor's attitude towards risk enables him to measure risk by standard deviation; therefore, the risk and the expected returns change in specific ways as the securities are added to the portfolio. Securities are added to the portfolios depending on how their expected returns co-vary with other securities. Markowitz framework sets the foundation on which Sharpe (1964), Litner (1965) and Mossin (1966) derived the CAPM model.

Elton and Gruber (2006) reported that the rate of return on large common stocks is 6.4% higher than the rate of return on long-term corporate bonds because of the greater risk associated with the future cash flows on large stocks. The rate on small stocks is 5.3% higher than the rate on larger stocks, due in part to the added risk associated with small stocks.

It is well-known that stocks and other equity-based financial assets are riskier than bonds. Therefore, it should be logical that the expected returns on the riskier assets (e.g. stocks) must be higher than those for the risk-less securities (e.g. bonds). But how big should the equity premium be in this case? Standard economics and finance theories suggest that stockholders should receive perhaps an extra 1% return from stocks over bonds as a compensation for holding larger risk associated with equity investing. However, Mehra and Prescott (1985) realized in their study that the equity premium obtained from the investigation of the US market (both stocks and bonds) in the period 1889-1978 was too large and beyond expectations. They found that over a nighty-year data, the average mean on the S&P 500 Index was 7%, while the average mean on the US government bonds was almost 1%. Consequently, the equity premium in this case is 6% which was considered being quite big; and this made Mehra and Prescott to declare this phenomenon as a puzzle (Shubbar, 2010).

2.1.3 Risk–Return Trade-Off

The risk-return tradeoff theory basically assumes that the greater the expected risk, the greater the expected return. This assumption is a part of the *Modern Portfolio Theory* Harry Markowitz introduced, where he stated that all investors are risk averse and will chose a portfolio with lower risk when choosing between two portfolios with exactly the same rate of return (Markowitz, 1952). The risk-return tradeoff assumes that markets are efficient and no alpha-profit could be found: if a higher expected return can be found there will be a rush to buy this security and the price of the security will increase. If the investor then buys the security when the price has already risen, she can expect a *fair return* given the risk taken, but no more than that. Similarly a security with too high risk relative to the price, there will be a rush to sell and the price will decrease until the risk matches the return of the stock and equilibrium is reached. This is the basic assumption of the risk-return tradeoff: the investor expects higher return when taking on securities with higher risk (Krantz, 2013).

The concept of the risk-return tradeoff is used to explain the relationship between risk and return. The hypothesis states that potential return increase when risk increases, and so this relationship is linear. Basically, an investor is only taking on more risk if compensated by a higher rate of return. Markowitz explains this in his paper *Portfolio Selection: Efficient Diversification of Investments* by stating that an investor's utility function must be quadratic: that is, if an investor prefers smaller standard deviation to larger standard deviation (expected return remains the same), given that the investor a) maximize the expected value of some utility function and b) his/her choice among portfolios depends only on his/her expected return and standard deviation Markowitz (as cited in Krantz, 2013).

Moreover, low levels of uncertainty are associated with low potential returns and vice versa and therefore the risk-return tradeoff states that an investor can only earn high returns if she is willing to take the risk of losing the investment made. This of course, causes a discussion of risk aversion: all investors are risk averse, but the level of risk aversion differs. The risk an investor takes on is the price she is paying for potential return: we assume that if the risk premium were zero, the investor would not be willing to invest any money in that portfolio. Thus, theoretically there must always be a positive risk premium in order to induce risk-averse investors to hold a risky portfolio instead of investing all her money in risk-free assets. (Bodie, Kane & Marcus, 2011).

The concept of risk and return relationship is based on two realities of investments and investment performance. First, investments are susceptible to some degree of risk because an investor stands the risk of losing all his cash when buying stocks, bonds, mutual funds or other investments. Second the more risk an investor assumes the greater the investment returns he may achieve. As indicated earlier there are different kinds of risks but risk return trade off encompasses volatility as the basic measure of risk. Volatility is the degree to which an investment changes in price. Price fluctuations will depend on the category of the asset, thus stocks prices change widely from one year to another as compared to swing in bonds prices which tend to be less dramatic (Harvey *et al*, 2005; Mandmika and Chinzara, 2010).

2.1.4 Stock market Index

A stock market index is a measurement of the value of a section of the stock market. It is computed from the prices of selected stocks (typically a weighted average). It is a tool used by investors and financial managers to describe the market, and to compare the return on specific investments. An index is a mathematical construct, so it may not be invested in directly. Financial indices are useful for investors seeking for summary, accurate, easily and rapidly available information on stock markets (Hautcoeur, 2006).

Financial market indices represent a means of measuring the performance of a particular segment of a financial market. One of the popular indices of the world is the S&P 500 which was introduced in 1957 which comprised of US large capitalization stocks. Another well-known index is the FTSE-100 which comprises the 100 largest stocks listed on the London stock exchange. In the Eurozone one of the best known stock indices is the Euro Stoxx 50, which composes of 50 of the largest publicly traded companies in the Eurozone. The MSCI world index comprises of stocks listed in 23 developed economy equity markets. However, benchmark administrators create indices based on other asset classes for instance, the Barleys Global Aggregate Index consist of investment grade bonds issued in 24 currencies by governments, government agencies, and corporations as well as securitized bonds from both developed and emerging economies. The performance of these indices, and many others, is monitored closely by investors, central banks and other regulators, and by the mainstream media (Clare and Thomas, 2015).

There are other regional indices such as Dow Jones Canada Index (CADOWD), Dow Jones Turkey Titans 20 Index TRY (TR20), FTSE All-World India Index GBP (WIIND), Dow Jones China Offshore 50 Index (DJCHOF50), FTSE World Taiwan Index USD (WITWN) etc.Indexes may be based on exchange, such as the NASDAQ 100, or groups of exchanges, such as the Euronext 100.

In recent time Islamic indices as alternative investments were produced by the major world indices spread across regions. In this regard there are Islamic indices such as Dow Jones Islamic Market Europe Index (DJIEU), Dow Jones Islamic Market Turkey Index (DJIMTR), Dow Jones Islamic Market Malaysia Titans 25 Index (DJMY25D), Dow Jones Islamic market China/Hong Kong Titans Index (DJICHK), FTSE DIFA Qatar 10 Sharia Index (DQAS) and FTSE Shariah India Index (SWIND) etc.

Benchmark administrators produce indices based upon a wide range of asset classes, such as stocks, bonds, currencies, commodities, real estate, alternative investments, and derivatives. Indices are also produced to represent different regions of the world, for example, the Eurozone, and within particular countries. Indices are also constructed according to both broad industrial sectors, for example the Energy sector, but also on sub-sectors of the main sectors, for example, the Oil Exploration sector, which is a sub-sector of the larger Energy sector. Finally, indices are also constructed by grouping securities according to specific security characteristics. For example, stock indices can be categorized according to the market capitalisation of the constituents – “small”, “medium”, “large” – while bond indices can be sub-divided according to the maturity or credit rating of the bonds (Clare and Thomas, 2015).

Indices are also classified according to the method used to determine their price. In a price-weighted index, such as, the Dow Jones Industrial Average (DJIA), the price of each component stock is the only consideration when determining the value of the index. Thus, price movement of even a single security will significantly affect the value of the index. On the contrary, a capitalized-weighted index (also called market-value-weighted) such as the Hang Seng index, it factors in the size of the company. Thus, a relatively small shift in the price of a large company will heavily affect the value of the index.

In February 1999, Dow Jones launched its first Islamic market index. The Dow Jones Islamic Market Index (DJIMI) is a subset of Dow Jones Global Indexes (DJGI) group, which includes stocks from 34 countries and covers 10 economic sectors, 18 market sectors, 51 industry groups and 89 subgroups defined by the Dow Jones Global Classification Standard. The DJIMI excludes from the index universe any industry group whose line of business is incompatible with Islamic principles. These activities include tobacco, alcoholic beverages, pork, gambling, arms, pornography, hotel and leisure industry, and conventional financial services (banking, insurance, etc) (Hussein, 2005). Stocks from lenders, such as banks, credit card companies, mortgagers, brokerages, insurers, companies with excessive debt and, conversely, excessive cash positions – both of which are banned by Islamic law – were also excluded based on Islamic screening principles (Nihalani, 2009).

Investors and economists watch the Dow Jones Averages to monitor the performance of sectors of the stock market, the stock market as a whole, and the economy. Movements of the indexes up or down influence when and how investors buy or sell securities, and may also influence national economic policy. Average prices are listed in points rather than dollar amounts, where one point equals one dollar. The DJIA, also referred to as *the Dow,* is the most important U.S. stock market performance indicator. It is an average of the value of the stocks of 30 large, primarily industrial companies. As a measure of overall stock market performance, the Dow has limited value. The 30 corporations comprising the index are among the largest in the world, including such giants as General Electric Company, General Motors Corporation, AT&T, Inc., and IBM. The stocks of these 30 companies represent close to 20 percent of the market value of all the stocks listed on the New York Stock Exchange. Economists refer to these kinds of stocks as *blue-chip stocks.* Traditionally, these are stocks of major businesses with long, stable histories and of enduring interest to many investors. The index, therefore, is essentially a measure of the performance of the stocks of large corporations (Case, 2009).

Once companies with unacceptable primary business activities have been eliminated from the universe, the remaining stocks are tested according to three filters designed to limit the Dow Jones Islamic universe to the most desirable firms. Debt and assets are considered, as to which extent that assets are financed by debt. Thus, the debt/capital ratio should not exceed 33% in order for a firm to be included in the DJIMI. Companies are also excluded if the sum of cash and interest bearing securities exceeds 33% of market capitalization. Firms also cannot be included in the DJIMI if accounts receivable is greater than 45% of total assets. Companies that pass these criteria are included in the DJIMI investable universe (Hussein, 2005).

At the end of December 1998 and due to the growing interest in Islamic finance, FTSE, in collaboration with the International investor, launched FTSE Global Islamic Index Series (GIIS). GIIS are equity benchmark indices designed to track the performance of leading publicly trading companies whose activities are consistent with Islamic shariah principles. The GIIS are a subset of FTSE All- World Index group 1 which includes stocks from 29 countries. FTSE has 15 Islamic indices, classification is based on industry (10 indices) and region (Global, Americas, Europe, Pacific Basin, South Africa) (Hussein, 2005).

The GIIS are calculated at the end of each day when the FTSE All-World Index is calculated where the base currency for the GIIS is the US dollar. Companies are included in the appropriate GIIS index, if they are current constituents of one of the FTSE All-World index markets and also meet the Islamic criteria. Islamic shariah principles exclude stocks whose core activities are related to any of the following: banking or any other interest related activity, alcohol, tobacco, gambling, arms manufacturing, life insurance, pork production, packaging and processing any activity related to pork, and companies with gross interest bearing debt to total assets exceeds 33%. GIIS have a management committee which is responsible for the calculation of the GIIS, reviewing the GIIS and approving changes to the constituents. The GIIS are reviewed semi-annually in the first week of March and September. If a stock drops out of the FTSE All-World Index markets, it is removed from the relevant GIIS index. Further, if a stock of the GIIS fails to meet the eligibility criteria, the management committee removes it from the relevant GIIS index. Changes arising from the semi-annual review are implemented after the close of the index calculation on the third Friday in March and September (Hussein, 2005).

Chronologically, Islamic indices were launched for the first time in the late nineties, the beginning was in April 1998 with the index DMI 150 (Dar al Mal al-Islami) launched jointly by two private banks (Faisal Finance and Bank Vontobel) in order to track the performance of the 150 largest global publicly traded companies. Another index was created in November of the same year, it was SAMI (Socially Aware Muslim Index) which measured the performance of 500 Shariah compliant companies. After this beginning, several financial markets had launched their own Islamic indices as a new alternative for investors seeking investment opportunities without compromising their beliefs. Hence, Dow Jones created the Dow Jones Islamic Market Index (DJIMI) on February 1999 and FTSE Group launched Global Islamic Index Series (GIIS) at the London Stock Exchange on October 1999 (El Khamlichi *et al*., 2014).

The index provider Standard and Poor's created the Global Benchmark Shariah indices on December 2006 and MSCI Barra launched its global family of Islamic indices in March 2007. In February 2011, Stoxx limited introduced the first set of Shariah compliant indices for Europe and Euro zone, these indices measure the performance of Shariah compliant companies selected from the universe of Stoxx Europe 600 index. In addition to the previous indices which had an internationally geographical coverage, some financial markets such as Malaysia, India, Pakistan, Saudi Arabia, Taiwan, Bahrain, Turkey, and Egypt have introduced their own Islamic indices with a local focus (El Khamlichi *et al.*, 2014).

2.1.5 Islamic Equity Investments

According to Dharani and Natarajan (2011), Islamic Index comprises Shari'ah compliant stocks which provide essential advantages of being socially responsible and ethically sound. Islamic investment principles emphasize ethical investing (known as Shariah-compliant investments) that complies with the principles of Shariah, which is the Islamic law that governs every facet of a Muslim's life. Investments in financial instruments with fixed income, such as, preferred stocks, bonds and some derivatives (e.g. options) are unacceptable as they promise a fixed rate of return and grant no voting rights (Walkshäusl and Lobe, 2012) cited in Reddy and Fu (2014:157). Furthermore, Islamic investors are not permitted to purchase stocks of companies whose main business activities are alcohol, gambling, conventional financial services, entertainment, pork-related products, tobacco, and weapons (Islamic Finance & Investment, 2014).

While Islamic banking based on the prohibition of interest, is well established throughout the Muslim world, many scholars point that attention has now turned towards applying Islamic principles in equity markets. They suggest that while common stocks are legitimate instruments in Islam, many of the practices associated with stock trading are not. These practices include speculation, short selling, margin trading, and equity futures and options, all of which would be either severely restricted or unlikely to be acceptable within an Islamic market. They conclude that regulatory authorities in Muslim countries will therefore find a vast array of problems in attempting to structure a trading system that will be acceptable (Hakim and Rashidian, 2004).

Islamic finance in general aims at promoting specified sectors/industries that provide added value to the real economy. On the other hand, Muslim investors expect their financial portfolio to provide stable earnings and capital growth opportunities in accepted investments. Islamic investing is low-debt, non-financial, social-ethical investment. It has much in common with modern forms of investing known as "ethical investing", "green investing", "faith investing" and "socially responsible investing" (DeLorenzo, 2001). The most important difference between Islamic and other ethical funds is that in addition to the exclusion of particular sectors, Islamic funds do not deal in fixed income market and the receipt and payment of interest is not permitted (Hussein, 2004:26).

Equity investing became permitted because *Shariah* scholars reached a consensus that, under certain conditions, trading stocks fulfill two important conditions in Islamic finance. First, trading stocks represent trading real assets that have intrinsic values and not just artificial ones. Second, capital gains and generated dividends from equity trading are comfortable with the *Shariah* law because they are based on the profit-loss sharing financing concept.

Islamic stock market indices have gained popularity in the global financial market due to their immense potential for growth and profitability Hassan and Girard (as cited in Ho *et al* (2013). The Islamic indices are designed to comply with Islamic ideology (Shariah) to filter what is deemed as unethical or prohibited behaviours such as fee-gauzing and other means of unethical transfers to operators. The Shari'ah Advisory Board (SAB) is the highest authority that provides the guidelines and regulations for investment in various financial portfolios. Some of the investment outlets abhorred by the Shari'ah includes but not limited to production of pork and alcohol for human consumption;

gambling; interest-based conventional financial contracts; advertising/media involving pornography; tobacco and trading of gold and silver as cash on deferred basis (Ho *et al*, 2013).

2.1.6 Screening for *Shariah*-Compliant Stocks

In practice, Shariah scholars and regulators have developed qualitative and quantitative screens to filter out the stocks and to assess their compliancy to Islamic principles. The independent Shariah boards define two-step screening process regarding the activity sector of firms and their financial ratios. The first step of screening is based on the line of companies business. The idea of the negative screening is to exclude companies operating in specific areas based on their activity sector. In addition to two classical classifications, namely the General Industry Classification Standard (GICS) and the Industry Classification Benchmark (ICB), the Standard Industrial Classification (SIC) system offers the advantage to assign multiple codes based on the businesses the company is operating in (Derigs & Marzban, 2009). The divergence between Shariah scholars occurs when the company's main business is lawful but fraught with some prohibited transactions. The issue here is the extent to which the unlawful activity is a primary activity of the company (El- Gamal, 2006).

The second step of screening concerns quantitative screens based on financial ratios. The idea of these ratios have germinated when pioneering Islamic institutions asked for allowance to include in their portfolios stocks of companies with small or negligible amount of interest and unlawful income (El-Gamal, 2006). The authorized levels are not the same for all Shariah-boards; this can lead to significantly different asset universes according to the used methodology (Derigs & Marzban, 2008). That's why this practice of screening could not gain scholars' unanimous support and the debate over its permissibility is not over yet.

Rosly (as cited in Albaity & Ahmad, 2011) indicated that there are four main methods of screening. The first method is production approach where the activities of the company are the focus of the screening. The second method is the capital structure approach where the modes of finance of the company will be under Shariah screening. The third method is the income approach where the income of the company is scrutinized. The last method is the asset approach where company's assets are to be screened. Most of the Islamic indices do not follow a single method but a mixture of almost all of them. The difference is only in the extent of the focus. Some indices focus more on income and production but might be flexible in modes of finance. Others might emphasis more on the production than on income.

Practically, it is not uncommon to find companies that fail to pass the ethical filter because they have a small portion of their revenues generated from impermissible activities (referred to as partially contaminated firms by Merdad (2012). Due to the large number of these contaminated companies Islamic scholars relaxed the rigidity a bit and came up with two additional requirements for those considered partially contaminated. The first requirement is that these partially contaminated firms must be perceived by the public as exemplary firms whose main businesses must be of public interest. The second requirement is that the permissible (*halal*) activities must represent the core activities of these firms, and the prohibited (*haram*) activities must be very negligible. Thus, if these two requirements are met, the partially contaminated firms could be regarded as *Shariah*-compliant.

The filter stipulates that the partially contaminated firms must maintain the following ratios to be considered as *Shariah*-compliant: a) the ratio of impermissible income to total income is less than 5 percent; b) the ratio of interest-based debt to total assets is less than 33 percent (or 30 percent in some cases); c) the ratio of account receivables to total assets is less than 45 percent (or 33 percent in some cases); and d) the ratio of interest-bearing cash and investments to total assets is less than 33 percent (or 30 percent in some cases) (Merdad, 2012).

To buttress the above facts, most of the major Islamic indices screen at two levels: industry screen and financial ration. For instance, as indicated on their websites DJIM, FTSE, MSCI and S&P at the industry screening level, screen out firms that deal in Alcohol, pork-related products, conventional financial services (non-Islamic finance and insurance etc.), entertainments (Casinos, gambling, and pornography), Tobacco, weapons and defense, arms. In addition, MSCI also screen out music, hotel and cinema whereas S&P removes firms engaged in trading gold and silver as cash on deferred payment. And in terms of financial ration most of the Islamic indices examined including DJIM, FTSE, MSCI and S&P adhere to the following criteria:

i. Debt < 33% of total assets.

ii. Cash and interest bearing items are < 33% of total assets.

iii. Account receivable and cash < 50% of total assets

iv. Total interest and non-compliant activities income not > 50% of total revenue.

2.2 Theories of Portfolio Investment

This section presents a number of theories that explains portfolio investment that are commonly used in financial investment literature. They are modern portfolio theory, capital asset pricing model, arbitrage pricing theory and market efficiency theory.

2.2.1 The Modern Portfolio Theory (MPT)

Markowitz (1952) introduced the Modern Portfolio Theory (MPT) which is concerned with the analysis of portfolio investments in terms of optimal portfolio selection. The MPT approach included portfolio formation by considering the expected rate of return and risk of individual stocks measured as standard deviation, and their interrelationship as measured by correlation. The theory encourages asset diversification to hedge against market risk as well as risk that is unique to a specific company (Levisauskaite, 2010). The MPT is a theory of investment which attempts to maximize portfolio expected return for a given amount of portfolio risk, or equivalently minimize risk for a given level of expected return by carefully choosing the proportions of various assets. Although the MPT is widely used in practice in the financial industry, in recent years, the basic assumptions of the MPT has been widely challenged (Omisore, 2012:21; Coleman, 2009).

The Markowitz focus was on the end-of-period wealth (terminal value) and using these expected end-of-period values for each security in the portfolio the expected end-of-period return for the whole portfolio can be calculated. The expected rate of return of a portfolio depends on the expected rates of return of each security included in the portfolio. This alternative method for calculating the expected rate of return on the portfolio is the weighted average of the expected returns on its component securities:

$$E(R_i) = \sum W_n \, r_n \qquad \text{(i)}$$

Where

W_i - the proportion of the portfolio's initial value invested in security n

$E(R_i)$ - the expected rate of return of security i

r_n - the expected returns of the number of securities in the portfolio.

Because a portfolio‘s expected return is a weighted average of the expected returns of its securities, the contribution of each security to the portfolio‘s expected rate of return depends on its expected return and its proportional share from the initial portfolio‘s market value (weight). Nothing else is relevant. The conclusion here could be that the investor who simply wants the highest possible expected rate of return must keep only one security in his portfolio which has a highest expected rate of return. But majority of investors in practice keep several different securities in their portfolios because they try to diversify their portfolios aiming to reduce the investment portfolio risk (Levisauskaite, 2010).

The most often used measure for the risk of investment is standard deviation, which shows the volatility of the securities actual return from their expected return. If a portfolio‘s expected rate of return is a weighted average of the expected rates of return of its securities, the calculation of standard deviation for the portfolio can‘t simply use the same approach. The reason is that the relationship between the securities in the same portfolio must be taken into account (Levisauskaite, 2010). The relationship between the assets can be estimated using the covariance and coefficient of correlation. As covariance can range from "–" to "+" infinity, it is more useful for identification of the direction of relationship (positive or negative), coefficients of correlation always lies between -1 and +1 and is the convenient measure of intensity and direction of the relationship between the assets.

Covariance is a measure of the degree to which two variables "move together" relative to their individual mean values over time. A positive covariance means that, the rate of return for two investments tend to move in the same direction relative to their individual means during the same time period. In contrast a negative covariance means that the rate of return for two individual investments tends to move in different directions relative to their means during specified time periods (Coleman, 2009:31-32).

The MPT advocates for diversification in investing, with the aim of selecting a collection of investment assets that have collectively lower risk than any individual asset. The possibility of this can be seen intuitively because different types of assets often change in value in opposite ways. But diversification lowers risk even if assets' returns are not negatively correlated-indeed, even if they are positively correlated. Investment is a trade-off between risk and expected return. Generally, assets with higher expected returns are riskier. For a given amount of risk, the MPT describes how to select a portfolio with the highest possible expected return. Or, for a given expected return, the MPT explains how to select a portfolio with the lowest possible risk. The fundamental concept behind the MPT is that assets in an investment portfolio should not be selected individually, each on their own merits. Rather, it is important to consider how each asset changes in price relative to how every other asset in the portfolio changes in price (Omisore, 2012:22).

2.2.2 Capital Asset Pricing Model (CAPM)

Capital Asset Pricing Model (CAPM) was developed by W. F. Sharpe who simplified the MPT and made it more practical. Markowitz showed that for a given level of expected return and for a given feasible set of securities, finding the optimal portfolio with the lowest total risk, measured as variance or standard deviation of portfolio returns, requires knowledge of the covariance or correlation between all possible security combinations. Investors could find it difficult to compute portfolio risk using standard deviation when dealing with diversified portfolio consisting large number of securities. CAPM postulates that the magnitude of an asset's risk premium is the difference between the asset's expected return and the risk-free interest rate (Yusof and Majid, 2007). Accordingly, Rose (2000) shows that the expected return of a capital asset in the CAPM is given as:

$$E(R_i) = r_f + \beta_j \left[E(R_m) - r_f\right] \qquad \textbf{(ii)}$$

Where,
$E(R_i)$ - expected return on stock i
r_f - risk free rate of return
$E(R_m)$ - expected rate of market return
β_i - coefficient Beta, measuring undiversified risk of security i

$E(R_i)$measures the expected return on the ith asset, $E(R_M)$ is the expected return on the market's entire collection of financial assets or the whole portfolio, β_i is a measure of an individual asset's risk exposure compared to the risk exposure of the whole market portfolio; and r_f is the risk-free interest rate (often approximated by the return on government bonds). The risk-free interest rate element can be influenced by the changes in money supply and thus affecting the expected return of a financial asset. Therefore, volatilities in monetary policy variables, may also affect the volatility in the expected return of a financial asset. Equation (ii) represents a straight line having an intercept of r_f and slope of $\beta_i\left[E(R_m) - r_f\right]$.This relationship between the expected return and Beta is known as Security Market Line (SML). Each security can be described by its specific security market line; they differ because their Betas are different and reflect different levels of market risk for these securities.

Coefficient Beta (β): Each security has its individual systematic - undiversified risk, measured using coefficient Beta. Coefficient Beta (β) indicates how the price of security return on security depends upon the market forces. Thus, coefficient Beta for any security can be calculated using the expression:

$$\beta_j = \frac{Cov(R_j R_m)}{\delta^2(r_m)} \qquad \text{(iii)}$$

One very important feature of Beta to the investor is that the Beta of a portfolio is simply a weighted average of the Betas of its component securities, where the proportions invested in the securities are the respective weights. Thus, Portfolio Beta can be calculated using:

$$\beta_i = \sum W_n \beta_n \qquad \text{(iv)}$$

Where,
W_n - the proportion of the portfolio's initial value invested in security n;
β_i - coefficient Beta for security i
β_n - coefficient Beta for security n

This means that the expected return on the portfolio is a weighted average of the expected returns of its components securities, where the proportions invested in the securities are the weights.

The CAPM is based on some important assumptions: All investors look only one-period expectation about the future, investors are price takers and they can't influence the market individually, there is risk free rate at which an investors may either lend (invest) or borrow money, investors are risk-averse, taxes and transaction costs are irrelevant, information is freely and instantly available to all investors.

Measuring Risk in CAPM is based on the identification of two key components of total risk (as measured by variance or standard deviation of return); *Systematic risk and Unsystematic risk.* Systematic risk is that associated with the market (purchasing power risk, interest rate risk, liquidity risk, etc.). Unsystematic risk is unique to an individual asset (business risk, financial risk, and other risks related to investment into particular asset). Unsystematic risk can be diversified away by holding many different assets in the portfolio, however systematic risk can't be diversified. In CAPM investors are compensated for taking only systematic risk. Though, CAPM only links investments via the market as a whole (Levisauskaite, 2010).

2.2.3 Arbitrage Pricing Theory (APT)

APT was proposed by Rose (1976) and presented in his article "The arbitrage theory of Capital Asset Pricing", published in the Journal of Economic Theory. Unlike the in the CAPM where returns on individual assets are related to returns on the market as a whole, in the APT stock returns is determined by a number of different factors. These factors can be fundamental factors or statistical. If these factors are essential, there will be no arbitrage opportunities and there must be restrictions on the investment process. Arbitrage here impliesthe earning of riskless profit by taking advantage of differential pricing for the same assets or security (Levisauskaite, 2010:60).

APT states that the expected rate of return of security i is the linear function from the complex economic factors common to all securities and can be estimated using the expression:

$$E(R_i) = E(r_i) + \sum \beta_{ni} F_{ni} + \varepsilon_i \qquad \text{(V)}$$

Where,
$E(R_i)$ - expected return on stock i
E(ŕi) - expected rate of return for security i, if the influence of all factors is 0
F_{ni} - Economic factor n (i = 1, ., n)
β_{ni} - Coefficient Beta shows sensitivity of security's i rate of return upon the factor i
ε_i - Error term

It is important to note that the arbitrage in the APT is only approximate; relating diversified portfolios, on assumption that the asset unsystematic (specific) risks are negligible compared with the factor risks. There could presumably be an infinitive number of factors, although the empirical research done by Ross and Roll (as cited in Levisauskaite, 2010) identified four factors – economic variables, to which assets having even the same CAPM Beta, are differently sensitive: inflation, industrial production, risk premiums, and slope of the term structure in interest rate.

In practice an investor can choose the macroeconomic factors which seem important and relate it with the expected returns of a particular asset. The examples of possible macroeconomic factors which could be included in using APT model include GDP growth, interest rate, exchange rate, and a default spread on corporate bonds, etc. Including more factors in APT model seems logical. The institutional investors and analysts closely watch macroeconomic statistics such as the money supply, inflation, interest rates, unemployment, changes in GDP, political events and many others. Reason for this might be their belief that new information about the changes in these macroeconomic indicators will influence future asset price movements. But it is important to point out that not all investors or analysts are concerned with the same set of economic information and they differently assess the importance of various macroeconomic factors to the assets they have invested already or are going to invest.

At the same time large number of factors in the APT model would be impractical, because the models are seldom 100 percent accurate and the asset prices are function of both macroeconomic factors and noise. The noise is coming from minor factors, with a little influence to the result – expected rate of return. The APT does not require identification of the market portfolio, but it does require the specification of the relevant macroeconomic factors. Much of the current empirical APT researches are focused on identification of these factors and the determination of the factors' Betas (Levisauskaite, 2010).

The CAPM and APT are not really essentially different, because they are developed for determining an expected rate of return based on one factor (market portfolio – CAPM) or a number of macroeconomic factors (APT). But both models predict how the return on asset will result from factor sensitivities and this is of great importance to the investor.

2.2.4 Market Efficiency Theory (MET)

The concept of market efficiency was proposed by Fama (1965) in his article "Random Walks in Stock Prices". Market efficiency means that the price which investor is paying for financial asset (stock, bond, other security) fully reflects fair or true information about the intrinsic value of this specific asset or fairly describes the value of the company – the issuer of this security. It is stated by the theory that the market price of stock reflects: (1).All known information, including: past information, e.g., last year's or last quarter's or month's earnings; Current information as well as events that have been announced but are still forthcoming, e.g. shareholders' meeting. (2) Information that can reasonably be inferred such as changes in interest rates or government deficits. All these may be reflected in stock prices before the actual event occurs (Levisauskaite, 2010). Therefore, MET asserts that the expected returns of a stock depends on all information regarding that stock past, present of future information.

Market efficiency requires that the adjustment to new information occurs very quickly as the information becomes known. Obviously, the internet has made the markets more efficient in the sense of the speed with which information circulates globally (Levisauskaite, 2010).

There are three forms of market efficiency under efficient market hypothesis: Weak form of efficiency, Semi- strong form of efficiency, and Strong form of efficiency. Under the weak form of efficiency stock prices are assumed to reflect any information that may be contained in the past history of the stock prices. Under the semi-strong form of efficiencyall publicly available information is presumed to be reflected in stocks' prices. This information includes information in the stock price series as well as information in the firm's financial reports, the reports of competing firms, announced information relating to the state of the economy and any other publicly available information, relevant to the valuation of the firm. Note that the market with a semi strong form of efficiency encompasses the weak form of the hypothesis because the historical market data are part of the larger set of all publicly available information. The strong form of efficiency which asserts that stock prices fully reflect all information, including private or inside information, as well as that which is publicly available. This form takes the notion of market efficiency to the ultimate extreme. Under this form of market efficiency securities' prices quickly adjust to reflect both the inside and public information (Levisauskaite, 2010).

In all the three situations above, no one investor or any group of investors should be able to earn over the defined period of time abnormal rates of return by using historical or publicly available fundamental information(such as financial statements) or all information available for them or technical analysis. Prices will respond to news, but if this news is random then price changes will also be random (Levisauskaite, 2010).

2.3 Volatility as Proxy for Risk

Under the assumption of a normal distribution of returns (*i.e.* stock prices follow a random walk process), which means that the distribution of returns is symmetrical; one can estimate the probabilities of potential gains or losses associated with each amount. This means the standard deviation of securities returns, which is called historical volatility and is usually calculated as a moving average, can be used as a risk indicator. The prices used for the calculations are usually the closing prices, but Parkinson (1980) suggests that the day's high and low prices would provide a better estimate of real volatility. One can also refine the analysis with high frequency data. Such data is important to avoid bias stemming from the use of closing (or opening) prices. The length of the observation period is another topic that is still under debate. There are no criteria that concludes that volatility calculated in relation to mean returns over 20 trading days (or one month) and then annualized is any more or less representative than volatility calculated over 130 trading days (or six months) and then annualized, or better than volatility measured directly over 260 trading days (one year) (Grouard, Levy, and Lubochinsky, 2003)

However, in reality, the distribution of returns is not normal. This raises a first problem stemming from financial agents' preferences. Their preferences are asymmetrical since they are naturally much more concerned about the risk of losses than by the risk of gains. Other risk measurements have therefore been developed. Most of them, including the ones recommended by prudential authorities, focus primarily on the notion of potential loss. More specifically, one can calculate the semi-variance, which corresponds to a variance calculated solely on the basis of negative deviations from the mean, the Value at Risk (VaR) or the extreme potential loss for a portfolio at a given time horizon and confidence interval.

Furthermore, it is restrictive to estimate only the first two moments of the distribution of returns (mean and variance), since the distributions can also be characterised by their third and fourth moments (skewness and kurtosis). This is a problem as the assumption of a normal distribution is rejected and it is admitted that the distribution of returns is skewed and leptokurtic. For example, in illiquid markets, prices may not change over a certain period simply because no transactions take place. In this case, low volatility should not be interpreted as indicating low market risk. It should be seen as a sign of high liquidity risk instead.

Furthermore, wide price fluctuations may be necessary in an illiquid market in order to match bid and offer transactions. In this case, the high price volatility is due to illiquidity and not to changes in the fundamental value of the assets. In other words, liquidity may be a critical factor for interpreting volatility. Clearly, volatility analysis alone does not provide complete information about the market risk incurred by financial agents. Volatility is an approximate and biased indicator of risk, both in the case of empirical volatility calculated from past prices (historical volatility) and in the case of implied volatility derived from option prices (Grouard, Levy, & Lubochinsky, 2003).

In any case, volatility has to be estimated since it cannot be observed directly. Several models have been constructed to represent the dynamics of the volatility of returns and to attempt to forecast it. These models are very frequently autoregressive conditional heteroskedasticity (ARCH) models, which were introduced by Engle in 1982 and then extended by Bollersev in 1986 with the Generalised ARCH (GARCH) model. These models introduced explicit modeling of the variance of returns. This variance follows a specific temporal process. Thus, given the historical information, the conditional distribution of returns is normal with a mean equal to zero and variance of ht, which is a function of historical variance. This makes it possible to introduce a correlation between returns and thereby formally represent persistence phenomena.

2.4 Summary

Out of the four portfolio theories reviewed in this section, the ones that become most relevant in this study are the MPT and the APT models. This is because MPT suggests that diversification of portfolio is a buffer against risk. This is more efficacious if the stocks do not exhibit any form of correlation. Based on this theory, combining conventional and Islamic indices will imply less risk and better expected returns in a portfolio. Therefore, the MPT forms the premise in this dissertation. Further, the APT relates the expected returns of individual assets to some fundamental economic factors as postulated by Rose (1976). The model is flexible and allows the researcher to choose the macroeconomic factors that are found more suitable for a study. The focus of this study is the Dow Jones and FTSE conventional and Islamic stock indices. Both indices used the US Dollar as a measure of their basis point, therefore, as in order studies; this study deems it appropriate to examine the effect of some US macroeconomic variables on the performance of these indices. Accordingly, the US macroeconomic variables of interest were chosen based on empirical works and they include federal funds rate, money supply, consumer price index, Treasury bill, economic uncertainty index, volatility fear index, and Brent oil price.

2.5 Empirical Literature

The review of the current empirical literature on the portfolio performances of conventional and Islamic indices revealed three major groupings: The first set of studies mostly focused on the risk-return evaluation of conventional and Islamic indices using Sharpe ratio, Treynor index and Jensen alpha. The second set of studies examine the volatility of both indices using various ARCH and GARCH models including GARCH-M, EGARCH or TARCH models respectively. The third sets are very few in number that is studies that include the leverage effect in studying volatilities of the indices. Most of the studies reviewed use either the Markowitz or the Capital Asset Pricing Model as there framework in analyzing both indices without using any unique framework for the Islamic indices. it was noticed that almost all the studies that examine Islamic indices use the conventional framework as there bases of analysis. This therefore, suggests that all the operations in the stock market are accepted in Islam except for the few stocks that are screen out which did not meet the Islamic criteria explained in 2.1.6. Another thing that is common to these studies is the use of T-bill as the risk-free rate as well as the use of the popular conventional indices such as DJIA, MSCI, FTSE, S&P 5000 or Wilshire 5000 as the world bench marks.

In terms of data some of the studies used daily, weekly or monthly closing data. Moreover, the findings from these studies could be summarized as follows; conventional indices perform better, Islamic indices perform better, the same performances, mixed results (i.e. in some period conventional and in some other period Islamic), and inconclusive results. In this section some of these studies were reviewed taking into cognizance the three groupings mentioned earlier.

2.5.1 Diversification Opportunities

Only a few studies have addressed the issues of the existence of diversification opportunities. Hakim and Rashidian (2004) found that despite investment restrictions, the exclusion of industries from the Islamic index of Dow Jones did not seem to have hurt its diversification, but may have contributed to reduce its market risk. Guyot (2011) analyzed the same index family and found the absence of cointegration over the long term between nine pairs of Islamic and conventional indices and therefore, diversification benefits for international investors. Girard and Hassan (2008) used a multivariate cointegration analysis and found that Islamic and conventional groups of FTSE are integrated. They also asserted that both types of indices have similar reward to risk and diversification benefits. Since the authors found no significant differences between Islamic and conventional indices of FTSE, they suggested using them as asset classes to have more diversification benefits. Kok *et al.* (2009), who found the similar conclusion, exhibited the existence of diversification opportunities by grouping FTSE Global Islamic with conventional and socially responsible indices. El Khamlichi, Sakar, Arouri and Teylon (2014) using cointegration analysis found Islamic indices of Dow Jones and S&P have no cointegrating relations with their respective benchmarks, which suggests the existence of long-run diversification opportunities.

Hakim and Rashidian (2002) used the cointegration technique to examine the relationship between DJIM, Wilshire 5000 index and risk-free rate (three-month

Treasury bill) over the 1999-2002 period. They found that an Islamic index with unique risk-return characteristics unaffected by the broad equity market.

2.5.2. Studies on Risk-Return of Conventional and Islamic Indices

Ho *et al* (2013), Hussein (2005), Hussein & Omran (2005) and Hussein (2004) used sub-periods to capture bearish and bullish market situations. This method supersedes other studies as it accounts for structural changes in the data missed out in others studies. In their studyAka (2009), Al-Rifai (2012), Hakim & Rashidian (2004), and Hoepner *et al* (2011) discovered Islamic indices perform better in terms of lower risk and higher returns during the study period. Perhaps, due to the screening that removed all highly leveraged firms and prioritizing industries that deal in real goods.

Albaity & Mudor (2012), Hassan and Girard (2011) Hussein (2005) and Hussein (2004) found no significant difference in performances of Islamic and conventional indices. on the contrary Shubbar (2010) had a mix result. He found no significant difference between Islamic and conventional indices; though the Islamic indices were less volatile than the conventional ones. He further discovered that the conventional indices perform relatively better than the Islamic indices, possibly due to arbitrage opportunities and other transactions disallowed in Islamic finance.

Ho *et al* (2013) and Merdad *et al* (2012) have very interesting and unique results. Whereas the former found Islamic indices to outperform their conventional counterparts during crises periods, the result was however inconclusive in non-crises period; the later discovered Islamic funds underperform conventional funds during overall and bullish periods, but outperform conventional ones in bearish and financial crises period. Though Abdullahi *et al* (2007) obtain a similar result, Hussein and Omran (2005) however reported a contrary finding as Islamic index outperform conventional indices in bullish market and underperforms in bearish market conditions. In other words, the first two studies found Islamic indices to be more resilient during the financial crises than their conventional counterparts. This suggests that including Islamic indices in one's portfolio could make one reap the benefit of diversification by risk-hedging and increased returns on investments.

Reddy & Fu (2014) examined whether there are differences in performance between the Shariah compliant stocks and the conventional stocks listed on the Australian Stock Exchange (ASX). Using OLS regression and Sharpe Ratio they found a statistically significant difference in risk, with the Islamic stocks being more risky. The results suggest that performance of Shariah stocks tends to be better compared to the conventional portfolio returns.

Shubbar (2010) investigated the performance of two key Islamic indices Dow Jones Islamic Market Index and FTSE Shariah All-World Index in the 2008 credit crisis with S&P 500 Index as a reference for all other indices. Trend analysis and performance measures Sharpe Ratio, Capital Asset Pricing Model (CAPM), Jensen.s Alpha, Market Timing Ability, Appraisal Ratio, Treynor Ratio, and Modigliani & Modigliani Measure were the methodologies employed in the study. He found no significant difference between Islamic and conventional indices. However Islamic indices were more stable than conventional ones since they have slightly a lower volatility and a good ability to adapt with the market fluctuations and changes. Conventional indices were found to perform quite better than Islamic ones in terms of gained returns which might be due to arbitrage opportunities and other business activities which are forbidden under Islamic finance.

Khathatay & Nisar (2007) reviewed and compared the Shariah screening rules used by three organizations such as Dow Jones Islamic Indices of USA, Securities and Exchange Commission (SEC) of Malaysia, and Meezan Bank of Pakistan and Bombay Stock Exchange 500 stocks as at end March 2005. The authors concluded that on the whole the SEC's criteria appear to be the most liberal and that of Dow Jones the most conservative. Based on the empirical results, they proposed an independent set of norms that better reflect the objectives of formulating Shariah compliance. They argued that the use of market capitalization in the screening ratios is inappropriate and should be replaced by other relevant balance sheet items, notably total assets.

Boujelbene-Abbes (2012) analysed the return and volatility characteristics of a large set of international data including 35 Islamic stock market indices and their conventional counterparts of developed markets, emerging markets, Arab and GCC markets over the period June 2002 to April 2012. Using differences in Sharpe ratio test and the CAPM model to study the risk adjusted performances of Islamic stock market indices versus their conventional counterpart indices, the author showed that in the entire period as well as in the crisis period there is no difference between performance the types of indices in risk adjusted return basis. Consequently, Muslim investors can pursue stock investments in conformity to their religious beliefs without sacrificing financial performance

2.5.3. Studies on Volatility of Conventional and Islamic Indices

Most of the studies encountered in the literature that studied volatility and the leverage effect of stock indices use a combination of various GARCH models comprising GARCH-M, EGARCH and TARCH models. This may not be unconnected with the stylized facts associated with financial time series data discussed in 3.2 which is concerned with the violation of the assumptions of OLS estimators. For instance it has been established that the disturbance of financial time series violates white noise, the variance (volatility) is not constant, there is serial correlation, the series is leptokurtic and extreme values appear in clusters (Ridwan, 2009). Therefore, modeling financial time series requires other models that are designed to take care of these anomalies. Some of these studies are examined below.

Arshad and Raza (2013); Albaity and Ahmad (2011) all analyzed the relationship between the volatility of Islamic stock indices and business cycles and assessed how it fairs against conventional stock indices. Whereas the former employed E-GARCH, the latter used GARCH, EGARCH and TARCH though they all came up with the same results. There was no significant difference in the volatilities between conventional and Islamic indices that is they exhibited similar pattern. The same outcome was also recorded by Miniaoui, Sayani and Chaibi (2015) with the addition that the GFC affected the mean return of some Islamic indices while others were unaffected.

Al-Zoubi & Maghyereh (2007) compared the relative risk performances of the Dow Jones Islamic Index (DJIS) and the Dow Jones World Index (DJIM). Using GARCH type model - AR(1) + APARCH(1,1) model They showed that the Value-at-Risk (VaR) is greater for DJIM World than for DJIS Islamic. This implied that the DJIS Islamic was less risky than the broader market basket of stocks, DJIM World, when portfolio risk is measured by VaR.

Miniaoui, Sayani & Chaibi (2015) studied the performance of Islamic and conventional indices of the Gulf Cooperation Council (GCC) countries in the wake of financial crisis of 2008 and test whether Islamic indices were less risky than conventional indices. They used data of the six GCC markets as well as the Dow Jones Islamic Market Index GCC. The mean and variance of each of the indices were analyzed based on augmented GARCH models. The results showed that the financial crisis impacted on the mean returns of Bahrain, the other indices remained unaffected. The financial crisis, however, impacted volatility in three GCC markets (Kuwait, Bahrain, and the UAE), while the impact on the remaining markets (Saudi Arabia, Oman, and Qatar) and the Islamic index was insignificant. Additionally Islamic index did not exhibit lower volatility than its conventional counterparts.

Using Engle & Granger's (1987) cointegration technique, in their study El Khamlichi *et al* (2014) found the absence of cointegration among two index families (Dow Jones and Standard & Poor's), which use market-capitalization screening requirements. This recommends that diversification opportunities exist for the mentioned indices. For the other two remaining pairs of indices (FTSE and MSCI), which use asset-based screening requirements, the study found that they were cointegrated and thus absence of diversification benefits. As random walk is linked to the efficient market hypothesis, variance ratio tests were used to assess the efficiency of the indices. The findings showed that both Islamic and conventional indices have the same tendencies and therefore the same level of (in) efficiency. The variance ratio tests revealed that the global indices of FTSE and MSCI are the less inefficient.

Empirical evidence suggests that the correlations between market returns increase when volatility is abnormally large. Bennett & Kelleher (1988) present evidence of a statistically significant positive linear relationship between the correlations of international markets' returns and the volatility of returns in markets that open and trade earlier in the day. Dwyer & Hafer also present evidence that inter-market correlations increased during periods of high volatility. Hamao, Masulis & Ng (1990) found that large price changes in a market tend to transfer or "cause" large price changes in markets temporally following it in the trading day. An explanation for the empirically observed positive relationship between market correlations and volatility is offered by Neumark, Tinsley & Tossini (1991). It attributes the positive relationship to transactions costs that limit the profitability of international arbitrage activities. Because international transactions are costly, profit opportunities must exceed a threshold level before arbitrage is undertaken. Without the international arbitrage, returns are less highly correlated than they would be in a transaction-costless market. There are many arbitrage trade dead-zones when markets are relatively calm. In instances of large price changes, arbitrage between markets becomes profitable and inter-market returns become more highly correlated.

2.5.4. Studies on Macroeconomic Variables and Stock Returns

The literature on the link between stock prices and macroeconomic variables could be broadly classified in to two: the first group is those that investigated the impact of macroeconomic factors on stock prices, and the second group concentrated on the nexus between volatility of stock prices and volatility of macroeconomic factors. Since the present study is based on the first group, we will then review the following related studies. Again the literature differs in terms of selected financial and macroeconomic variables, methodology employed, and level of equity market development. In line with the main purpose of this study, both groups of studies are reviewed here but with emphasis on studies that deal with long run co-movements and short run dynamics of macroeconomic variables and stock prices.

High volatility in stock market could be caused by so many factors. To determine what are the most likely causes of the conventional and Islamic stock prices volatilities, the study models the relation between stock prices and a set of macroeconomic variables of the US. This is important because in recent times and given the mortgage financial crises of 2008, the US has become the epicenter of global financial shocks. Its economic might and strategic position in global economy affects and reinforces the connectivity between the US financial market and other regional markets in Europe, Asia, Africa, and the Middle-east (Nazlioglu, Hammoudeh & Gupta, 2013;Yousef & Majid, 2007). There is a stronger focus in this study on the United States because more than 60% of the DJIM indexes are stocks from the United States and the rest are from Europe and East Asia (Nazlioglu, Hammoudeh & Gupta, 2013; Yousef & Majid, 2007). To the researchers' knowledge, the number of stock indexes from the Muslim countries is minimal because most of those countries do not have sharia-compliant stock markets.

Previous studies on factors affecting stock market volatility have long recognized the relationship between equity price, dividend payoff, company performance, economic variables, financial liberalisation and market integration. Caner & Onder (2005), for example, have stated that stock price volatility is related to company performance, which is presented as dividend yield. Kay & Putten (2007) extended the knowledge by arguing that dividend payoff is a significant source of stock market volatility. Abugri (2002) and Bilson, Brailsford & Hooper (2001) stated that economic variables in each country are used as proxies for fiscal and monetary policies, which relate to stock market volatility. Moreover, the study of Hardouvelis, Malliaropulos & Priestly (2006), Blecker (2005) and Stiglitz (2002) found that financial liberalisation and market integration bring about market efficiency, improved transparency, standardised prices and reduced transaction costs. In addition, market integration can make the market more orderly, whereas in the case of the Asian financial crisis, financial liberalisation and market integration was the cause of volatility in the stock market (Cipriani & Kaminsky, 2007).

The above factors can lead to stock market volatility. However, the findings of Papapetron (2001), Sadorsky (2001), Chen (2009), Brouwer (2003), Wang & Lin (2009), Diebold & Yilmaz (2008) and Longstaff (2010) argue that oil price fluctuation, the US subprime mortgage crisis and politically uncertainty can strongly influence stock market volatility. The present study will, therefore fill the knowledge gap in the literature on the factors affecting global conventional and Islamic stock market volatilities by adding the variables of oil price fluctuation, and economic uncertainty as factors affecting stock market volatility.

The reported studies of Abugri (2002), Caner & Onder (2005), and Granger, Huang & Yang (2000) identified that inflation rate, interest rate, exchange rate, dividend yield and money supply are the notable factors affecting market volatility. Recent events in the developed world has shown that bad financial policies and management, such as the subprime mortgage crisis of the US, rapidly rising oil prices and country risk, such as political uncertainty, significantly affect the financial markets in the developing world. Harvey & Becaert (1997) investigated the reasons for different volatility levels across emerging markets with particular emphasis on the timing of capital market reforms in the respective countries. They discovered that capital market liberalization doesn't spur volatility though it increases the correlation between a country's domestic return and the global market.

Humpe & Macmillan (2007) demonstrated that US stock prices were positively influenced by industrial production and negatively by inflation and the long interest rate, whereas money supply had a negative effect. Nasseh & Strauss (2000) found a strong relationship between stock prices and some selected macroeconomic variables comprising production, interest rates, business expectations and the consumer price index in France, Germany, Italy, Netherlands, Switzerland and the UK. Using Engle-Granger test and Johansen and Julius maximum likelihood procedure, Mahmood & Dinniah (2009) examined the relationship between stock price and three macroeconomic variables consisting of inflation, output and exchange rates of six countries in the Asian-Pacific region. They found a long-run relationship between stock prices and these variables in all countries. However, there was no evidence of short-run relationship between stock prices and the macroeconomic variables in the selected countries except between foreign exchange rates and stock price in Hong Kong and between real output and stock price in Thailand.

Brahmasrene & Jiranyakul (2007) examined the relation between stock market index and a set of macroeconomic variables in Thailand. They found a positive relation between the stock index and money supply and a negative relation with the industrial production index, the exchange rate and oil prices. Employing the same methodology on Turkish equity market, Karamustafa & Kucukkale (2003), showed that money supply, exchange rate of USD, trade balance, and the industrial production index were cointegrated with stock returns. However, the macroeconomic variables were not the leading indicators for the stock returns, while stock returns was the leading indicator for the macroeconomic performance. Robert (2008) examined the effect of two macroeconomic variables (exchange rate and oil price) on stock market returns for the

BRIC countries. He found no significant relationship between present and past market returns with macroeconomic variables.

Attari & Safdar (2013) investigated the relationships between some macroeconomic variables and stock returns in developed and developing countries. Using EGARCH, they discovered that macroeconomic variables had substantial influence on stock prices. Akbar *et al*. (2012) studied the relationship between the Karachi stock exchange index and macroeconomic variables using vector error correction model (VECM), they discovered a long-run equilibrium relationship between the variables. The results suggested whereas a positive relationship existed between stock prices with money supply and short-term interest rates, a negative one existed with inflation and foreign exchange reserve. In their study, using a VECM model Maysami *et al*. (2004) reported a significant long-run equilibrium relationship between the Singapore stock market and macroeconomic variables. Using a similar method Pethe & Karnik (2000) examined the inter-relationship between stock price and macroeconomic variables. They found that there was no significant relationship between the state of economy and stock prices.

Other studies that also used the Johansen‘s co-integration and Vector Error Correction Model (VECM) to study the linkage between macroeconomic variables and stock prices included Rahman *et al*. (2009), Naik and Padhi (2012) and Ray & Vani (2003). Rahman *et al*. (2009) revealed that in the Malaysian stock market, interest rates, reserves and industrial production index were positively related to stock returns while money supply and exchange rate were inversely related to stock returns in the long-run. Naik & Padhi (2012) studied the Indian stock market index (BSE) and five macroeconomic variables (treasury bills rates, money supply, wholesale price index, industrial production index and exchange rates). They found that BSE had a significant and positive relation with money supply and industrial production but relates negatively with inflation. However, an insignificant relationship was found with exchange rate and the short-term interest rate, and BSE. Ray & Vani (2003) showed that, interest rate, industrial production, money supply, inflation rate and exchange rate had significant effects on stock prices. The studies of Ahmed (2008) and Pal & Mittal (2011) corroborated this finding.

In a study that examined the relationship between economic variables and abnormal returns in Amman stock exchange, AL- Shubiri (2013) found a statistically significant relationship between abnormal stock returns and consumer price index, gross fixed capital formation and money supply. In a similar study, Mookerjee & Yu (1997) discovered a positive relationship between Singapore stock returns and narrow and broad money supply. Chen *et al*. (1986) reported a significant effect of a set of macroeconomic variables on stock prices in US. This was transmitted through their impact on future dividends and discount rates. Fama (1981) examined the linkages between stock market and macroeconomic variables. He found a strong relationship between the real output and stock prices.

Wongbampo & Sharma (2002) investigated the effect of some macroeconomic factors comprising GNP, Exchange rate, money supply, interest rate and inflation on the stock returns in Asian countries. They reported a long run positive correlation between stock returns and economic growth and negative correlation with the aggregate price level. However, they found a positive relationship between stock returns and interest rate in Indonesia and Malaysia, and a negative one in Philippines, Singapore and Thailand. In a similar study, Altay (2003) conducted the same investigation for Germany and Turkey stock markets and found a significant relationship between stock prices and interest rate and inflation rate in the Germany but a negative relation in Turkey.

In their study of the Japanese stock market, Mukherjee & Naka (1995) found a long run cointegration between the stock market return and the selected macroeconomic variables (inflation, money supply, exchange rate, industrial production index, the long-term government bond rate and call money rate). A similar result was obtained by Gan *et al.* (2006) who also found a long run relationship between market index and the macroeconomic variables (money supply, interest rate and real GDP) in New Zealand. These results corroborated the findings of Ratanapakorn & Sharma (2007) who found positive long-run linkage between stock prices and money supply, short term interest rate, industrial production, inflation, and exchange rate with the exception of long term interest rate.

Islam (2003) examined the short-run dynamic adjustment and the long-run equilibrium relationships between four macroeconomic variables (interest rate, inflation rate, exchange rate, and the industrial productivity) and the Kuala Lumpur Stock Exchange (KLSE) Composite Index. He found a statistically significant short-run (dynamic) and long-run (equilibrium) relationships among the macroeconomic variables and the KLSE stock returns. Cooper, Chuin & Atkin, (2004) examined the long-term equilibrium relationships between selected macroeconomic variables and the Singapore stock market index (STI), as well as with various Singapore Exchange Sector indices—the finance index, the property index, and the hotel index. The study concludes that the Singapore's stock market and the property index form cointegrating relationship with changes in the short and long-term interest rates, industrial production, price levels, exchange rate and money supply.

Maysami & Koh (2000) examined such relationships in Singapore. They found that inflation, money supply growth, changes in short- and long-term interest rate and variations in exchange rate formed a cointegrating relation with changes in Singapore's stock market levels. Maghyereh (2002) investigated the long-run relationship between the Jordanian stock prices and selected macroeconomic variables, again by using Johansen's (1988) cointegration analysis and monthly time series data for the period from January 1987 to December 2000. The study showed that macroeconomic variables were reflected in stock prices in the Jordanian capital market.

Ahmed (2000) examines the causal relation between DSE stock index and a couple of macroeconomic variables like consumption expenditure, investment expenditures, real economic activity measured by GDP and industrial production index. He employed Granger (1988) causality test and found a causal relation from stock price to consumption expenditures. He also found a unidirectional causality from investment to stock prices; weak relationship between stock price and GDP and no causal relation between stock price and industrial production index. Finally he concluded in that study that stock market is not informational efficient in Bangladesh.

Ahmed & Imam (2007) examined the long run equilibrium and short tern dynamics between DSE stock index and a set of macroeconomic variables. In the macroeconomic variables they use money supply, 91 day T-bill rate, interest rate GDP and Industrial production index. They applied Johansen & Juselius (1990) maximum likelihood Cointegration test, Vector Error Correction Model (VECM) and also employed Granger Causality test. In the cointegration test, they found two cointegrating vectors but between them one is statistically significant. In the VECM test, they found that the lagged stock index was adjusted to long run equilibrium by 43.82 percent by the combined lagged influence of all the selected macroeconomic variables. Granger causality test provides a unidirectional causality from interest rate change to stock market return.

The current study builds upon and extends the literature through the employment of Johansen (1988) cointegration test and VECM to examine the long-run equilibrium relationship between selected US macroeconomic variables and conventional and Islamic indices in 11 countries.

2.6. Theoretical Framework

Veal (2005) indicates that a theoretical framework should be applied to the conceptual framework when the research is quantitative in nature, and that the framework indicates how the research analyzes the concepts involved in the study via the relationship between concepts. The theoretical framework of this study was developed from the MPT, APT and MET. MPT proposes diversification of portfolio in order to minimize risk and increase returns. It is expected a priori that the inclusion of conventional and Islamic indices in the same portfolio should provide this benefit if they turn ou not to have strong correlation. The APT is relevant in this framework as return on assets is related to some economic factors. That is, the expected return of a security is the linear function from the complex economic factors common to all securities or what the APT theory calls macroeconomic factors. This was applied to examine how US macroeconomic factors affect the performance of conventional and Islamic indices of Dow Jones and FTSE.

High volatility in stock market could be caused by a number of factors. To determine what are the most likely sources of the stock price volatility this study models the relation between stock returns volatility and a set of macroeconomic variables in line with the APT theory. The theory was flexible as to the macroeconomic variables that should be considered, it depends largely on the purpose of the research. Since the conventional and Islamic stock indices that were the concern of this study are the Dow Jones and FTSE whose basis points are measured in US dollars, we therefore deem it more appropriate to select some US macroeconomic variables. The macroeconomic variables of interest here include Brent oil price, economic uncertainty index, federal funds rate, T-bills, inflation, money supply and volatility and fear index.

Many studies used different sets of macroeconomic variables; therefore this study fell back on some empirical works as its selection criteria. Papapetron (2001), Sadorsky (2001), Chen (2009), Brouwer (2003), Wang & Lin (2009), Diebold & Yilmaz (2008) & Longstaff (2010) argue that oil price fluctuation, the US subprime mortgage crisis and politically uncertainty can strongly influence stock market volatility. Yilmaz (2008) and Longstaff (2010) regarded oil price and political uncertainty as the major determinants of stock volatility. Based on this, this study built on the work of Nazlioghu, Hammoudeh & Gupta (2013) in including in the APT model Brent oil price as a measure of oil market sensitivity in equity market, US Economic Uncertainty Index (EUI) as proxy for US economic and political news, Federal Funds Rate to capture impact of monetary policy on equity market and volatility fear index (VFI) as proxy for anxiety of investors. Recent events in the developed world has shown that bad financial policies and management, such as the subprime mortgage crisis of the US, rapidly rising oil prices and country risk, such as political uncertainty, significantly affect the financial markets in both developed and developing world.

Studies that included inflation, money supply and interest rates in their macroeconomic model includes Maysami & Koh (2000), Ratanapakorn & Sharma (2007), Wongbampo

& Sharma (2002), Ray & Vani (2003), Akbar *et al*. (2012), Humpe & Macmillan (2007), Abugri (2002), Caner & Onder (2005), and Granger, Huang & Yang (2000). Those that used consumer price index and inflation were Mukherjee & Naka (1995), Islam (2003) Altay (2003), and Mahmood & Dinniah (2009). Relation between Money supply and stock prices was the main concern of Ahmed and Imam (2007), Naik & Padhi (2012), Brahmasrene & Jiranyakul (2007), AL- Shubiri F.N. (2013), Rahman *et al*. (2009), Mookerjee & Yu (1997), Yilmaz (2008) and Longstaff (2010), Gan *et al*.(2006) Mukherjee and Naka (1995). Oil was considered as the main macroeconomic variable in Yilmaz (2008) and Longstaff (2010), Brahmasrene & Jiranyakul (2007), and Robert (2008).Treasury bill Ahmed & Imam (2007) and Naik & Padhi (2012) and interest rate Gan *et al*.(2006), Ahmed & Imam (2007), Humpe & Macmillan (2007), Rahman *et al*. (2009) Islam (2003) Altay (2003).

The market efficiency theory (MET) is also part of the theoretical framework as information is very vital in the stock market. The MET asserts that the expected returns of a stock reflect all market information. On this note the impact of information is incorporated into the framework through leverage effect as a component determining expected returns of the sampled stock indices. The theory suggests that bad news affect stocks more than good and its effect last longer.

Black (1976) asserts that volatilities and asset returns can be negatively correlated and this relationship is popularly known as the leverage effect. This was further explained by Brooks (2008) that leverage effect happens when a fall in the price of a firm’s stock causes the firm’s debt to equity ratio to increase. When a huge decline in an equity price is not matched by a decline in the value of debt, the firm’s debt to equity ratio will increase alongside with the financial risk of the firm’s investors. Due to the higher risk, investors would expect the volatility of the stock return to rise also. A number of studies have dwelt on leverage effect for instance Koutmos (1996), Koutmos & Booth (1995), and Booth, Martikainen & Tse (1997) found that there is a significant leverage effect and bad news (i.e. decrease in stock prices) seem to have a greater influence on stock prices than good news (i.e., increase in stock price). If the Islamic indices screen high debt to equity ratio firms then they should minimize the leverage effect compared to their conventional counterparts which do not have any screening act against debt to equity ratio. This is because a company having a higher than the benchmark debt to equity ratio is excluded from the Islamic indices such as DJIM, FTSE, MSCI etc.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This section presents the methodology adopted in the study. It starts with the conceptual framework and then followed by the theoretical framework, the model specification – which consist of the data, model specification and analytical techniques. The methodology for this study was developed from the works of Merdad (2012), Khositkulporn (2013) and Ho *et al* (2013).

3.2 Conceptual Framework

Figure 3.1 provides the conceptual framework developed to guide this study and which forms the basic contribution of this study to the existing literature on conventional and Islamic stock markets indices.

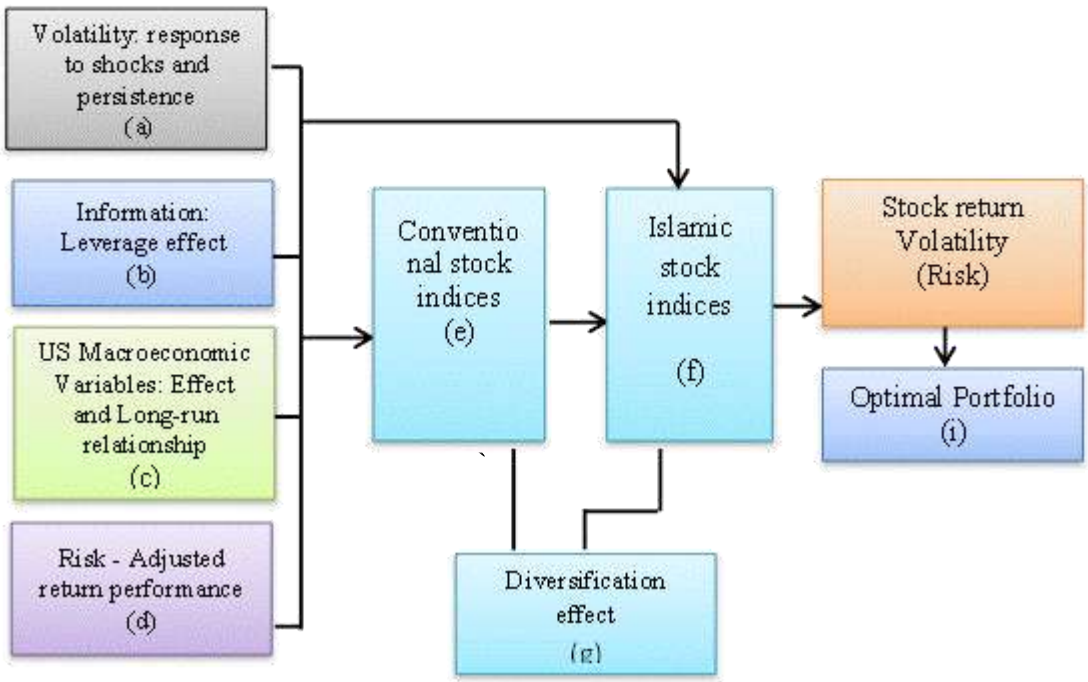


Figure 3.1 Conceptual Framework of the Study

The theoretical underpinning of this study is the MPT theory which postulates that diversification of portfolio investment is the most effective way to cushion against risk. But this can only be achieved if there is no long run association between the stocks, once there is they tend to behave in the same way and therefore, no incentive to include them in the same portfolio. In this case, if conventional and Islamic indices turn out to have long run association, and in which case they did, undermines the diversification effect (Panel g). The theory suggests that for a given feasible set of securities, finding the optimal portfolio (Panel i) requires the one with the lowest risk, measured as variance or standard deviation of the portfolio returns (Panel h). To achieve this, the theory requires knowledge of the covariance or correlation between all possible combinations. Since this is difficult in practice, this study therefore used variances of the stock returns as the proxies for their respective risks or volatilities (Kupiac, 1991:33).

In this study the stock return volatility of the conventional and Islamic stocks indices were assumed to be affected by three factors: The first is the effect of information transmitted through leverage effect, volatility shocks and persistence. These are represented in panels (a) and (b) and which is in line with the works of Koutmos (1996), Koutmos & Booth (1995), and Booth, Martikainen & Tse (1997) on leverage effects. The second and third were the effects of macroeconomic variables on the stock return volatilities of the conventional and Islamic stocks indices (Panel C) as postulated in the APT model. This was achieved at two levels. Firstly, the long-run relationship between the Stock indices, the broad market index (Dow Jones Industrial Average) and the US macroeconomic. This is important as it gave insight on the long-term co-movement between conventional and Islamic Dow Jones and FTSE with Dow Jones Industrial Average and the seven selected US macroeconomic variables comprising, federal funds rate, money supply, consumer price index, Treasury bill, volatility fear index, economic uncertainty index and Brent oil price (Ahmad el al, 2015; Naserih & Masih, 2013; Barbic & Condic-Jurkic, 2011: Husin *et al*, 2012; Al-Majali & Al-Assaf, 2014; Cooper & Atkin, 2004). If the Islamic indices are correlated or have a long-run association with the broad market index and the macroeconomic variables it implies that having the two indices in the same portfolio undermines diversification benefit as postulated by the MPT theory. In order words, conventional and Islamic indices could be regarded as the same, that is, there shouldn't be significant difference in terms of their risk or returns (Panel g).

Secondly the effect of the US macroeconomic variables on the stock return volatility of both the conventional and Islamic indices was also examined as postulated by the APT. This gave clue as to the combine influence of these variables on the conditional variance of these indices.

Paned (d) aimed to measure the investment risk associated with both the conventional and Islamic indices and the risk-adjusted performances of the conventional and Islamic stock indices in order to determine which of them has higher risk in terms of returns to investment.

3.3 Data Sources

This study employed the 5 – day weekly closing stock prices of 22 major global Islamic and conventional indices from eleven countries comprising, US, EU, Canada, Kuwait, Qatar, Malaysia, Japan, China, Turkey, India, and Taiwan. All the stock prices were given in USD with $1 equivalent to 1 basis point which is the unit of measuring stock prices in international stock markets. Therefore all the stock indices have the same unit of measurement. In order to enable equitable comparisons, a pair of conventional and Islamic indices wwas selected from each country and the data was obtained from the official website of Wall Street Journal at www.wsj.com. This generated about 3000 data points for the period 1st January 2006 to 31st December 2017 (See Table 3.1). The other set of data used in the study were United States (US) macroeconomic data comprising Brent oil price, US Economic Uncertainty Index (EUI), Federal Funds Rate (FFR), volatility and fear index, US three months T-bills, US inflation rate, and Broad money supply (M2). All these were obtained from FRED database of St. Louis Federal Reserve at www.fred.stlouisfed.org (See Table 3.2)

3.4 Variables Measurement

The conventional and Islamic indices of Dow Jones and FTSE were used in the study. All the data series were transformed into logarithms and the returns of the series were used for the computations. Table 3.1 presents the conventional and Islamic indices selected in each of the sampled countries. Dow Jones index was the preferred index because it has wider coverage of Islamic indices amongst countries but where it was not available the FTSE was used. Conventional and Islamic Dow Jones where used in US, Canada, Japan, Turkey, Malaysia, and China. A mix of FTSE and Dow Jones were however, used for Europe because those were the only indices available. Conventional and Islamic FTSE indices were used in India, Qatar, Kuwait and Taiwan. In the coding section one (1) was used to represent conventional indices whereas two (2) was used to represent Islamic indices.

Table 3.1: Conventional and Islamic Indices

SN	Country	Conventional Indices	Code	Islamic Indices	Code
1	United States	Dow Jones Industrial Average (DJIA)	US1	Dow Jones Islamic Market small cap index (IMUSS)	US2
2	Europe	FTSE/ATHEX Top 20 Index	EU1	Dow Jones Islamic Market Europe Index (DJIEU)	EU2
3	Canada	Dow Jones Canada Index (CADOWD)	CA1	Dow Jones Islamic Market Canada Index (DJICA)	CA2
4	Japan	Dow Jones Japan Index USD (JPDOWD)	JP1	Dow Jones Islamic Market Japan Index (DJIJP)	JP2
5	Turkey	Dow Jones Turkey Titans 20 Index TRY (TR20)	TKY1	Dow Jones Islamic Market Turkey Index (DJIMTR)	TKY 2
6	Malaysia	Dow Jones Malaysia Index USD (MYDOWD)	MLY 1	Dow Jones Islamic Market Malaysia Titans 25 Index (DJMY25D)	MLY 2
7	China	Dow Jones China Offshore 50 Index (DJCHOF50)	CHN 1	Dow Jones Islamic market China/Hong Kong Titans Index (DJICHK)	CHN 2
8	India	FTSE All-World India Index GBP (WIIND)	IND1	FTSE Shariah India Index (SWIND)	IND2
9	Qatar	FTSE DIFX Qatar 10 Index (DQAT)	QTR1	FTSE DIFA Qatar 10 Sharia Index (DQAS)	QTR2
10	Kuwait	FTSE DIFX Kuwait 15 Index (DKUW)	KWT 1	FTSE DIFX Kuwait 15 Index (DKUS)	KWT 2
11	Taiwan	FTSE World Taiwan Index USD (WITWN)	TWN 1	FTSE Shariah Taiwan index (TWSH)	TWN 2

Source: Wall Street Journal website *www.wsj.com*

US macroeconomic variables were the second set of data used in this study. However, unlike the stock data that the daily data was available as low frequency data, most of the macroeconomic data were high frequency data (weekly or monthly). Therefore, Eviews 9 was used to convert the macroeconomic high frequency data to daily low frequency data. It was only the data for FFR and Brent Oil (Oil) that were available in 5-day daily data. Though EUI was also available but it was given in 7-day weekly data, thus it was converted to 5-day weekly data. Broad Money supply (M2) data was converted from weekly to 5-day weekly data. The data for Treasury Bill (TB) was monthly and CPI was quarterly and therefore both had to be converted to 5-day daily data.

Numerous empirical studies have used some of these macroeconomic variables to study their effect on stock volatility. For instance, Brent oil price, EUI, FFR and VFI were used in (Nazlioghu, Hammoudeh & Gupta, 2013). Oilis a measure of market sensitivity in equity market, EUI is a proxy for US policy which is responsive to economic and political news, Federal Funds Rate measures the impact of monetary policy on equity market and volatility fear index (VFI) as proxy for anxiety of investors. TB is a proxy for short-term interest rate (Akhtar, 2015), CPI as proxy for inflation and M2 is US broad money supply (Khosikulporn, 2013:Abugri, 2002: Caner & Onder, 2005: and Granger, Huang & Yang, 2000). The selected macroeconomic variables are presented in Table 3.2.

Table 3.2: Macroeconomic Variables

SN	US Macroeconomic Variable	Proxy
1	Brent oil price (OIL)	Oil Price
2	US Economic Uncertainty Index (EUI)	Response to US economic and political news

3	Federal Funds Rate (FFR)	Impact of monetary policy on equity market
4	Volatility and Fear Index (VFI)	Anxiety of investors
5	US three months T-bills (TB)	short-term interest rate
6	Consumer Price Index (CPI)	Inflation
7	Broad Money Supply (M2)	Money supply

Source: FRED database of St. Louis Federal Reserve website*www.fred.stlouisfed.org*

3.5 Model Specification

The first model of this study was adopted from the works of Albaity & Ahmad (2011) and Pryymachenko (2003). This model was used to achieve objective (ii) of the study which is to analyze the leverage effect (asymmetry), volatility reaction to the market and volatility persistence of conventional and Islamic indices. An extension of the same model as specified in Pryymachenko (2003) was used to achieve objective (iii) which is to determine the effect of macroeconomic variables on the stock return volatility of the conventional and Islamic indices.

Financial time series data such as stocks exhibit certain special characteristics which are referred to as stylized facts (Taylor, 1986; Alexander, 2001; Ridwan, 2009). First, they exhibit volatility clustering or volatility pooling. In other words, periods of high volatility are followed by periods of high volatility and the same applies for periods of low volatility. Second, their distribution is leptokurtosis, which means that the distribution is fat-tailed. Third characteristic is the leverage effect. The leverage effect is the fact that bad news affects returns more than good news. In other words, changes in the prices tend to be negatively correlated with changes in volatility (Brooks, 2014; Albaity & Ahmad, 2011; Ridwan, 2009; David, 1997).

Due to these special characteristics the normal OLS regression model is found inappropriate because of the violations of its assumptions. Most econometricians suggest the use of Autoregressive Conditional Heteroscedastic (ARCH) process proposed by Engle (1982) for modeling financial time series. Bollerslev (1986) later generalized the ARCH process to the generalized Autoregressive Conditional Heteroscedastic (GARCH) process. These processes together with various extensions and/or variations performed exceedingly well in modeling the stylized facts present in financial return series (Ridwan, 2009). The models as specified in Albaity & Ahmad (2011:165) and Pryymachenko (2003:25).are as follows:

$$R_t = a_t + \delta\sigma_t^2 + \varepsilon_t \qquad \textbf{(3.1)}$$

Where:

R_t = daily return for stock X

$\sigma_t^2 = Conditional$ variance of stock X

δ – coefficient of the conditional variance

ε_t = error term - $\varepsilon_t \sim N(0, \sigma^2)$

Equation (3.1) is the mean equation which measures the relationship of the conditional variance on the expected return of the stock index. Here either the standard deviation or the variance is included in the mean equation in order to test whether there is a risk premium or a tradeoff between risk and returns (Albaity & Ahmad 2011). The coefficient δ accounts for the effect of the conditional variance on the expected return. If δ is positive and significant it implies that investors are compensated for bearing higher level of risk by higher returns. However, if δ is significant but negative, it means investors were penalized for taking the risk. The error term $\varepsilon_t \sim N(0, \sigma^2)$ is assumed to have zero mean and a constant variance or homoscedastic. However, it is unlikely in the financial time series that the variance of the error term be homoscedastic. Ignoring the fact that the variance of the error term is heteroscedastic will result in either over/under estimation of the standard error and therefore bias inferences. To overcome this problem ARCH model is used. The ARCH model is as follows:

$$\sigma_t^2 = \omega + \alpha_i \varepsilon_{t-1}^2 \qquad \textbf{(3.2)}$$

Equation (3.2) is the ARCH model where σ_t^2 is the conditional variance, and ε_{t-i}^2 is the lagged term of the squared error term from the mean equation. The significance and magnitude of α_i measures the influence of the lagged squared residuals on the conditional variance. The significance of α_i indicates the presence of ARCH effect in the model.

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i\, \varepsilon_{t-1}^2 + \sum_{i=1}^{q} \beta_j\, \sigma_{t-j}^2 \qquad \textbf{(3.3)}$$

Where:

ε_{t-i}^2 = lagged squared error term from mean equation

σ_{t-j}^2 = lagged conditional variance

ω,α_i and β_i = coefficients

Equation (3.3) is the GARCH model whereσ_{t-j}^2 is the lagged conditional variance, and ω,α_i and $\beta_i$are the coefficients respectively. The inequality restrictions $\omega > 0, \alpha \geq 0, \beta \geq 0$ are imposed in order to ensure the non-negativity constraint of the conditional variance i.e. σ_t^2 is positive.

Although the GARCH is more parsimonious than the ARCH and less likely to breach the non-negative constraint, it still however does not account for leverage effect in the series. It does not allow for any direct feedback between the conditional variance and the conditional mean (Albaity & Ahmad, 2011 and Ridwan, 2009). One of the problems in GARCH is that it treats any shocks to the volatility as symmetrical. That is good news and bad news has the same effect. However, it was argued by previous studies such as Black (1976), Christie (1982), and Engle & Ng (1993) that volatility responds asymmetrically to news especially bad news[1]. Therefore to address this issue of asymmetric information the EGARCH (Exponential GARCH) and TARCH (Threshold GARCH) were developed. Any of them could be applied to account for possible asymmetry and leverage effect in the stock market.

The TARCH model was introduced by Zakoian (1994) and Glosten, Jagannathan & Runkle (1993). This model is designed to test whether there is asymmetric impact of news and leverage effect. The specification of the TARCH model is as in equation (3.4):

$$\sigma_{X,t}^2 = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-1}^2 + \sum_{i=1}^{q} \beta_i \sigma_{t-j}^2 + \gamma \varepsilon_{t-1} d_{t-1} \qquad \textbf{(3.4)}$$

Where

d_{t-1} = indicator variable ($d_{t-1} = 1$ if $\varepsilon_{t-1}^2 < 0$ and 0 otherwise).

$\gamma = good\ news$

$\alpha + \gamma = bad\ news$

The estimated coefficients must satisfy the non-negativity constraint $\alpha + \gamma \geq 0\ and\ \alpha \geq 0$. In this model, good news$\varepsilon_1(t-1) < 0$, and bad news is ($\varepsilon_{t-1} < 0$). Good news has the impact γ while bad news has the impact$(\alpha + \gamma)$. Further if $\gamma > 0$ there is leverage effect, whereas if $\gamma \neq 0$ then the news impact is asymmetric. Thus, negative return has greater impact on the conditional variance than good news Pryymachenko (2003).

Nelson (1991) developed the EGARCH model to address asymmetry in volatility and address the non-negativity constraints which is specified in equation (3.5):

EGARCH $$log(\sigma_{,t}^2) = \omega + \sum_{i=1}^{q} \alpha_{i} \frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} + \sum_{i=1}^{q} \gamma_{i} \frac{\varepsilon_{t-i}}{\sigma_{t-1}} + \sum_{j=1}^{p} \beta_j Log(\sigma_{t-j}^2) \textbf{(3.5)}$$

[1]Good news = γ and bad news =$\alpha + \gamma$. This shows the greater effect of bad news compared to good news

Where

d_{t-1} = indicator variable (d_{t-1} = 1 if $\varepsilon_{t-1}^2 < 0$ and 0 otherwise).

$\gamma = good\ news$

$\alpha + \gamma = bad\ news$

The left-hand side is the log of the conditional variance. This implies that the leverage effect is exponential, rather than quadratic, and that forecasts of the conditional variance are guaranteed to be nonnegative. That is, in order to take care of the non-negativity constraints the variance equation appears to be in logarithms (which guarantee the non-negative variance). The presence of leverage effects can be tested by the hypothesis that $\gamma < 0$ where the alternative is $\gamma \neq 0$different from zero.

In this study, as in Pryymachenko (2003:25) the EGARCH and TARCH were used to achieve objective (ii) of this study.

3.6 Model on Macroeconomic Variables

In order to examine the relationship between the conditional variance i.e. stock returns volatility and the selected US macroeconomic variables, this study adopts the model of Pryymachenko (2003) and modified it by adding some exogenous variables to the variance equation of the GARCH model by Engle (1982). It was used to achieve objective (iii) of this study which is to determine the effect of macroeconomic variables on the stock return volatility of conventional and Islamic stock indices. The specification by Pryymachenko (2003) is given as:

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i\, \varepsilon_{t-1}^2 + \sum_{i=1}^{q} \beta_j\, \sigma_{t-j}^2 + \theta X_{t-i} + \gamma \varepsilon_{t-1} d_{t-1} \qquad \textbf{(3.6)}$$

Where,

d_{t-1} = indicator variable (d_{t-1} = 1 if $\varepsilon_{t-1}^2 < 0$ and 0 otherwise).

θ_1 = coefficients of macroeconomic variables

$X_{t-i} =$ matrix of macroeconomic variables

The estimated coefficients must satisfy the non-negativity constraint$\alpha + \gamma \geq 0$ and $\alpha \geq 0$.Positive γ suggests the presence of leverage effect on the market. X_{t-i} is introduced in to the conditional variance equation to account for possible impact of macroeconomic variables on the conditional variance i.e. stock market volatility. The modified form of the model to suit the purpose of this study becomes

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i\, \varepsilon_{t-1}^2 + \sum_{i=1}^{q} \beta_j\, \sigma_{t-j}^2 + \theta_1 LogOP_{it} + \theta_2 LogEUI_{it} + \theta_3 LogFFR_{it} + \theta_4 LogVLF_{it} + \theta_5 LogTB_{it} + \theta_6 LogIR_{it} + \theta_7 LogMS_{it} + \gamma\varepsilon_{t-1}^2 d_{t-1} \qquad \textbf{(3.7)}$$

Where

θ_1 = coefficient of macroeconomic variables

$LogOP_{it}$ = Log of Brent oil Price

$LogEUI_{it}$= Log of Economic Uncertainty Index

$LogFFR_{it}$ = Log of Federal Funds Rate

$LogVLF_{it}$= Log of Volatility and Fear Index

$LogTB_{it}$ = Log of US T-Bills

$LogIR_{it}$ = Log of US Inflation Rate

$LogMS_{it}$= Log of US Money Supply

3.7 Estimation Techniques

3.7.1 Unit Root Test

The data was tested for the presence of unit root using three standard unit root tests: Augmented Dickey Fuller (ADF), Philips – Perron (PP) and KPSS tests. This method was also used in Hakim and Rashidian (2014) and Bidda (2010). The tests determined the stationarity of the series, that is, whether the movements of the indices over time were purely random and unpredictable (white noise) or not. In the stock literature the randomness of the series is a sign of market efficiency (Hakim & Rashidian, 2014).

3.7.2 Johansen Cointegration and Vector Error Correction Model (VECM)

The Johansen cointegration and VECM models were used to achieve objective (i) of this study that is to determine the long-run relationship between conventional and Islamic indices, and the US macroeconomic variables. This methodology was adopted from the work of Barbic & Conduic-Jurkic (2011).

The Johansen test of Cointegration model has two fundamental assumptions: the variables must be non-stationary at levels and their first difference must be stationary. All the variables must be integrated of the same order. This has been verified and it turned out that all the variables were non stationary at the levels and all became stationary at the first difference using the ADF, PP and KPSS tests respectively. To further verify this result, the correlogram tests was checked which further confirms the results by the ADF, PP and KPSS tests Therefore, this provided the justification for the estimation of the Johansen and VECM models respectively. If the variables have long run association, that is cointegrated, then we can run the VECM model or the restricted VAR model. But if the variables were not cointegrated we cannot run VECM model rather we can only run unrestricted VAR. but since our variables were cointegrated then we ran the VECM.

The Vector Error Correction Model (VECM) is a restricted VAR designed for use with nonstationary series that are known to be cointegrated The VEC has Cointegration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The Cointegration term is known as the *error correction term* since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments (Eviews.com, 2018).

In order to test for long run equilibrium relationships between conventional and Islamic stock market indices and the set of US macroeconomic variables comprising Dow Jones Industrial average (broad market index), economic uncertainty index, federal funds rate, money supply, volatility fear index, consumer price index, Treasury bill and Brent oil price Johansen cointegration method was employed (Johansen, 1991). Cointegration analyses consider a setting where time series of individual variables "can wander extensively and yet some pairs of series may be expected to move so they do not drift too far apart" (Engle and Granger, 1987). In other words, when two time series are cointegrated, they move together over time maintaining long term equilibrium, although short term disturbances are allowed.

The Johansen method applies the maximum likelihood procedure to determine the presence of cointegrating vectors in non-stationary time series as a vector autoregressive (VAR). Consider a VAR of order *p*

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-2} + BX_t + \varepsilon_t \quad \textbf{(3.7)}$$

Where

Yt - k-vector of non-stationary I(1) variables,

Xt - d-vector of deterministic variables

Et - is a vector of innovations

Alternatively, VAR can be written as specified in Barbic & Conduic-Jurkic (2011):

$$\Delta Y_t = \pi Z_{t-1} + \sum_{i=1}^{p=1} r \Delta Y_{t-i} + BX_t + \varepsilon_t \quad \textbf{(3.8)}$$

$$\pi = \sum_{i=1}^{p} A_i - I \; and \; r_i = -\sum_{j=i+1}^{p} A_j$$

Where

Yt - vector of non-stationary variables,

If variables are I(1) and cointegration vector(s) between n variables are found, VAR should be transformed into VECM in the following way as specified in Barbic & Conduic-Jurkic (2011):

$$\Delta Y_t = \pi Y_{t-k} + r_1 \Delta y_{t-1} + r \Delta y_{t-2} + \cdots + r_{k-1} \Delta y_{t-(k-1)} + u_t \quad \textbf{(3.9)}$$

The VEC specification restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing a wide range of short-run dynamics.

Johansen & Juselius (1990) specify two likelihood ratio test statistics to test for the number of cointegrating vectors. The first likelihood ratio statistics for the null of exactly *r* cointegrating vectors against the alternative of *r+1* vectors are the maximum eigenvalue statistic. The second statistic for the hypothesis of at most *r* cointegrating vectors against the alternative is the trace statistic. Critical values for both test statistics are tabulated in Johansen & Juselius (1990). The number of lags applied in the cointegration tests is based on the information provided by the multivariate generalization of the AIC. The speed of adjustment of the series was measured by the estimated coefficients towards the long-run relations after a shock to the equilibrium has taken place. Burgstaller (2002) claimed that at least one of the long run variables must be responsible for the adjustment.

The Dow Jones Industrial Average of the US (US1) was chosen as the broad market index as it was the first index to create an Islamic counterpart the Dow Jones Islamic Market Index (US2). It is expected a priori that all the other indices will be cointegrated with it, suggesting a long run relationship. Examining the relationship of stock market indices and macroeconomic variables is in line with the work of Barbic & Conduic-

Jurkic (2011). The rationale is straightforward: if long run relationship between macroeconomic variables and stock market index exists, macroeconomic variables are significantly and consistently priced in stock market returns. i.e. stock prices reflect available macroeconomic data.

3.7.3 Risk-Adjustment Return Performance

Financial investment theory suggests that the goal of any investor is to maximize utility obtained from an investment after considering the market risks. In order to adjust for investment risk, several statistics derived from the Capital Asset Pricing Model (CAPM) including beta, Sharpe ratio (Sharpe, 1966), Treynor Index (Treynor, 1965) and Jensen alpha (Jensen, 1968) are suggested as suitable methodologies and have been widely applied. These risk measures were applied in this study to examine the risk – adjusted performances of the selected Islamic and conventional indices. The methodology here was adopted from the study of Reddy and Fu (2014). According to the Capital Market Theory, the risk adjusted return incorporates risk in computing the returns and it is assumed that investors are holding diversified portfolios (Reddy & Fu, 2014).

The Dow Jones Industrial Average Index is chosen as the market benchmark for both indices and used as a proxy for the market return. This method is similar to Hassan & Girard (2011), Hussein (2004) and Ho *et al* (2013). Furthermore, US Treasury-bill was used as a proxy for the risk free rate of interest (Hakim and Rashidian, 2014; Ho *et al*, 2013).

The arithmetic returns were estimated by subtracting the previous day's index value from the current day’s index value and dividing it by the previous days's index value as shown in equation (3.10), where Rt is the return at time t, P_t is the index at time t (current period) and P_{t-1} is the index at time t-1 (previous period).

$$R_t = Ln(P_t - P_{t-1})/P_{t-1} \qquad \textbf{(3.10)}$$

The first performance measure is Sharpe ratio (SR) which indicates if an investment's high return is a result of excessive risk. It measures the performance of an index by dividing the amount of excess return to total risk, measured by standard deviation.High SR is consistent with high probability that the index return exceed the risk-free return. The SR is calculated as in equation (3.11) where AR_i is the average return for the index over the period, ARFR is average of the risk free rate (US T-bill) and σ_i is standard deviation of index return.

$$SR_{it} = [(AR_{it} - ARFR)]/\sigma_i \qquad \textbf{(3.11)}$$

The second performance measure is Treynor index (TI) which measures the index performance for its given level of market risk (CAPM) and is associated with the general market fluctuations as in equation (3.12) This performance measure differs from SR because it applies beta or systematic risk, whereas Sharpe ratio uses standard deviation of returns as a measure of total risk in examining index performance (Shubbar, 2010:62; Reddy & Fu, 2014:159). High SR and TI indicate superior performance. Both these measures produce relative performance rankings. For TI calculation, AR is the average return of the index, ARFR is the average risk free rate and β is the beta coefficient computed using market model.

$$TI_{it} = (AR_{it} - ARFR)/\beta \textbf{(3.12)}$$

Equations (3.11) and (3.12) were used to achieve objective (4) in determining the risk-adjusted return performances of conventional and Islamic indices.

3.7.4 Summary of Models Adopted in the Study

(i) Adopted from Barbic & Conduic-Jurkic (2011) to achieve objectives (i)

$$\Delta Y_t = \pi Z_{t-1} + \sum_{i=1}^{p=1} r\Delta Y_{t-i} + BX_t + \varepsilon_t \quad (\mathbf{3.8})$$

$$\Delta Y_t = \pi Y_{t-k} + r_1\Delta y_{t-1} + r\Delta y_{t-2} + \cdots + r_{k-1}\Delta y_{t-(k-1)} + u_t \quad (\mathbf{3.9})$$

(ii) Adopted from Albaity and Ahmad (2011) and Pryymachenko (2003) to achieve objectives (ii)

$$R_t = a_t + \delta\sigma_t^2 + \varepsilon_t$$

$$\sigma_t^2 = \omega + \delta_1\varepsilon_{t-1}^2$$

$$\sigma_{X\,t}^2 = \omega + \sum_{i=1}^{p}\alpha_i\,\varepsilon_{t-1}^2 + \sum_{i=1}^{q}\beta_j\,\sigma_{t-j}^2$$

$$log(\sigma_{X,t}^2) = \omega + \sum_{i=1}^{q}\alpha_i\frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} + \sum_{i=1}^{q}\gamma_i\frac{\varepsilon_{t-i}}{\sigma_{t-1}} + \sum_{j=1}^{p}\beta_j Log(\sigma_{t-j}^2)$$

$$\sigma_{X,t}^2 = \omega + \sum_{i=1}^{q}\alpha_i\varepsilon_{t-1}^2 + \sum_{i=1}^{q}\beta_i\sigma_{t-j}^2 + \gamma\varepsilon_{t-1}^2 d_{t-1}$$

(iii) Developed from Pryymachenko (2003) to achieve objective (iii)

$$\sigma_t^2 = \omega + \sum_{i=1}^{p}\alpha_i\,\varepsilon_{t-1}^2 + \sum_{i=1}^{q}\beta_j\,\sigma_{t-j}^2 + \theta_1 LogOP_{it} + \theta_2 LogEUI_{it} + \theta_3 LogFFR_{it} + \theta_4 LogVLF_{it} + \theta_5 LogTB_{it} + \theta_6 LogIR_{it} + \theta_7 LogMS_{it}$$

(iv) Adopted from Reddy and Fu (2014) to achieve objective (iv)

$$SI_{it} = [(AR_{it} - ARFR)]/\sigma_i$$

$$TI_{it} = (AR_{it} - ARFR)/\beta$$

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

The focus of this chapter is on the presentation of result based on the stated objectives. The analysis commenced with trend and descriptive statistics of the data before proceeding with the cointegration analysis (Johansen and VECM). The regression analysis follows using the ARCH, GARCH, TARCH and EGARCH models. The last aspect presents the results for the risk – adjusted measures.

4.2 Trend and Descriptive Statistics

The first step in a time series analysis is to plot the data and observe the trend in order to have a superficial knowledge of the behavior of the series. Gujarati (2011) suggests that the log of the series should be plotted because a change in the log of a variable represents a relative change (or rate of return), whereas a change in the variable itself represents an absolute change. As depicted in Figures 4.1 to 4.4 all the series were random walk and random walks with drift processes, they exhibit ‘long swings’ away from their mean values, which they cross very rarely.

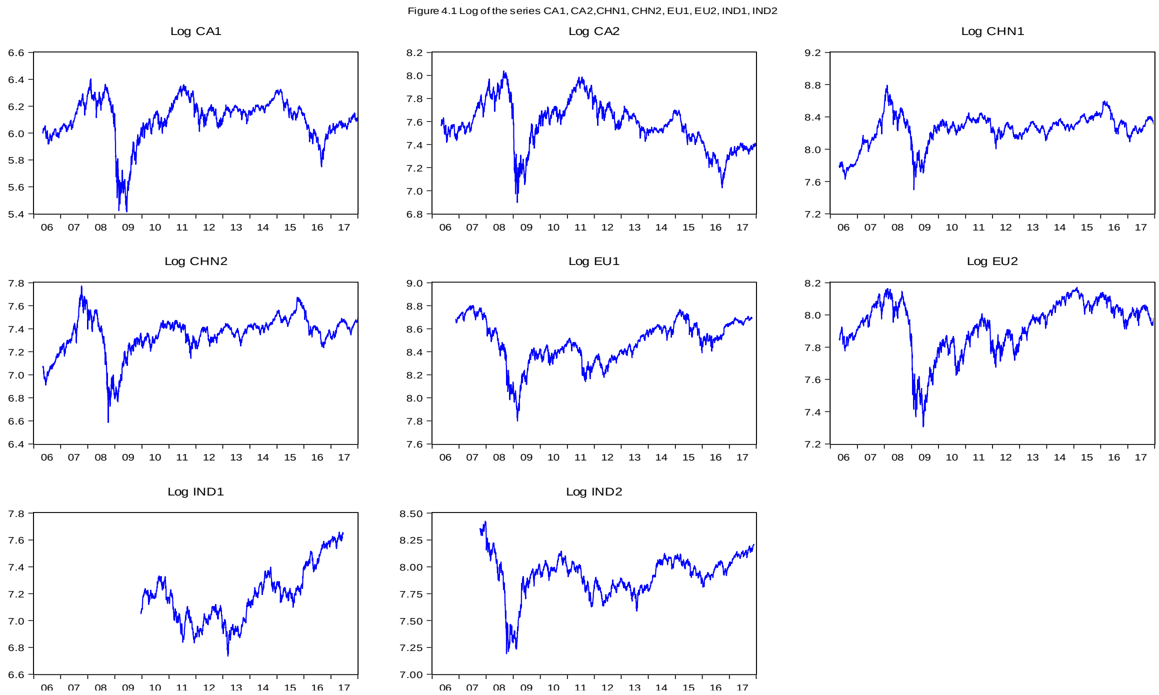


Figure 4.1 Logs of the time Series CA1, CA2, CHN1, CHN2, EU1, EU2, IND1, and IND2

Figure 4.1 gives the logs of the conventional and Islamic indices of Canada, China, EU and India. Clearly all the series have trend drifting upward or down with noticeable considerable variation. This suggests that neither the mean nor variances are constant implying non-stationary of the time series. The results from their correlogram indicated similar findings for non-stationarity for all the indices. All the autocorrelation coefficients and Q-statistics were highly statistically significant resulting in the non-rejection of the null hypothesis.

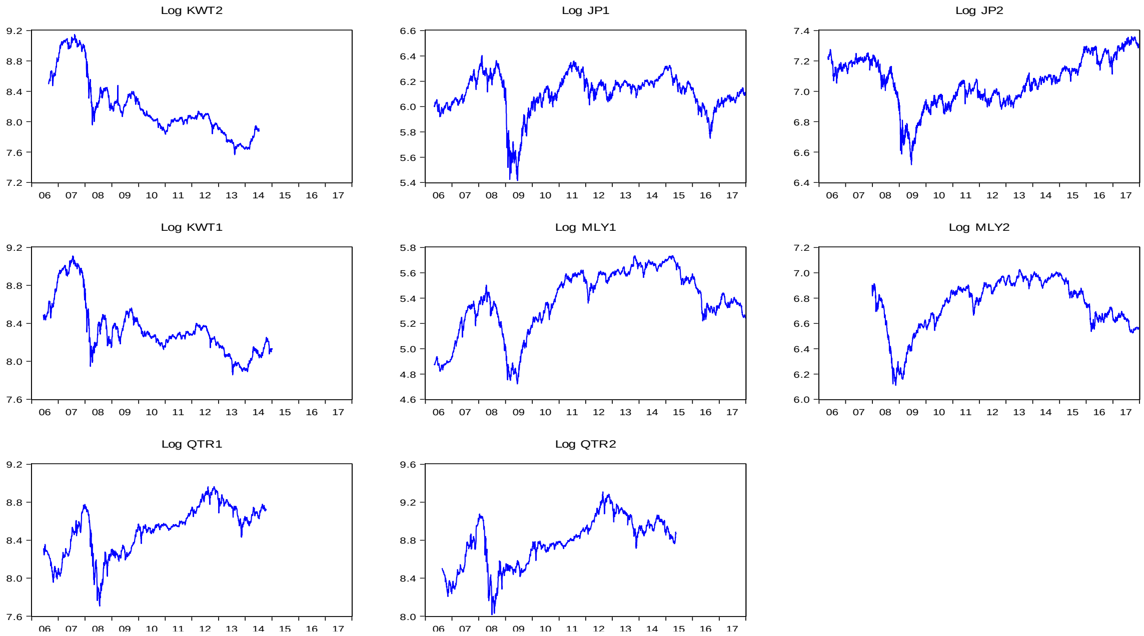


Figure 4.2 Logs of the time Series KWT1, KWT2, JP1, JP2, MLY1, MLY2, QTR1, and QTR2

In Figure 4.2 the trend of the log of the returns of the conventional and Islamic indices of Kuwait, Japan, Malaysia and Qatar are presented. There are strong reasons from the charts to suggest that all the time series were non-stationary with discernable drifts in the period 2006 – 2017. On a similar note, this was verified by their correlogram results.

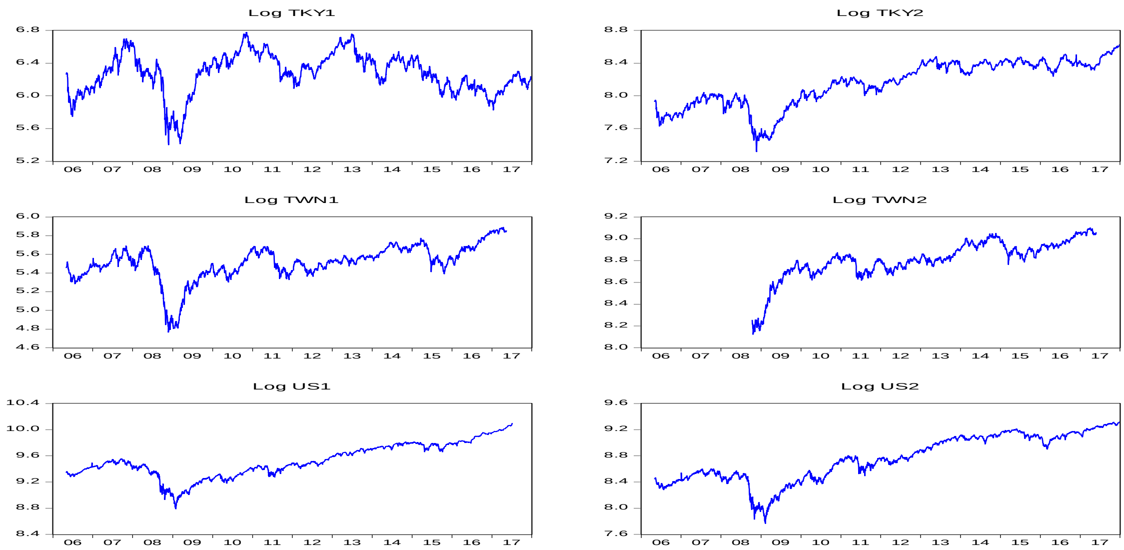


Figure 4.3 Logs of the time Series TKY1, TKY2, TWN1, TWN2, US1, and US2

As indicated in Figure 4.3 all the conventional and Islamic indices of Turkey, Taiwan and United States show evidence of non-stationarity by drifting which is an indication that their means and variances are not constant violating the assumptions of white noise disturbances. This was corroborated from the correlogram results for each of the variables. It could be concluded that the ordinary OLS multiple regression method may not be suitable in capturing the stylized behavior of these series.

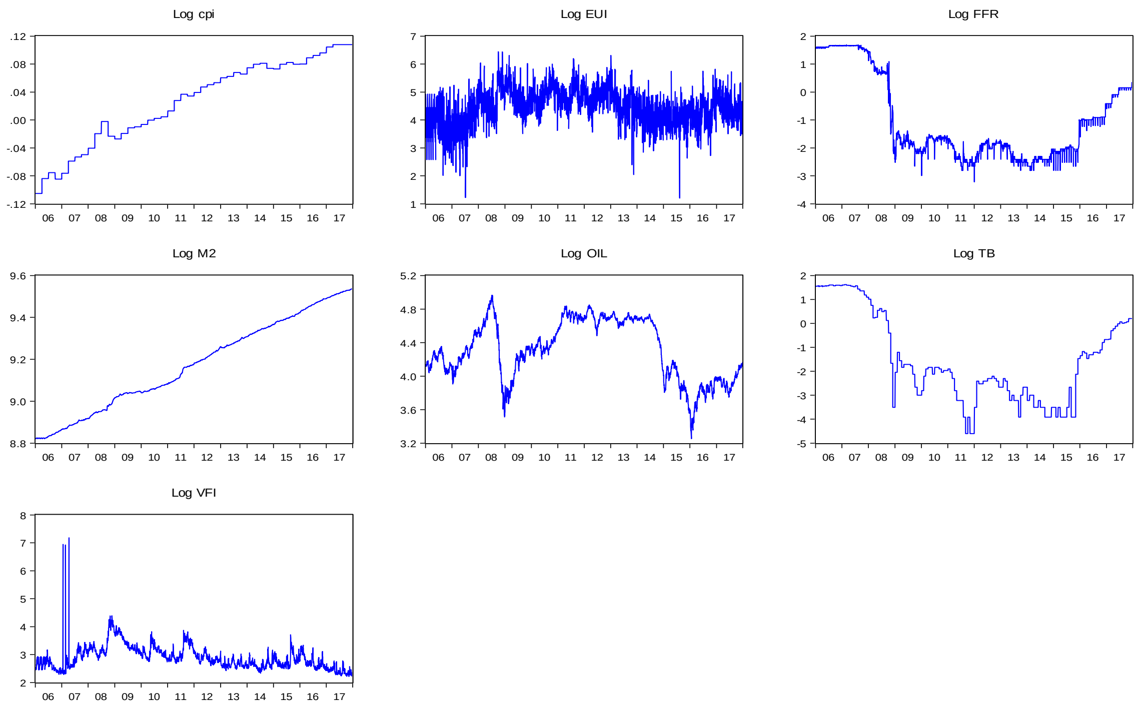


Figure 4.4 Log of US macroeconomic variables

Figure 4.4 shows the trend of the logs of the US macroeconomic variables considered in this study. These comprise of consumer price index, economic uncertainty index, volatility fear index, federal funds rate, broad money supply, Treasury bill and Brent oil price. All the variables were not stationary and this was doubled checked and verified from the results of their correlogram. All the autocorrelation coefficients and Q-statistics were highly statistically significant resulting in the non-rejection of the null hypothesis. It was noticed however, that broad money supply (M2) and consumer price index were the only ones that had a deterministic trend, perhaps due to the influence of monetary policy of the US.

Tables 4.1 – 4.5 present the descriptive statistics of all the stock indices and the macroeconomic variables. The results suggests that each pair of indices (Conventional and Islamic) selected from a particular country could not be treated as homogenous since each has a different descriptive statistics. It is worth noting that if the conventional and Islamic indices from a particular country that were exposed to the same macroeconomic environment were heterogeneous, we therefore have strong reasons to suggest that the difference will become accentuated across countries. It therefore becomes paramount to examine the stochastic properties of the data in order to know the appropriate analytical technique.

Table 4.1: Descriptive Statistics of Stock Indices Returns in Selected Countries

	RTCA1	RTCA2	RTCHN1	RTCHN2	RTEU1	RTEU2	RTIND1	RTIND2
Mean	0.006582	-0.000966	0.024885	0.018591	0.000339	0.007109	0.030818	-0.005273
Median	0.042663	0.015168	0.000511	0.001232	0.027720	0.022740	0.070497	0.000000
Maximum	9.143706	11.30819	14.08842	13.67998	9.593682	12.04912	5.481889	19.82435
Minimum	-12.54695	-13.39210	-13.21961	-12.61474	-8.933000	-9.714265	-8.229563	-16.08202
Std. Dev.	1.475336	1.782999	1.732570	1.514377	1.384748	1.358374	1.263702	1.664482
Skewness	-0.750542	-0.733809	0.050580	-0.207155	-0.155816	-0.061969	-0.298481	-0.105360
Kurtosis	12.04621	12.30713	11.74960	11.65021	8.949328	11.98836	5.401172	17.25756
Jarque-Bera	10962.87	11574.25	9979.072	9768.471	4233.854	10531.70	498.1771	22390.88
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	20.59402	-3.023131	77.83988	58.11417	0.971293	22.23636	60.18788	-13.93695
Sum Sq. Dev.	6808.454	9944.179	9386.622	7166.684	5487.960	5769.879	3117.233	7319.658
Observations	3129	3129	3128	3126	2863	3128	1953	2643

Table 4.1 presents the descriptive statistics of the stock indices returns of Canada, China, EU and India. For each country the statistics for both the conventional and Islamic indices were reported. At this level the ones of interest are the mean, the maximum and minimum values, and the standard deviation. The other statistics comprising skewness, kurtosis and the Jarque-Bera were discussed in detail in section *4.5 Testing for ARCH Effect.*From the results it's clear in Canada whereas as the mean, maximum and minimum values for conventional index were 0.006582, 9.143706, and -12.54695, those of the Islamic index were -0.000966, 11.30819 and -13.39210. Their standard deviations were 1.475336 and 1.782999 respectively. This shows dissimilarity

in the statistics of the conventional and Islamic stock indices returns even in the same country in the period under review. The same kinds of difference between the conventional and Islamic indices were observed for China, EU and India. This suggests that whole time series could be treated as heterogeneous.

Table 4.2: Descriptive Statistics of Stock Indices Returns in Selected Countries

	RTJP1	**RTJP2**	**RTKWT1**	**RTKWT2**	**RTMLY1**	**RTMLY2**	**RTQTR1**	**RTQTR2**
Mean	0.006446	0.004582	-0.015868	-0.030162	0.014728	-0.013107	0.018602	0.015972
Median	0.042584	0.021169	0.013708	0.009222	0.003669	0.000000	0.039455	0.036723
Maximum	9.143706	12.34636	9.565600	22.66322	5.272028	5.982614	12.17554	12.36284
Minimum	-12.54695	-12.46948	-12.89144	-26.06601	-10.93052	-11.97518	-14.57039	-16.22179
Std. Dev.	1.475543	1.306473	1.513245	1.764565	0.947060	0.976604	1.665562	1.724765
Skewness	-0.750201	-0.598181	-0.998553	-1.129501	-0.815330	-0.712181	-0.476150	-0.558223
Kurtosis	12.04301	14.05681	13.79125	43.70151	13.02112	15.15219	16.37913	16.55971
Jarque-Bera	10951.55	16120.19	11230.99	142630.6	13430.72	16292.83	16326.66	17631.95
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	20.16362	14.33402	-35.51294	-62.13317	46.05408	-34.23652	40.51514	36.51289
Sum Sq. Dev.	6808.193	5337.389	5122.527	6411.088	2803.783	2490.255	6039.206	6797.449
Observations	3128	3128	2238	2060	3127	2612	2178	2286

Table 4.2 presents the descriptive statistics of the stock returns of the conventional and Islamic indices of Japan, Kuwait, Malaysia and Qatar. The statistics of conventional and Islamic indices of Japan seemed to have close values except for the maximum values (9.143706 and 12.34636) in which the difference was highest. There was no substantial difference in the means (0.006446 and 0.004582), the minimum values (-12.54695 and -12.46948) and the standard deviations (1.475543 and 1.306473). This corroborates what was observed on the graphs. In Kuwait there was a noticeable difference between the statistics of the conventional (KWT1) and Islamic (KWT2) indices. For instance, the maximum values were 9.565600 and 22.66322, and the minimum values were -12.89144 and -26.06601 respectively. However, the statistics of the indices of Malaysia

were closely knitted together as in their graph presented earlier except for the mean of the Islamic index that was negative (-0.013107) while that of the conventional was positive (0.014728). On a similar note, the conventional and islamic indices of Qatar had similar maximum (12.17554 and 12.36284) , minimum (-14.57039 and -16.22179) and standard deviation (1.665562 and 1.724765) statistics.

Table 4.3: Descriptive Statistics of Stock Indices Returns in Selected Countries

	RTTKY1	RTTKY2	RTTWN1	RTTWN2	RTUS1	RTUS2
Mean	0.003648	0.023693	0.017673	0.035775	0.026800	0.032110
Median	0.036076	0.000232	0.011496	0.059758	0.053523	0.022179
Maximum	15.99203	10.90822	8.243062	6.450488	10.50835	11.83571
Minimum	-14.80654	-9.082121	-8.525886	-5.609285	-8.200513	-11.83571
Std. Dev.	2.246290	1.356781	1.403329	1.105233	1.141514	1.460181
Skewness	-0.247123	-0.488127	-0.250293	-0.113246	-0.111459	-0.373088
Kurtosis	7.346250	9.248743	6.933843	5.823567	14.28121	10.56663
Jarque-Bera	2489.036	5211.648	1940.814	751.5655	15909.11	7532.253
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	11.38804	74.08935	52.34824	80.42207	80.37308	100.4093
Sum Sq. Dev.	15748.00	5754.516	5831.193	2744.802	3906.558	6665.034
Observations	3122	3127	2962	2248	2999	3127

The descriptive statistics of the stock returns of the conventional and Islamic indices of Turkey, Taiwan and US are given in Table 4.3. In all the three countries it appeared there were more differences than similarities in the statistical values of the conventional and Islamic indices. In Turkey the mean return of Islamic index (0.023693) is higher than the mean return of the conventional index (0.003648) while the conventional index had higher maximum return (15.99203) than the Islamic index (10.90822). This result is similar to that of Taiwan. In US however the Islamic index had higer mean (0.032110) and maximum returns (11.83571) though its standard deviation was wider (1.46) while that of the conventional was (1.14).

Table 4.4: Descriptive Statistics of US Macroeconomic Variables

	CPI	EUI	FFR	M2	OIL	TB	VFI
Mean	1.024025	104.1397	1.184875	9883.184	79.54203	1.019530	19.27157
Median	1.037600	87.39000	0.180000	9646.300	75.18000	0.150000	16.47000
Maximum	1.113800	626.0300	5.410000	13849.70	143.9500	5.030000	80.86000
Minimum	0.900200	3.320000	0.040000	6681.300	26.01000	0.010000	9.140000
Std. Dev.	0.059527	67.81590	1.812353	2131.507	26.59778	1.658569	9.488805
Skewness	-0.368705	1.820460	1.500962	0.243443	0.142131	1.601125	2.411669
Kurtosis	1.934289	8.722341	3.531757	1.807259	1.728035	3.883872	10.80199
Jarque-Bera	209.9391	5995.526	1211.359	215.8286	214.3899	1429.575	10580.06
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	3072.075	325749.1	3706.290	30845418	240932.8	3169.720	58161.59
Sum Sq. Dev.	10.62683	14381062	10271.02	1.42E+10	2142134.	8549.643	271642.9
Observations	3000	3128	3128	3121	3029	3109	3018

Table 4.4 presents the descriptive statistics of the selected US macroeconomic variables considered in this study. Clearly there was wide variation in their statistics which could be attributed to differences in the units of their measurements. To account for these variations the log of the series was used in the estimations. The literature suggests this method as a way of harmonizing wide variations amongst data set.

4.3 Unit Root Test

In order to examine the existence of stochastic non-stationarity in the series the study establishes the order of integration of individual time series through the unit root tests. Three standard unit root tests; the Augmented Dickey-Fuller (ADF), the Phillips-Peron (PP) and the KPSS test developed by Kwiatkowski, Phillips, Schmidt and Shin (1992) were conducted. Bida (2010), Luintel & Khan (1999) and Liang and Teng (2006) noted that the ADF and PP tests have problems of lower power in rejecting the null hypothesis of a unit root. The ADF test is an adjustment of the DF test to take care of possible serial correlation in the disturbance term by including the lagged difference terms of the dependent variable. Whereas the PP uses nonparametric statistical methods to address the problem of serial correlation without the need for adding lagged values. Both ADF and PP have the same asymptotic distribution (Gujarati and Porter, 2009:758). KPSS was found to have very large powers over the conventional unit root test as such it was employed to complement the results of the ADF and PP tests.

Stationarity in this work was defined as in Brooks (2014) who suggests that a series is stationary if it has *a constant mean, constant variance and constant autocovariances*. The stationarity of the series are crucial for the purpose of economic forecasting. Otherwise non-stationary series could only be useful for the period under review, as it cannot be generalized to other periods. Clearly, it is not possible to validly conduct a hypothesis tests on the regression parameters if the data are not stationary. Therefore, for the purpose of forecasting, a non-stationary series may be of little practical significance (Gujarati and Porter, 2009:741).

Most economic time series are generally integrated of order 1(Gujarati and Porter, 2009:747). The idea of including more lagged difference terms is to ensure that the error term is serially uncorrelated with the dependent variable, so that we can have an unbiased estimate of δ. EViews automatically selects the lag length based on Schwarz Information Criterion (SIC).

To effectively distinguish the stocks, conventional indices were labeled as (1) and Islamic index (2) e.g. US1 (Conventional) and US2 (Islamic).

Table 4.5: Results for Unit Root Tests: Levels

Unit Root Test	Test: Level			Test: First Difference		
Variable	ADF	PP	KPSS	ADF	PP	KPSS
US1	0.998575	1.153444	5.355197	-59.8011	-60.1752	0.404988
US2	-0.30681	-0.15815	6.501568	-58.7662	-58.9586	0.103279
CA1	-2.69384	-2.76457	*0.406786	-54.9784	-54.9727	0.057033
CA2	-2.31873	-2.36459	1.734754	-54.6142	-54.5999	0.07628
JP1	-2.691	-2.76165	*0.408308	-54.9578	-54.952	0.05728
JP2	-1.52042	-1.40971	1.997162	-45.0291	-64.6132	0.174815
TKY1	-2.67888	-2.77907	0.592915	-54.6314	-54.6309	0.043879
TKY2	-0.66892	-0.64165	6.236758	-56.177	-56.182	0.075505
MLY1	-1.88199	-1.88396	3.565561	-50.4104	-50.6016	0.396728
MLY2	-1.26393	-1.35838	1.601448	-47.3717	-47.5177	0.197101
CHN1	**-3.10256	**-3.13137	1.540722	-54.2079	-54.2	0.091193
CHN2	**-2.89571	-2.80618	1.845581	-57.8755	-57.9459	0.062327
IND1	-0.04654	-0.1839	3.265395	-41.4196	-41.4043	0.209418
IND2	-2.7571	-2.83016	0.625885	-49.1848	-49.1829	0.305673
QTR1	-1.61201	-1.58873	3.80131	-41.5634	-41.52	0.052572
QTR2	-1.79868	-1.78086	3.356092	-43.3533	-43.3771	0.071492
KWT1	-1.35348	-1.14651	3.406737	-11.5207	-42.6698	0.11817
KWT2	-0.94111	-0.97878	3.831432	-44.9833	-45.0056	0.133952
EU1	-1.87509	-1.73376	1.278181	-52.6659	-52.8976	0.193746
EU2	-2.41359	-2.29464	1.842516	-58.6415	-58.7568	0.058961
TWN1	-1.52928	-1.47103	2.90706	-54.0344	-54.0616	0.073521
TWN2	-2.26872	-2.23747	4.601263	-45.7426	-45.774	0.085227
US MACROECONOMIC VARIABLES						
OIL	-1.599154	-1.615346	1.249688	-52.40338	-52.39610	0.093347
VFI	-2.186307	*-4.957853	1.593470	-21.78689	-63.99724	0.033379
FFR	-2.462663	-2.098046	3.777666	-22.45245	-62.36295	0.820596
EUI	*-6.691499	-43.54159	0.936865	-28.75689	-493.3229	0.060885
TB	-2.525841	-2.548085	3.693658	-7.670289	-56.58084	1.393265
M2	2.231925	2.996604	7.139616	-9.712949	-15.58709	1.063345
CPI	-0.932660	-0.932761	6.759878	-54.98392	-54.98978	0.060924

*, and ** imply 1%, and 5% levels of significance respectively

Table 4.5 presents the results for unit root at levels and first difference. Clearly for the ADF/PP tests, most of the conventional and Islamic indices as well as the US macroeconomic variables were not more negative than the critical values; therefore the null hypotheses cannot be rejected, the series were non-stationary. Similarly for the KPSS tests most of the test statistics exceeds the critical values, even at the 1% level, thus the null hypotheses of a stationary series were rejected. The KPSS result corroborates the results of the ADF and PP. Based on these, it is ruled that all the time series were non stationary at the levels. However, the notable exceptions that seemed to be stationary at the level were conventional and Islamic indices of China (CHN1 and CHN2) in the ADF and PP tests at 5% level. In the KPSS test the conventional stocks for Canada (CA1) and Japan (JP1) appeared stationary. The US Volatility fear index (VFI) was stationary using the PP statistics as well as economic uncertainty index (EUI) for the ADF statistics.

As expected, almost all the series became stationary at first differences as depicted in Table 4.5. Precisely, all the stock indices were stationary at the first difference using the three unit root tests. However, the KPSS test showed some of the macroeconomic variables to be non-stationary which comprises ffr (5%), TB (1%), and M32 (1%) and at various levels of significance though they were found stationary using the ADF and PP tests. Thus, based on the first two tests it's reasonable to assume that all the series were stationary.

Clearly all the series became stationary as indicated in Figures 4.1, 4.2 and 4.3 respectively. The graphs visibly depict purely white noise processes with no trending behavior and the frequencies cross their mean values of zero. Apparently, one thing common amongst the series is volatility clustering, that is period of high volatility are followed by periods of high volatility, and similarly periods of low volatility are followed by periods of low volatility. This implies that the lagged values of the series are autocorrelated. Econometrics literature suggests that time series with this kind of behavior cannot be model with the usual OLS model.

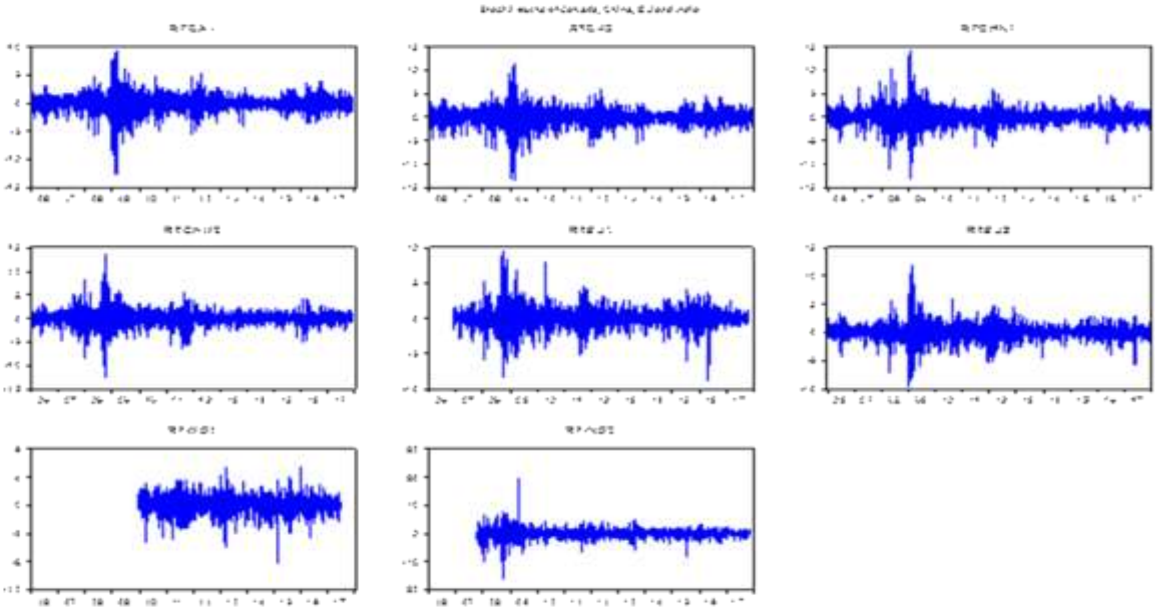


Figure 4.5: Stock Returns of Canada, China, EU and India

Figure 4.1 presents the trend of the stock returns of the conventional and Islamic indices of Canada, China, EU and India. It appears from the graphs that all the indices exhibit volatility clustering, implying that they are heteroscedastic. For instance, in Canada the returns of the conventional (CA1) and Islamic (CA2) indices exhibit similar volatility movements within the period 2006 – 2017. Both had their outliers of major swings in 2008 – 2009. Similarly, the conventional (CHN1) and Islamic (CHN2) had similar pattern of volatility movements with their highest peaks recorded in 2008 – 2009. But in EU the returns of the conventional (EU1) indices appeared to be more volatile than its Islamic counterpart (EU2) though both exhibit volatility clustering. Like the other two, their volatility was also highest in 2008 – 2009. There is no designated pattern that could be discerned from trend of the conventional and Islamic indices of India apart from the fact that they were also volatile.

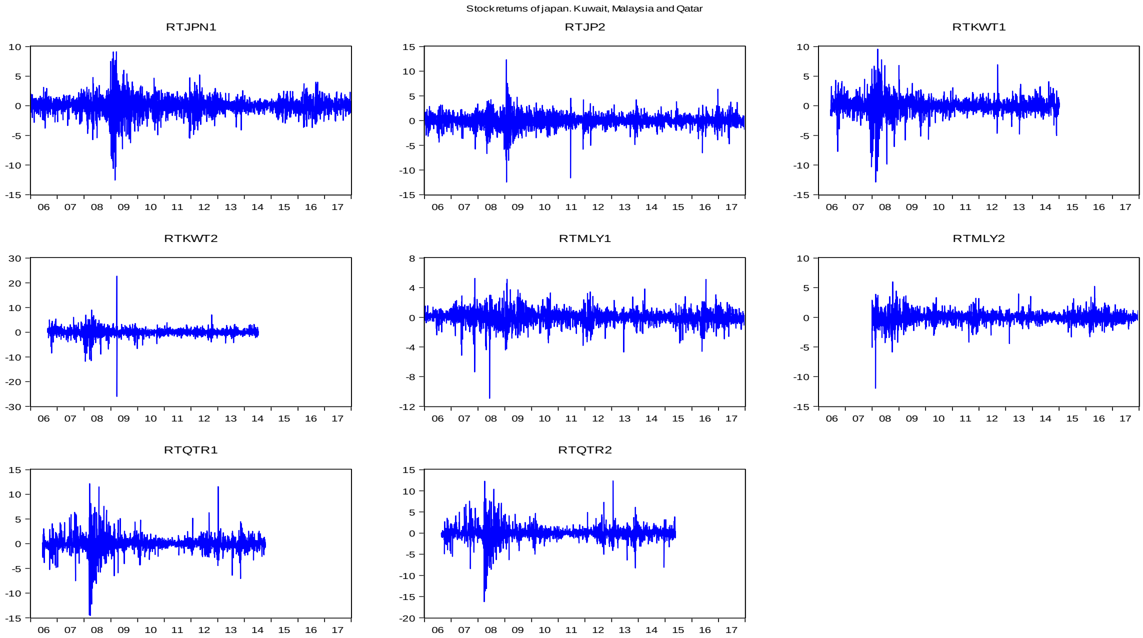


Figure 4.6: Stock Returns of Japan, Kuwait, Malaysia and Qatar

Figure 4.2 presents the stock returns of conventional and Islamic indices in Japan, Kuwait, Malaysia and Qatar. For Japan, the conventional index (JP1) appeared to be more volatile than the Islamic index (JP2) though both had their major swing in 2009. The returns of the conventional and Islamic indices of Japan appeared to have different patterns of volatility. The Islamic index showed less volatility than its conventional counterpart in 2006 to 2017. In Malaysia and Qatar both the Islamic and conventional indices exhibited similar trend of volatility movements in the period under review

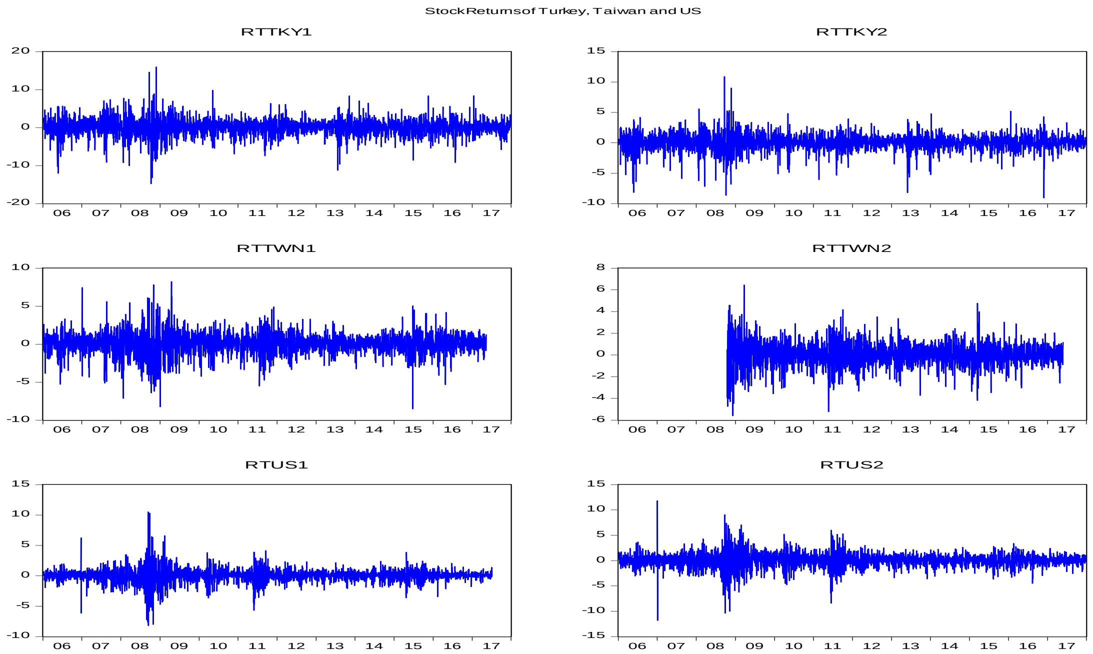


Figure 4.7: Stock Returns of Turkey, Taiwan and US

Figure 4.3 illustrates the stock returns of conventional and Islamic indices of Turkey, Taiwan and the US. In all the three countries, a similar pattern of volatility movement was observed amongst the indices. For instance, in Turkey both the conventional (TKY1) and Islamic (TKY2) indices became more volatile in 2008 to 2009. This result was also applicable to the conventional and Islamic indices of Taiwan and the US. This suggests that there may be some kind of long term association between the conventional and Islamic indices in the respective countries. Though graphs are not sufficient tools to make any inference regarding the behavior of the observed stock indices, it however provides a glimpse of what to expect from a deeper analysis.

4.4 Johansen Co-integration Test

The Johansen Cointegration test was used to test for cointegration and the presence of a long run relationship and to determine the number of cointegrating vectors. To estimate the VAR model, the first step was to check the lag structure of the model. From the results obtained it was clear that 8 lags was the optimum for both the Johansen and VEC models. Therefore, using the AIC criterion 8 lags was used as presented in Table 4.6.

Table 4.6: Lag Order Selection Criteria

INDEX	LAG	LR	FPE	AIC	SC	HQ
US2	8*	8*	8*	8*	3*	8*
EU1	8*	8*	8*	8*	3*	7*
EU2	8*	8*	8*	8*	3*	7*
CA1	8*	8*	8*	8*	3*	7*
CA2	8*	8*	8*	8*	3*	7*
CHN1	8*	8*	8*	8*	3*	7*
CHN2	8*	8*	8*	8*	3*	7*
IND1	7*	8*	7*	7*	3*	3*
IND2	8*	8*	8*	8*	3*	7*
JP1	8*	8*	8*	8*	3*	7*
JP2	8*	8*	8*	8*	3*	7*
KWT1	8*	8*	8*	8*	3*	7*
KWT2	8*	8*	8*	8*	3*	4*
MLY1	8*	8*	8*	8*	3*	7*
MLY2	8*	8*	8*	8*	3*	7*
TKY1	8*	8*	8*	8*	3*	7*
TKY2	8*	8*	8*	8*	3*	7*
TWN1	8*	8*	8*	8*	3*	7*
TWN2	8*	8*	8*	8*	3*	5*
QTR1	8*	8*	8*	8*	3*	4*
QTR2	8*	8*	8*	8*	3*	5*
* 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						

Table 4.6 shows that the best lag order selected by most of the criterion was 8 lags with the notable exception of the SIC and HQ criteria. Here the condition is the lower the value the better the criterion that is why each criterion has a star on its lowest value. Since 8 lags was clearly the majority, it was therefore chosen in this study based on the AIC.

Table 4.7 presents the cointegration results between the conventional indices and broad market index, represented by Dow Jones Industrial Average (US1) and US macroeconomic variables.

Table 4.7 Johansen Test of Co-integration Conventional Indices

Indices	No. of CE(s)	Trace Statistics	0.05 Critical Value	Probability**	Max-Eigen Statistic	0.05 Critical Value	Probability**
EU1	None*	1313.517	197.3709	1.0000	347.9329	58.43354	0.0000
	At Most 6	28.48589	29.79707	0.0702	5.883830	14.26460	0.6282
CA1	None*	1340.839	197.3709	1.0000	22.98497	29.79707	0.2468
	At Most 6	369.4948	58.43354	0.0000	16.38711	21.13162	0.2031
CHN1	None*	1033.351	197.3709	0.0001	20.93456	29.79707	0.3617
	At Most 6	355.4999	58.43354	0.0000	13.34932	21.13162	0.4206
IND1	None*	771.3934	197.3709	0.0001	7.689165	15.49471	0.4992
	At Most 7	271.6285	58.43354	0.0000	7.668427	14.26460	0.4134
JP1	None*	1342.755	197.3709	1.0000	23.00829	29.79707	0.2457
	At Most 6	372.5934	58.43354	0.0000	16.41580	21.13162	0.2015
KWT1	None*	1060.897	197.3709	0.0001	17.06629	29.79707	0.6352
	At Most 6	298.8548	58.43354	0.0000	9.160708	21.13162	0.8193
MLY1	None*	1285.261	197.3709	1.0000	23.00887	29.79707	0.2456
	At Most 7	363.9327	58.43354	0.0000	16.44645	21.13162	0.1998
TKY1	None*	1338.912	197.3709	1.0000	23.18366	29.79707	0.2372
	At Most 6	376.1663	58.43354	0.0000	16.53295	21.13162	0.1952
TWN1	None*	1319.953	197.3709	1.0000	22.57000	29.79707	0.2678
	At Most 6	376.8689	58.43354	0.0000	15.94474	21.13162	0.2281
QTR1	None*	1049.818	197.3709	0.0001	19.09977	29.79707	0.4858
	At Most 6	292.7622	58.43354	0.0000	11.18199	21.13162	0.6291

CE(s) number of cointegrating equations at the 0.05 level
* denotes rejection of hypothesis at the 0.05 level
**MacKinnon-Haug-Michelles (1999) p-values
Note: optimal number of time lags selected using AIC obtained after VAR estimated of all endogenous variables

From Table 4.7 it's clear that the model for Europe conventional index (EU1) has very significant Trace and Eigen statistics resulting in the non-rejection of the at most 6 cointegrating equations. This implies the existence of long run association with the broad market index and the US macroeconomic variables. A similar result was obtained for the models of the conventional indices of Canada (CA1), China (CHN1), Japan (JP1), Kuwait (KWT1), Turkey (TKY1), Taiwan (TWN1) and Qatar (QTR1) with highly significant Trace and maximum Eigen values and at most six cointegrating equation. The highly statistical significance of the Trace and Eigen Statistics for India and Malaysia led to the non-rejection of at most seven cointegrating equations implying the presence of very strong cointegration with the variables.

The cointegration results presented in Table 4.8 suggests a long run relationship between Islamic indices and the broad market index, represented by Dow Jones Industrial Average (US1) and macroeconomic variables of the US.

Table 4.8: Johansen Test of Co-integration Islamic Indices

Indices	No. of CE(s)	Trace Statistics	0.05 Critical Value	Probability **	Max-Eigen Statistic	0.05 Critical Value	Probability**
US2	None*	720.7195	197.3709	0.0001	303.3308	58.43354	0.0000
	At Most 5	43.24918	47.85613	0.1266	23.32606	27.58434	0.1600
EU2	None*	768.6238	197.3709	0.0001	313.6106	58.43354	0.0000
	At Most 6	23.36422	29.79707	0.2286	12.47583	21.13162	0.5014
CA2	None*	773.9467	239.2354	0.0000	308.3863	64.50472	0.0001
	At Most 5/6	69.64402	69.81889	0.0516	13.93548	27.58434	0.8271
CHN2	None*	815.2894	239.2354	0.0001	305.2217	64.50472	0.0001
	At Most 6	43.57532	47.85613	0.1192	25.21674	27.58434	0.0975
IND2	None*	420.2817	239.2354	0.0000	146.3172	50.45921	0.0000
	At Most 4	90.85373	95.75366	0.1037	35.64463	40.07757	0.1453
JP2	None*	786.3816	239.2354	0.0000	306.2951	64.50472	0.0001
	At Most 6	46.86213	47.85613	0.0618	22.19774	27.58434	0.2104
KWT2	None*	723.5732	239.2354	0.0000	250.9998	64.50472	0.0001
	At Most 6	47.69246	47.85613	0.0518	29.74428	33.87687	0.1440
MLY2	None*	578.8148	239.2354	0.0000	163.9123	64.50472	0.0000
	At Most 7	18.73103	29.79707	0.5124	10.34474	21.13162	0.7117
TKY2	None*	760.2918	239.2354	0.0000	310.6401	64.50472	0.0001
	At Most 5	68.37990	69.81889	0.0648	33.60312	33.87687	0.0539
TWN2	None*	498.8559	239.2354	0.0000	137.1736	64.50472	0.0000
	At Most 6	45.05494	47.85613	0.0895	20.76254	27.58434	0.2908
QTR2	None*	1211.533	239.2354	0.0001	624.4988	64.50472	0.0001
	At Most 6/5	46.94422	47.85613	0.0608	21.22219	27.58434	0.2630

CE(s) number of cointegrating equations at the 0.05 level
* denotes rejection of hypothesis at the 0.05 level
**MacKinnon-Haug-Michelles (1999) p-values
Note: optimal number of time lags selected using AIC obtained after VAR estimated of all endogenous variables

The result for the US Islamic index (US2) shows that both the Trace and Eigen statistics indicated the presence of cointegration or long run association with the US conventional index (US1) and the US macroeconomic variables with at least 5 cointegrating equations. The specification for Islamic EU (EU2) index had highly significant Trace and Eigen statistics with at least 6 cointegrating equations. Canada Islamic index (CA2) had 5 cointegrating equations in the Trace statistics and 6 cointegrating equations for the Eigen statistics. Both the Trace and Eigen statistics have 6 cointegrating equations for China indices. India indices had 4 cointegrating equations indicating a long term associations with the US macroeconomic variables. Both the Islamic indices of Japan (JP2) and Kuwait (KWT2) had highly significant Trace and Eigen statistics with each having 6 cointegrating equations. The Islamic index of Malaysia (MLY2) had 7 cointegrating equations in its long term association with the US macroeconomic variables. Turkey's Islamic Index (TKY2) had at most 5 cointegrating equations whereas Taiwan (TWN2) had at most 6 cointegrating equations. For Qatar's Islamic Index (QTR2), the Trace statistics had at most 6 cointegrating equations and the Eigen statistics had at most 5 cointegrating equations.

From the foregoing analysis, we could thus conclude that there is a long-run association between the conventional and Islamic indices of the respective countries and the broad market index represented by Dow Jones Industrial Average (US1) and US macroeconomic variables comprising economic uncertainty index, federal funds rate, money supply, volatility fear index, consumer price index, Treasury bill and Brent oil price. A similar result was obtained by Barbic and Condic-Jurkic (2011).

In all the cases the null hypothesis was rejected which implies that there is cointegration between the selected stock indices and the US macroeconomic variables. In order words they move in the same direction. Its important therefore, for investors in either conventional or Islamic indices of the Dow Jones and FTSE stocks to keep vigil of changes in the macroeconomic variables of the US irrespective of the country, as they have a significant impact on the stock prices. The Islamic indices in particular show evidence of long-term co-movement with the Dow Jones Industrial Average and the rest of the US macroeconomic factors considered in this study. This is especially important because the basis point of Dow Jones as well as FTSE is both measured in dollars. Therefore, by implication it could be reasoned that macroeconomic factors that affects the dollar could also affect stock prices of the Dow Jones and FTSE families be it conventional or Islamic.

4.5 Results of Vector Error Correction Model (VECM)

The results of the VECM is presented in Table 4.10, it shows the Error Correction Term (ECT) or speed of adjustment coefficients, the standard errors, the t-statistics and the probability values. The error correction term or speed of adjustment coefficient needs to be negative and significant for the existence of a long-run relationship between the variables.

Table 4.9: Results of VECM for Conventional Indices

Variables	ECT	Std. Error	t-Statistic	Prob
EU1	-0.997584*	0.057044	-17.48804	0.0000
CA1	-0.995418*	0.055403	-17.96687	0.0000
CHN1	-0.213652*	0.025016	-8.540544	0.0000
IND1	-0.141684*	0.022911	-6.184038	0.0000
JP1	-0.894537*	0.052695	-16.97571	0.0000
KWT1	-0.655542*	0.052021	-12.60150	0.0000
MLY1	-0.128224*	0.020936	-6.124629	0.0000
TKY1	-0.796052*	0.049011	-16.24231	0.0000
TWN1	-0.743084*	0.049423	-15.03513	0.0000
QTR1	-0.783247*	0.054258	-14.43558	0.0000

*Significant at the 5% level

As indicated in Table 4.9 all the ECT for the conventional indices had the desired negative sign and were also found to be statistically significant. For instance the ECM for the conventional indices of EU (-0.997584), Canada (-0.995418), China (-0.213652), India (-0.141684), Kuwait (-0.655542), Malaysia (-0.128224), Turkey (-0.796052), Taiwan (-0.743084), and Qatar (-0.783247) were all negative and highly statistically significant. Meaning that, we cannot accept the null hypotheses of no cointegration and therefore conclude that there is long term causality between all the conventional indices, the broad market index and the US macroeconomic variables. This implies that they all converge to equilibrium in the long-run.

Table 4.10 Results of VECM for Islamic Indices

Variables	ECT	Std. Error	t-Statistic	Prob
US2	-0.750592*	0.040221	-18.66189	0.0000
EU2	-0.839434*	0.051668	-16.24664	0.0000
CA2	-0.872150*	0.052642	-16.56744	0.0000
CHN2	-0.756533*	0.047070	-16.07236	0.0000
IND2	-0.304980*	0.029019	-10.50981	0.0000
JP2	-1.046617*	0.059313	-17.64564	0.0000
KWT2	-1.142114*	0.069860	-16.34871	0.0000
MLY2	-0.035410*	0.014854	-2.383819	0.0172
TKY2	-0.969069*	0.054592	-17.75117	0.0000
TWN2	-0.994226*	0.068871	-14.43601	0.0000
QTR2	-0.714779*	0.049296	-14.49970	0.0000

*Significant at the 5% level

The result in Table 4.10 shows the Error Correction Terms (ECT) or speed of adjustment coefficients of the Islamic indices of US (-0.750592), EU (-0.839434), Canada (-0.872150), China (-0.756533), India (-0.304980), Japan (-1.046617), Kuwait (-1.142114), Malaysia (-0.035410), Turkey (-0.969069), Taiwan (-0.994226) and Qatar (-0.714779) were found to be statistically significant with the anticipated negative sign. This gives sufficient evidence to reject the null hypothesis of “no cointegration” and confirm the existence of a long-run association between the Islamic indices of these countries as well as the Dow Jones Industrial average (broad market index), and the US macroeconomic variables. This implies that they all converge to equilibrium in the long-run.

It was further observed from the result that the speed of adjustments to equilibrium in all the equations was relatively slow. This implies that the series were highly volatile and takes long time to converge to equilibrium. This is due to the fact that a fall in stock returns is likely to be followed by further falls in the returns. Similarly, a rise in the stock returns will probably be followed by further rises. This explains the possible reason for the slow adjustment coefficients. As such investment decisions on these stocks should be based on all available information regarding the dynamics of the US macroeconomic variables.

4.6 Testing for ARCH Effect

Here the analysis was commenced with testing for ARCH effects in the residuals of the estimated models of the stock return series. Thus, the test is one of a joint null hypothesis that all q lags of the squared residuals have coefficient values that are not significantly different from zero. If the value of the test statistic is greater than the critical value from the Chi square distribution(χ^2), then the null hypothesis is rejected. Brooks (2014) assert that this test could also be thought of as test for autocorrelation in the squared residuals. The residuals of the returns of all the stock indices was tested for ARCH effect and it turned out all of them were significant, and therefore there was the justification to specify the ARCH family model for the time series.

The conventional Dow Jones US (US1) was significant for ARCH effect. Clearly this result was corroborated with the plot of the data which shows volatility clustering with the highest volatility falling in 2008 – 2009, corresponding to the US mortgage financial crises. The data was negatively skewed (-0.314129) and fat-tailed (13.42819) and the Jarque – Bera probality (0.0000) shows that it's not normally distributed. This is indicated in the figures 4.8.

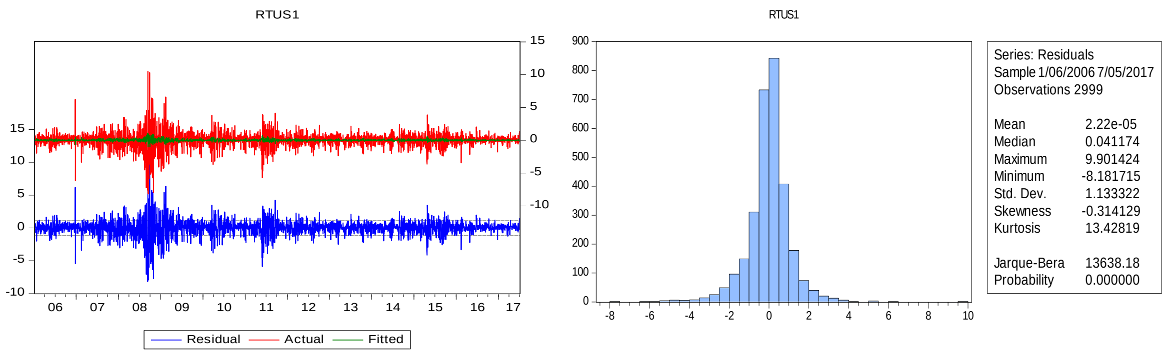


Figure 4.8 Conventional Dow Jones US (US1)

The Dow Jones Islamic US (US2) exhibited a similar pattern with its conventional counterpart. Since it has its highest volatility in the same period as the conventional one, there is reason to suspect contagion. It also had an ARCH effect negatively skewed (-0.453820) and fat-tailed (10.25353). The result is depicted in the Figures 4.9.

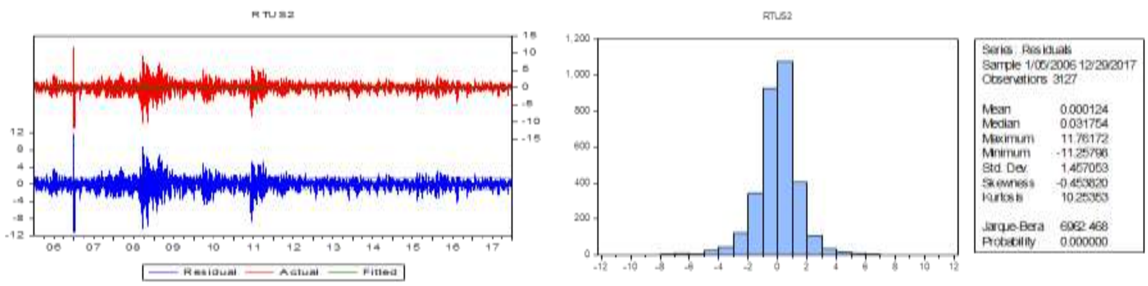


Figure 4.9: Dow Jones Islamic US (US2)

As shown in Figure 4.6a and 4.6b in Europe the returns of the conventional index FTSE/ATHEX Top 20 (EU1) had ARCH effect, negatively skewed (-0.131033), fat tailed (9.085885) and was not normally distributed. Incidentally like the US indices the highly volatile periods were in 2008 – 2009 and 2011-2012 and 2015-2016.

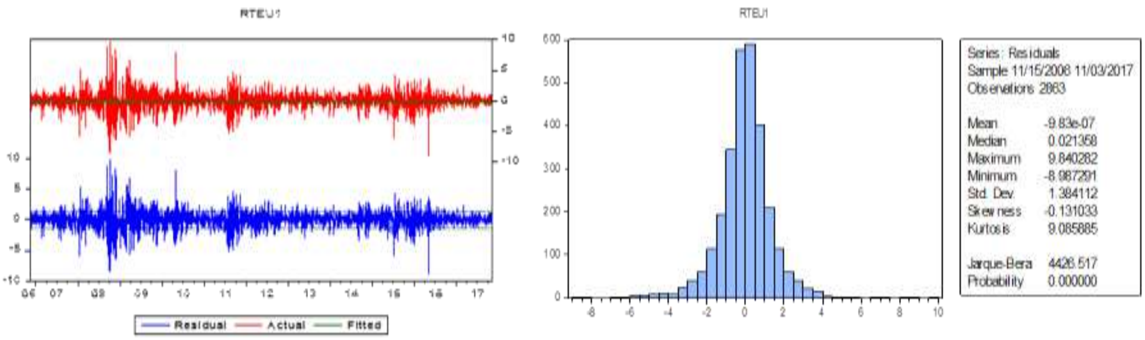


Figure 4.10 Europe conventional index FTSE/ATHEX Top 20 (EU1)

The returns of Dow Jones Islamic Market Europe Index (EU2) had ARCH effect with its most volatile residuals in 2008 – 2009, and 2011 – 2012. Unlike its conventional counterpart it was relatively more stable in 2015 – 2016. From its histogram it's fat-tailed (11.59714) and negatively (-0.196458) skewed. The residual violates the assumption of normality as presented in Figures 4.10.

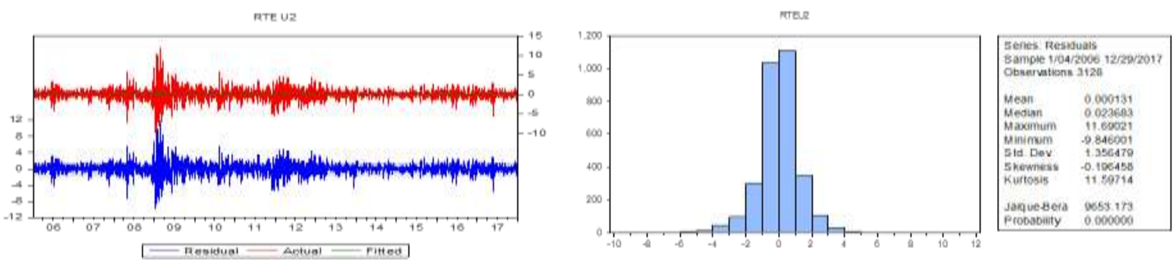


Figure 4.11: Dow Jones Islamic Market Europe Index (EU2)

The returns of conventional Dow Jones Canada Index (CA1) had ARCH effect and not normally distributed giving its Jarque – Bera probability. Its residuals were highly volatile in 2008-2009. Volatility pooling was clearly evident as well as negatively skewed and fat-tailed as shown in Figures 4.11.

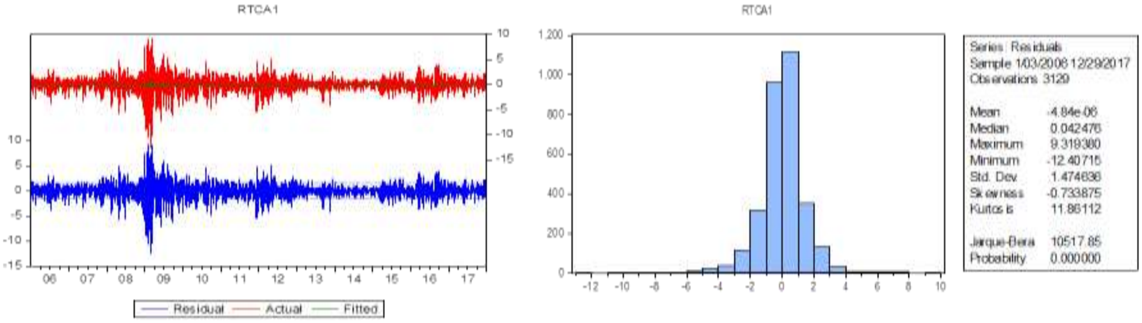


Figure 4.12: Conventional Dow Jones Canada Index (CA1)

The Dow Jones Islamic Market Canada Index (DJICA) had similar features with its conventional counterparts. It has ARCH effect, negatively skewed and fat-tailed. It was also not normally distributed as indicated in Figures 4.12.

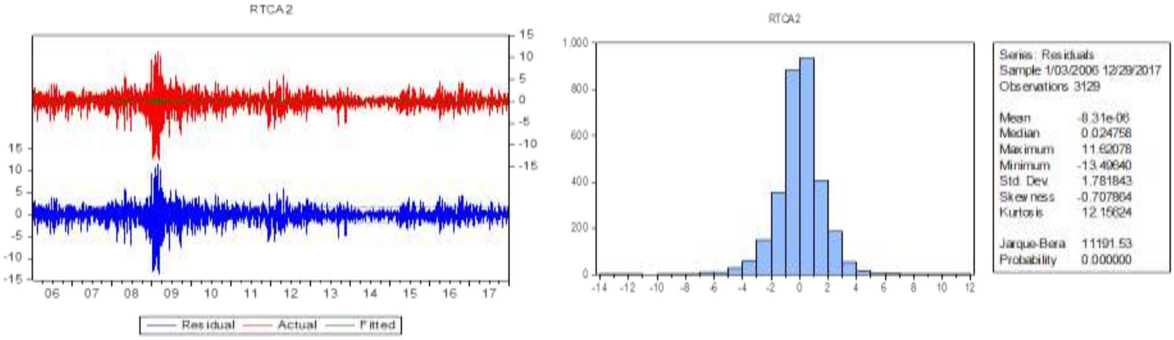


Figure 4.13: Dow Jones Islamic Market Canada Index (DJICA)

In Japan the residuals of the return of the conventional Dow Jones Japan Index USD (JP1) has ARCH effect and therefore heteroscedastic. It does not conform to normality, negatively skewed (-0.733527) and fat-tailed (11.85792). Its volatility burst is highest in

2008-2009 clearly shown in Figures 4.13

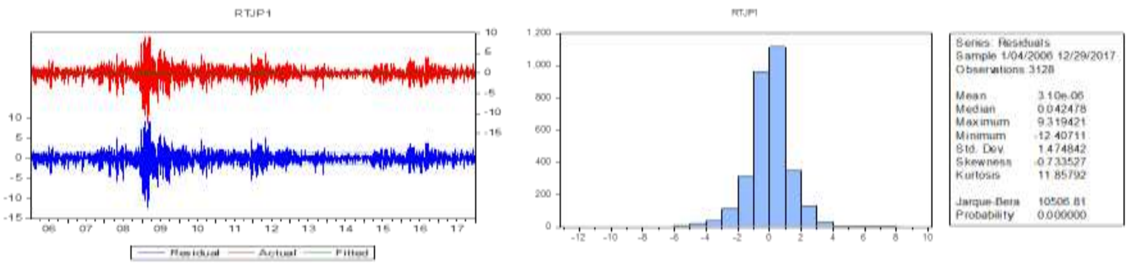


Figure 4.14: Conventional Dow Jones Japan Index USD (JPN1)

Figures 4.14 depict Dow Jones Islamic Market Japan Index (JP2), it exhibits similar volatility as its conventional counterpart. It has heavy presence of ARCH effect, negatively skewed, fat-tailed and lacks normal distribution. The residuals show remarkable volatility in 2008 – 2009. The rest of the period was relatively tranquil.

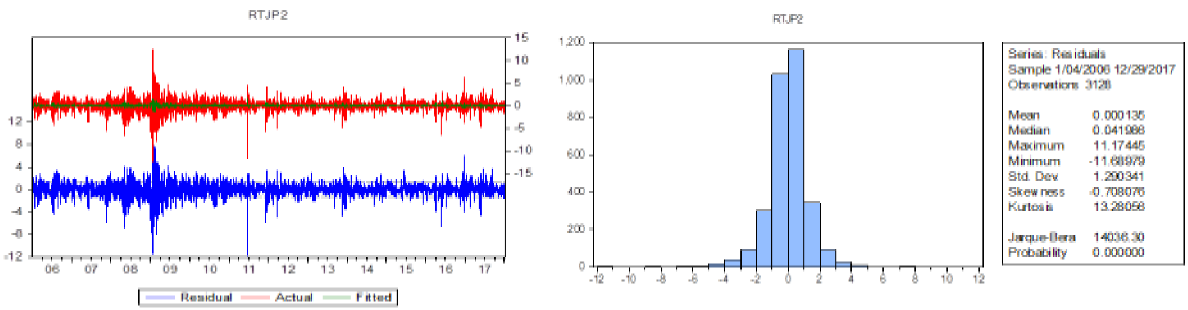


Figure 4.15: Dow Jones Islamic Market Japan Index (JP2)

FTSE DIFX Kuwait 15 Index (KWT1) is the conventional index used as there was no available data for Dow Jones. Its residuals have a clear ARCH effect. Its volatility is highest towards the end of 2007 and the beginning of 2009. It's negatively skewed and fat tailed. The Jarque-Bera probability shows that it’s not normally distributed as presented in Figures 4.15

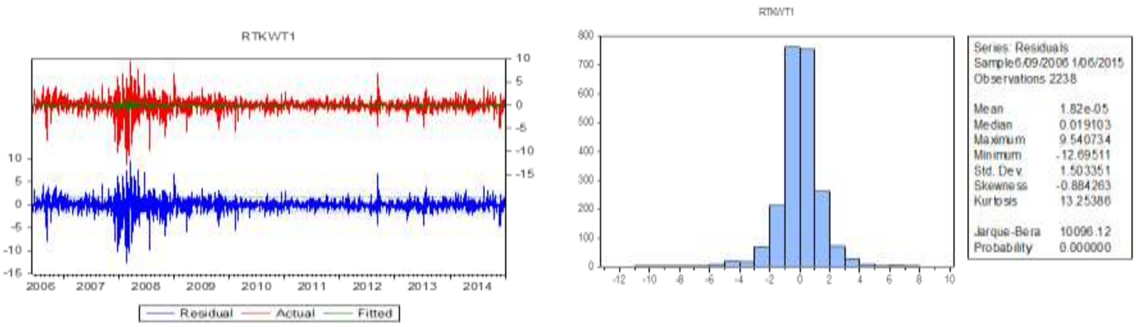


Figure 4.16: FTSE DIFX Kuwait 15 Index (KWT1)

FTSE DIFX Kuwait 15 Index (KWT2) is the Kuwait Islamic index and it was the only index that did not show ARCH effect. As it appeared its volatility is fairly stable over a longer period compared to its conventional counterpart though it’s fat-tailed and negatively skewed as shown in Figures 4.16.

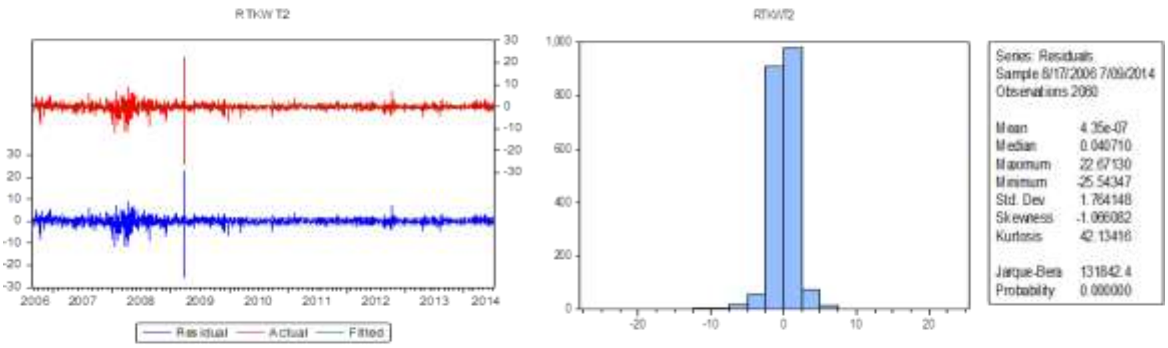


Figure 4.17: FTSE DIFX Kuwait 15 Index (KWT2)

The presence of ARCH effect was noted in the conventional Dow Jones Malaysia Index (RTMLY1). It’s also fat-tailed and negatively skewed with a non-normal distribution as depicted in Figures 4.17.

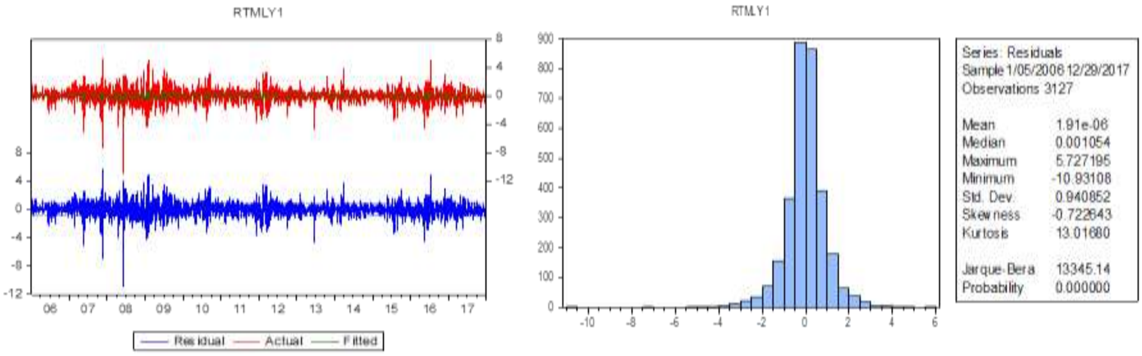


Figure 4.18 Conventional Dow Jones Malaysia Index (MLY1).

Similarly, as presented in Figures 4.18 the Islamic index in Malaysia the Dow Jones Islamic Market Malaysia Titans 25 Index (MLY2) though has ARCH effect but it appeared calmer than the conventional volatility. It is also not normally distributed, negatively skewed (-0.663811) and fat-tailed (15.10030).

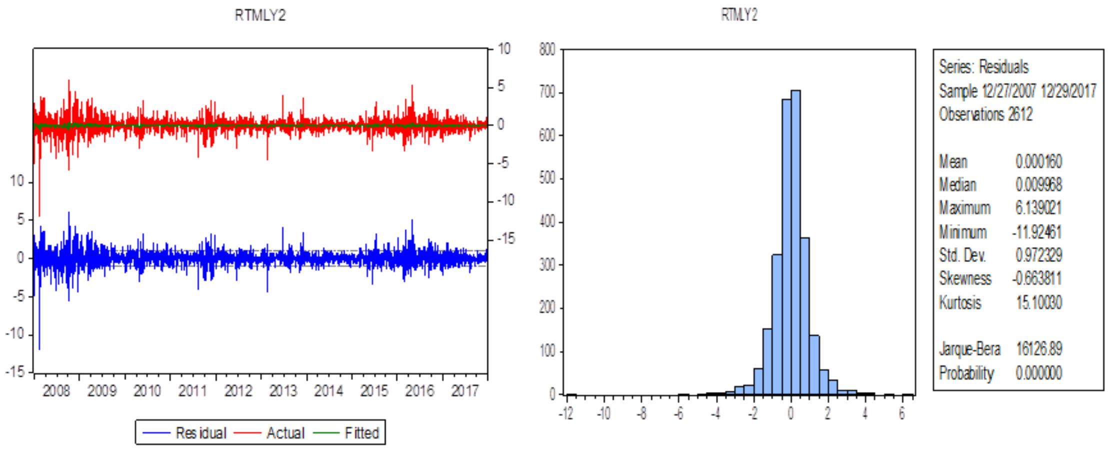


Figure 4.19: Dow Jones Islamic Market Malaysia Titans 25 Index (MLY2)

Dow Jones Turkey Titans 20 Index TRY (TKY1) is the conventional stock index used for Turkey which showed evidence of ARCH effect after the test was conducted. Volatility clustering was obvious from the residual graph and the series was fat-tailed

(7.304427) and negatively skewed (-0.206808). It lacks normal distribution. This is indicated in Figures 4.19.

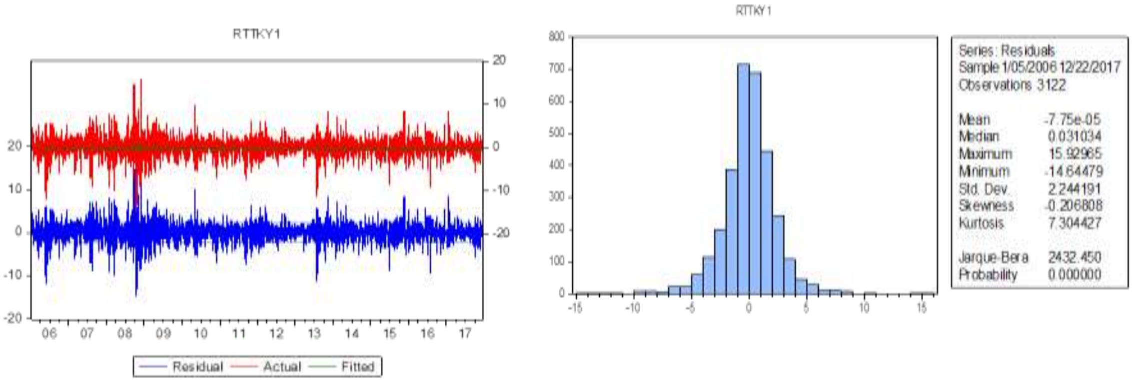


Figure 4.20: Dow Jones Turkey Titans 20 Index TRY (TKY1)

The residuals of the Islamic index of Turkey the Dow Jones Islamic Market Turkey Index (TKY2) has similar volatility pattern with its conventional one. The fluctuations were heaviest in 2008 – 2009. The residuals were not normally distributed with fat-tailed (9.220397) and negative skewness (-0.453028). This is presented in Figures 4.20.

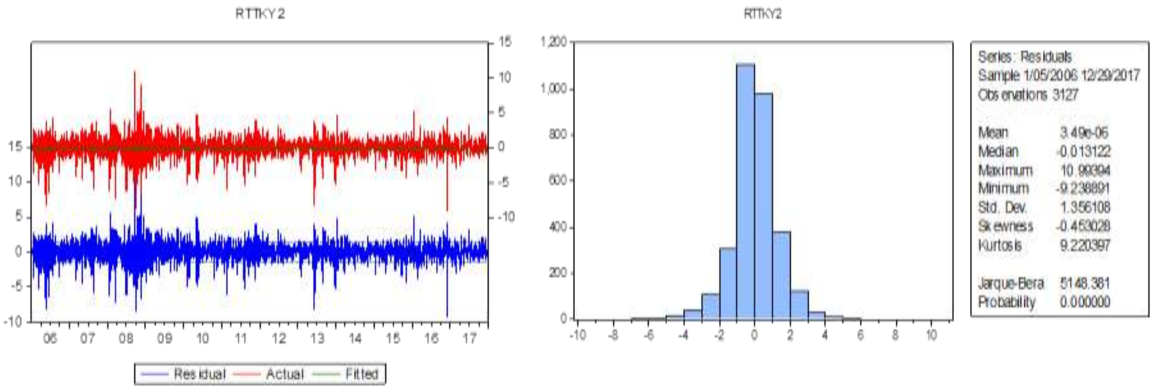


Figure 4.21: Dow Jones Islamic Market Turkey Index (TKY2)

The residuals of the conventional index of India FTSE All-World India Index GBP (IND1) shows evidence of ARCH effect as observed in the ARCH test. It's also characterized by volatility clustering, fat-tail (9.220397), negative skewedness (-0.453028) and not normally distributed as presented in Figure 4.21.

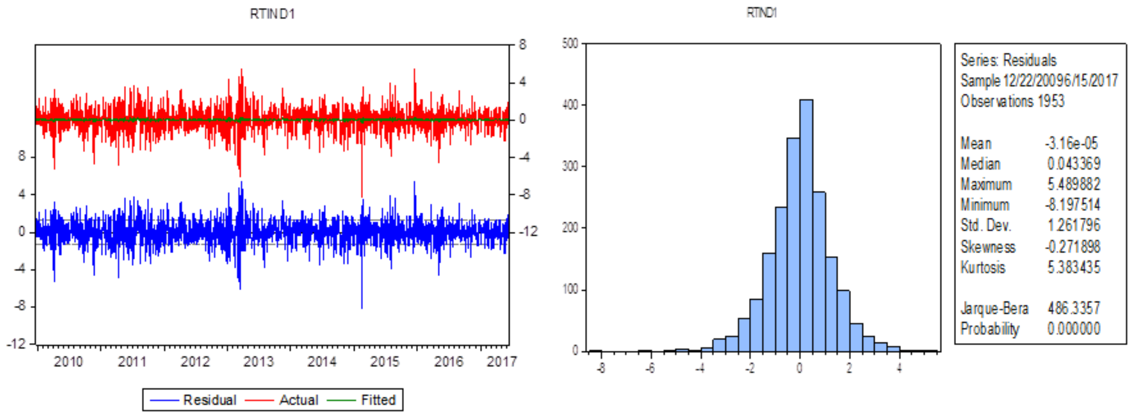


Figure 4.22: FTSE All-World India Index GBP (IND1)

Figures 4.22 show that the Islamic index of India FTSE Shariah India Index (IND2) exhibits similar features with the conventional one. The nature of its volatility clustering is typical of an ARCH effect as corroborated by the test. It has a non-normal distribution as reported in the Jarque-Bera probability. It has fat-tail (16.95385) and negatively skewed (-0.079653).

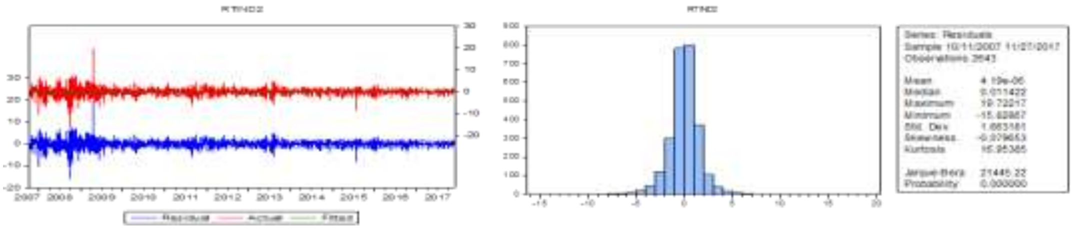


Figure 4.23: FTSE Shariah India Index (IND2)

Dow Jones China Offshore 50 Index (CHN1) which is the conventional index had ARCH effect and has its highest volatility in 2008 – 2009. This implied that it responded to the external shock from the US too. Its skewness is positive (0.092025) and its Kurtosis is fat-tail (11.78524). It also lacks normal distribution as shown in Figures 4.23.

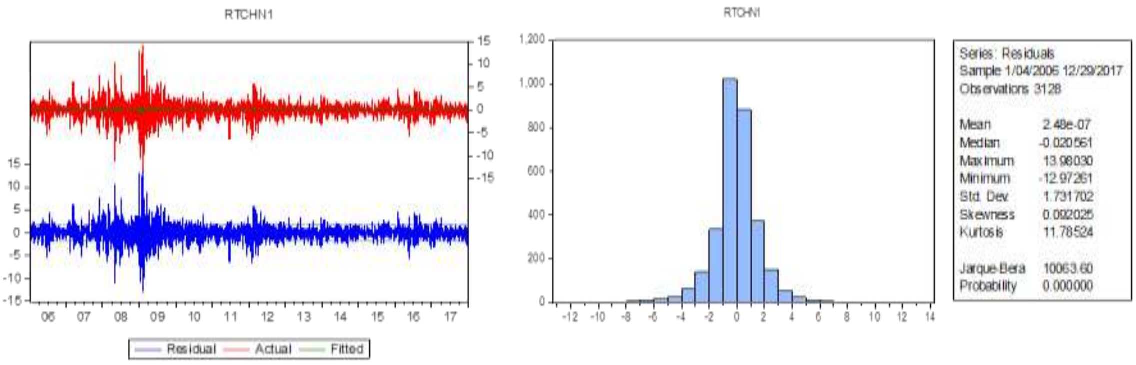


Figure 4.24: Dow Jones China Offshore 50 Index (CHN1)

China Islamic Index Dow Jones Islamic market China/Hong Kong Titans Index (CHN2) is asymmetric in its distribution (-0240798) and fat tailed (11.58155). It is not normally distributed and has ARCH effect like its conventional counterpart as presented in Figures 4.24.

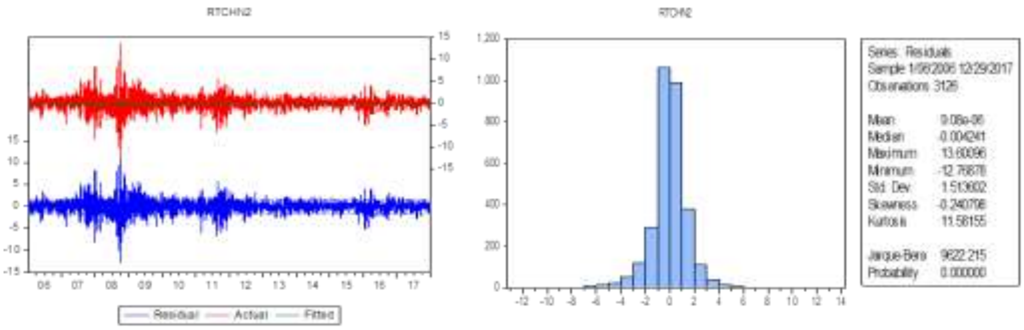


Figure 4.25: Dow Jones Islamic market China/Hong Kong Titans Index (CHN2)

Figures 4.25 indicated that the Conventional FTSE World Taiwan Index USD (TWN1) had ARCH effect with its greatest shocks occurring in 2008 – 2009 in perhaps in response to the US shocks. Its negatively skewed and fat-tail. The residuals were not normally distributed. This justifies modeling it using the ARCH and GARCH family models like the rest of the stocks.

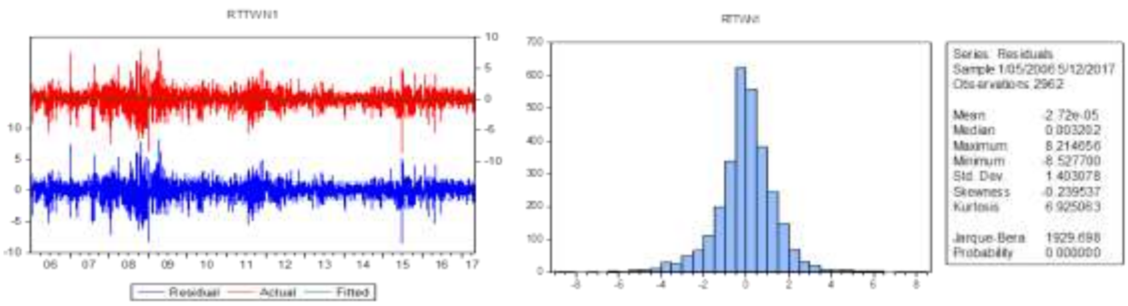


Figure 4.26: Conventional FTSE World Taiwan Index USD (TWN1)

FTSE Shariah Taiwan index (TWN2) shows ARCH effect and normal distribution. It also shows big swings at the tail end of 2008 and midway through 2009. Its fat- tail

(5.759620) and negatively skewed (-0.099293) as shown in Figures 4.26.

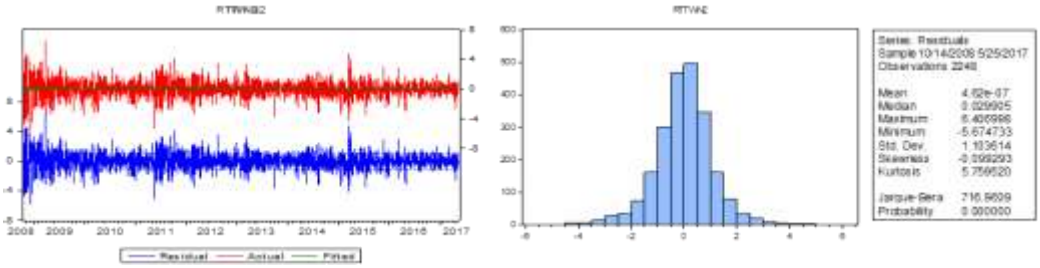


Figure 4.27: FTSE Shariah Taiwan index (TWN2)

The conventional FTSE DIFX Qatar 10 Index (QTR1) responded profoundly to US external shock of 2008 – 2009 and clearly shows volatility clustering. Its residuals have a negative distribution with a fat-tail and not normally distributed as depicted in Figures 4.27. The literature suggest that series that exhibits these features should be modeled using the ARCH family models.

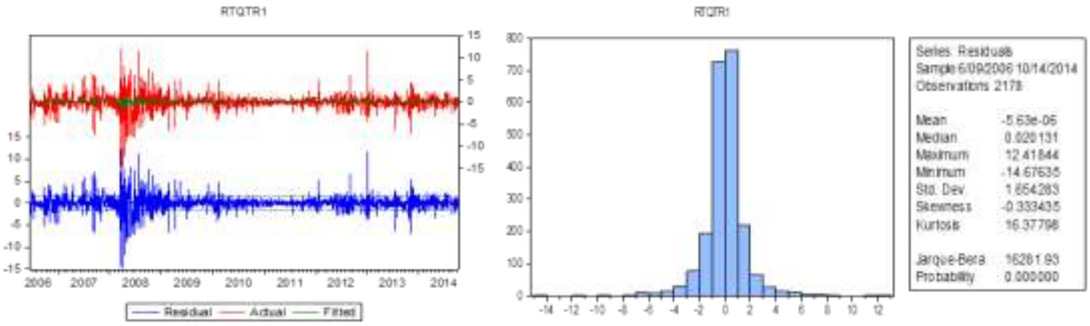


Figure 4.28: conventional FTSE DIFX Qatar 10 Index (QTR1)

FTSE DIFA Qatar 10 Sharia Index (QTR2) showed similar residual pattern as the FTSE conventional. It has ARCH effect with highest volatility in 2008 – 2009. The distribution of the residuals is fat-tailed and negatively skewed. It lacks normal distribution suggesting the suitability of ARCH model as presented in Figures 4.28.

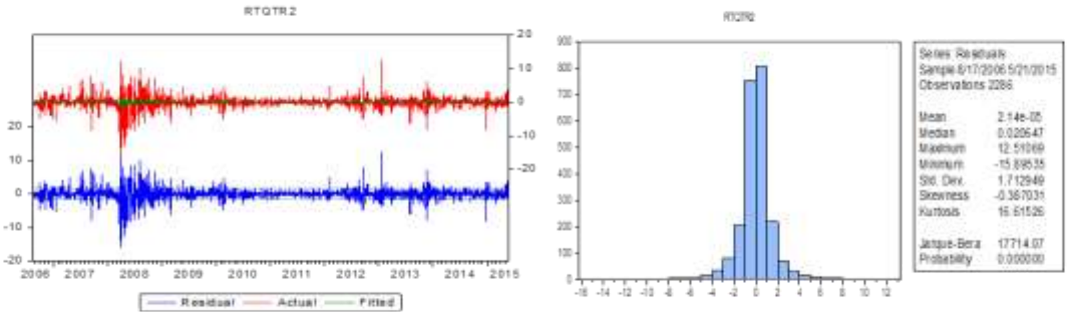


Figure 4.29: FTSE DIFA Qatar 10 Sharia Index (QTR2)

Brooks (2014:435) observed that even if the conditional normality assumption does not hold, the parameter estimates will still be consistent if the equations for the mean and variance were correctly specified. However, the usual standard error estimates will be inappropriate, and therefore he suggested the maximum likelihood due to Bollerslev and Wooldridge (1992) known as quasi-maximum likelihood (QML).

Table 4.11 gives a summary of the heteroscedasticity tests conducted on each of the returns of the conventional and Islamic indices. As presented earlier it’s only FTSE DIFX Kuwait 15 Index (rtkwt2) that doesn’t show ARCH effect. However, statistically it’s clear from the chart that it does have some volatility clustering though fairly more stable than its conventional counterpart. Nevertheless, since it is fat tail and leptokurtic it could be reasonably assumed that it has ARCH effect especially that the index is not normally distributed.

Table 4.11: Heteroscedasticity Test

Country	Stock Returns	F-statistic*	Obs R squared*
US	US1	218.0814	676.4357
		[0.0000]	[0.0000]
	US2	43.42313	164.7884
		[0.0000]	[0.0000]
EU	EU1	57.35011	212.7000
		[0.0000]	[0.0000]
	EU2	57.35011	212.7000
		[0.0000]	[0.0000]
Canada	CA1	62.54209	231.9641
		[0.0000]	[0.0000]
	CA2	60.55526	225.1261
		[0.0000]	[0.0000]
Japan	JP1	61.98282	230.0372
		[0.0000]	[0.0000]
	JP2	32.17547	123.7982
		[0.0000]	[0.0000]
Kuwait	KWT1	13.04387	51.09599
		[0.0000]	[0.0000]
	KWT2	0.297825	1.193510
		[0.8795]	[0.8792]
Malaysia	MLY1	14.27066	56.14600
		[0.0000]	[0.0000]
	MLY2	10.89751	42.95420
		[0.0000]	[0.0000]
Turkey	TKY1	45.18183	171.0822
		[0.0000]	[0.0000]
	TKY2	31.00227	119.4555
		[0.0000]	[0.0000]
India	IND1	10.20781	40.09376
		[0.0000]	[0.0000]
	IND2	16.39586	64.11108
		[0.0000]	[0.0000]
China	CHN1	86.31499	311.3387
		[0.0000]	[0.0000]
	CHN2	93.35188	333.9836
		[0.0000]	[0.0000]
Taiwan	TWN1	37.85215	144.2656
		[0.0000]	[0.0000]
	TWN2	23.20085	89.30743
		[0.0000]	[0.0000]
Qatar	QTR1	9.230426	36.38717
		[0.0000]	[0.0000]
	QTR2	10.15211	39.98426
		[0.0000]	[0.0000]

Source: Authors' computation using Eviews 9

4.7 Results for Selecting the Best Model

The best model for each of the indices was selected based on maximum likelihood (LLF) and Schwarz criterion. This is because once a model is no longer of the usual linear form the OLS model cannot be used for its estimation. OLS only minimizes the Residual Sum of Squares (RSS) and the RSS depends only on the parameters in the conditional mean equation and not the conditional variance. The use of Maximum likelihood seeks to find the most likely values of the parameters given the actual data. Therefore as suggested by Brooks (2014) the study selected the model that maximizes the LLF and minimizes the SIC. By default, ARCH models in EViews are estimated by the method of maximum likelihood under the assumption that the errors are conditionally normally distributed. But from the results of the diagnostic tests it was clear that the residuals of the stock returns were not normally distributed, therefore, student's t was used instead. When we previously estimated GARCH(1,1) model with the data, the standardized residual showed evidence of excess kurtosis. To model the thick tail in the residuals, we assumed that the errors follow a Student's *t*-distribution. The model was then tested for serial correlation in the conditional mean and conditional variance using correlogram test. Table 4.12 presents the correlogram of standardized residuals for the conditional means and the correlogram of standardized residuals squared for the conditional variance. The 4^{th} and the 8^{th} probabilities of the correlogram were reported as is the usual practice.

Table 4.12: Selecting the Best Model

Stock Returns	Arch Student-*t*	Garch Student-*t*	TGARCH Student-*t*	EGARCH Student-*t*	Corr Std resid(EGARCH) Q(4)&Q(8)	Corr. Std resid sqr(EGARCH) Q(4)&Q(8)
US1	{- 3999.45}	{-3726.522}	{-3677.181}	{-3672.895}	{0.065}	{ 0.0000}
	[2.684104]	[2.504698]	[2.474452]	[2.471593]	{0.017)	{0.0000)
US2	{-5163.851}	{-4929.503}	{-4901.415}	{-4886.569}	{0.035}	{ 0.000}
	[3.319254]	[3.171893]	[3.156497]	[3.146999]	[0.119]	{0.000)
EU1	{-4620.881}	{-4377.750}	{-4316.932}	{-4306.782}	{0.359}	{0.339}
	[3.245813]	[3.078691]	[3.038972]	[3.031879]	[0.054]	[0.714]
EU2	{-4620.881}	{-4377.750}	{-4316.932}	{-4306.782}	{0.612}	{0.330}
	[3.245813]	[3.078691]	[3.038972]	[3.031879]	[0.787]	[0.656]
CA1	{-5085.223}	{-4798.715}	{-4779.673}	{-4777.444}	{0.657}	{0.097}
	[3.266859]	[3.086243]	[3.076640]	[3.075215]	[0.275]	[0.156]
CA2	{-5715.903}	{-5462.115}	{-5451.345}	{-5449.346}	{0.422}	{0.303}
	[3.670107]	[3.510411]	[3.506098]	[3.504820]	[0.235]	[0.218]
JP1	{-5086.418}	{-4800.267}	{-4780.773}	{-4778.697}	{0.635}	{0.101}
	[3.268667]	[3.088222]	[3.078327]	[3.076999]	[0.244]	[0.144]
JP2	{-4763.301}	{-4599.908}	{-4592.270}	{-4575.452}	{0.070}	{0.389}
	[3.062004]	[2.960074]	[2.957762]	[2.947006]	[0.296]	[0.750]
KWT1*	{-3577.965}	{-3449.391}	{-3443.786}	{-3444.206}	{0.0000}	{0.185}
	[3.219583]	[3.108079]	[3.106516]	[3.106891]	[0.0000]	[0.132]
KWT2	{-3492.746}	{-3402.822}	{-3401.644}	{-3392.789}	{0.001}	{0.895}
	[3.414896]	[3.331255]	[3.333816]	[3.325215]	[0.000]	[0.992]
MLY1	{-3826.968}	{-3678.952}	{-3674.930}	{-3670.650}	{0.127}	{0.733}
	[2.463923]	[2.371797]	[2.371798]	[2.369060]	[0.325]	[0.308]
MLY2	{-3298.106}	{-3150.113}	{-3145.339}	{-3142.157}	{0.090}	{0.433}
	[2.544396]	[2.434048]	[2.433404]	[2.430966]	[0.461]	[0.788]
TKY1	{-6712.519}	{-6582.236}	{-6568.477}	{-6565.547}	{0.384}	{0.065}
	[4.316986]	[4.236076]	[4.229837]	[4.227960]	[0.623]	[0.249]
TKY2*	{-4992.868}	{-4874.784}	{-4865.167}	{-4865.525}	{0.037}	{0.0000}
	3.209860 []	[3.136884]	[3.133306]	[3.133535]	[0.102]	[0.0000]
IND1*	{-3143.194}	{-3103.760}	{-3092.612}	{-3093.064}	{0.080}	{0.801}
	[3.243774]	[3.207252]	[3.199711]	[3.200175]	[0.210]	[0.960]
IND2	{-4661.381}	{-4491.714}	{-4473.097}	{-4470.270}	{0.556}	{0.837}
	[3.546570]	[3.421114]	[3.410003]	[3.407863]	[0.488]	[0.898]
CHN1*	{-5624.310}	{-5377.628}	{-5366.487}	{-5369.202}	{0.193}	{0.291}
	[3.612698]	[3.457496]	[3.452944]	[3.454681]	[0.319]	[0.018]
CHN2*	{-5198.687}	{-4933.053}	{-4927.333}	{-4928.425}	{0.120}	{0.001}
	[3.342611]	[3.175179]	[3.174094]	[3.174793]	[0.276]	[0.003]
TWN1	{-4943.014}	{-4787.829}	{-4775.548}	{-4774.058}	{0.063}	{0.006}
	[3.354944]	[3.252824]	[3.247228]	[3.246222]	[0.010]	[0.048]
TWN2*	{-3280.397}	{-3188.076}	{-3177.403}	{-3177.852}	{0.087}	{0.072}
	[2.940408]	[2.861670]	[2.855605]	[2.856005]	[0.100]	[0.149]
QTR1*	{-3508.862}	{-3389.849}	{-3381.175}	{-3381.647}	{0.089}	{0.614}
	[3.244758]	[3.138952]	[3.134514]	[3.134947]	[0.099]	[0.012]
QTR2*	{-3775.396}	{-3650.698}	{-3638.880}	{-3641.337}	{0.018}	{0.710}
	[3.324812]	[3.219053]	[3.212093]	[3.214243]	[0.099]	[0.571]

Values in { } are coefficients and [ ] corresponding p-Values

Out of the 22 stock indices sampled, 14 had EGARCH as their best fitted model that maximizes LLF and minimizes SIC these were US1, US2, EU1, EU2, CA1, CA2, JP1, JP2, KWT2, MLY1, MLY2, TKY1, IND2, and TWN1. The TARCH model was best fitted for 8 indices which are KWT1, TKY2, IND1, CHN1, CHN2, TWN2, QTR1 and QTR2. After the estimations almost all the time series had no serial correlation except US1 and TKY2 that showed some serial correlation of the conditional variances.

Form the estimated ARCH family models it's clear that the EGARCH model had the best mechanism for capturing heteroscedasticity and asymmetry associated with financial time series since it yielded parameters that were more robust compared with ARCH, GARCH and the TARCH models. The TARCH model is the second best in capturing the stylized nature of the financial time series selected in this study.

Table 4.13 presents the parameter estimates of the coefficients of the selected best fitted asymmetry models.

Table 4.13: Parameter Estimates of the Best Fitted Asymmetric Models

Stock Returns	**Best Model**	**Variance equation**			
		INTERCEPT	**ARCH** (α)	**ASYM** (γ)	**GARCH** (β)
US1	EGARCH	{-0.142527} [0.0000]	{0.176554 } [0.0000]	{-0.143345} [0.0000]	{ 0.979043} [0.0000]
US2	EGARCH	{-0.088544} [0.0000]	{0.118926} [0.0000]	{-0.093424} [0.0000]	{0.986703} [0.0000]
EU1	EGARCH	{-0.103243} [0.0000]	{0.135602} [0.0000]	{-0.148769} [0.0000]	{0.982821} [0.0000]
EU2	EGARCH	{-0.103243} [0.0000]	{0.135602} [0.0000]	{-0.148769} [0.0000]	{0.982821} [0.0000]
CA1	EGARCH	{-0.082504} [0.0000]	{0.109060} [0.0000]	{-0.072021} [0.0000]	{0.993732} [0.0000]
CA2	EGARCH	{-0.080912} [0.0000]	{0.112084} [0.0000]	{-0.058506} [0.0000]	{0.993974} [0.0000]
JP1	EGARCH	{-0.082135} [0.0000]	{0.108389} [0.0000]	{-0.072810} [0.0000]	{0.993799} [0.0000]
JP2	EGARCH	{-0.075299} [0.0000]	{0.103185} [0.0000]	{-0.063992} [0.0000]	{0.989788} [0.0000]
KWT1	TARCH*	{{0.041487} [0.0000]	{0.070691} [0.0000]	{0.072763} [0.0000]	{0.874324} [0.0000]
KWT2	EGARCH	{-0.175832} [0.0000]	{0.270123} [0.0000]	{-0.043906} [0.0105]	{0.965224} [0.0000]
MLY1	EGARCH	{-0.125259} [0.0000]	{0.170819} [0.0000]	{-0.052220} [0.0000]	{0.982512} [0.0000]
MLY2	EGARCH	{-0.075980} [0.0000]	{0.097938} [0.0000]	{-0.039516} [0.0000]	{0.992137} [0.0000]
TKY1	EGARCH	{-0.066426} [0.0000]	{0.143177} [0.0000]	{-0.081568} [0.0000]	{0.970972} [0.0000]
TKY2	TARCH*	{0.062990}	{0.053806}	{0.099331}	{0.868153}

		[0.0000]	[0.0000]	[0.0000]	[0.0000]
IND1	TARCH*	{0.106275} [0.0000]	{0.018862} [0.0000]	{0.115182} [0.0000]	{0.853739} [0.0000]
IND2	EGARCH	{-0.100629} [0.0000]	{0.144588} [0.0000]	{-0.083267} [0.0000]	{0.984587} [0.0000]
CHN1	TARCH*	{0.016128} [0.0000]	{0.027410} [0.0000]	{0.060928} [0.0000]	{0.937347} [0.0000]
CHN2	TARCH*	{0.012632} [0.0010]	{0.037263} [0.0007]	{0.047239} [0.0005]	{0.933925} [0.0000]
TWN1	EGARCH	{-0.055864} [0.0000]	{0.078642} [0.0000]	{-0.045823} [0.0000]	{0.993203} [0.0000]
TWN2	TARCH*	{0.008963} [0.0000]	{0.003266} [0.0000]	{0.053083} [0.0000]	{0.959895} [0.0000]
QTR1	TARCH*	{0.042846} [0.0001]	{0.096863} [0.0000]	{0.131638} [0.0003]	{0.845329} [0.0000]
QTR2	TARCH*	{0.050499} [0.0000]	{0.071729} [0.0002]	{0.136629} [0.0000]	{0.860437} [0.0000]

Values in { } are coefficients and [ ] corresponding p-Values

Table 4.13 revealed that all the coefficients were significant. The ARCH parameters correspond to α, the GARCH parameters to β and the asymmetric EGARCH/TARCH to γ This implies that volatility in the previous period, the asymmetric term and the lagged conditional variance had significant impact on the conditional variances or stock returns volatility. In other words, these models were good in capturing volatility clustering often seen in financial returns data, where large changes in returns are likely to be followed by further large changes. Similarly, almost all the coefficients of the leverage effect terms were negative, they were nevertheless, highly statistically significant. This finding confirms that bad news had greater impact than good news on the conditional variance of the indices. Another discovery that could be discerned from the results is that, the GARCH term which represents volatility persistence is by far higher than the ARCH term that represents volatility reaction to external shocks. In all the results the sum of the ARCH and GARCH coefficients ($\alpha + \beta$) were greater than one, indicating that the series were highly volatile. This result is often observed in high frequency financial data.

For the conditional variance of the US conventional index (US1) both the ARCH (0.176554) and GARCH (0.979043) coefficients were highly statistically significant. Also the sum of the lagged squared residual and the lagged conditional variance was greater than unity around (1.16) which implies that it's an explosive series. This means that shocks to the conditional variance will be highly persistent. The intercept term 'C' is small and negative (-0.142527). The asymmetric term was also highly statistically significant but negative (-0.143345). The ARCH and GARCH parameters of the Islamic index of US (US2) were also statistically significant given as (0.118926) and (0.986703). Their combine sum was also explosive (1.11) like its conventional counterpart, meaning that, the volatility of its conditional variance is highly responsive and persistent. Its symmetric term shows evidence of leverage effect (--0.093424) though the coefficient is very low. This could imply that US2 respond slowly to market information.

The conventional index of Europe (EU1) is a highly explosive series as the summation of its ARCH and GARCH coefficients were greater than unity (1.12). Its ARCH and GARCH terms were highly statistically significant. This implies shocks to the conditional variance will be highly persistent. The EGARCH term (-0.14876) was highly significant though its negative sign imply that bad news affects the volatility of the conditional variance more than good news which is in line with theoretical postulation. The ARCH and GARCH coefficients of Islamic index of Europe (EU2) were highly statistically significant and also have strong leverage effect. Its conditional variance was highly persistent to external shocks.

The ARCH (0.109060) and GARCH (0.993732) terms of conventional Canada Index (CA1) was highly statistically significant. Since the sum of the ARCH and GARCH terms is greater than unity it could be concluded that the time series is highly responsive and persistent to shocks. Though its asymmetric term was statistically significant ({-0.072021) but its low magnitude suggests it respond slowly to market information. The EGARCH coefficient of Islamic index of Canada (CA2) was highly statistically significant meaning that there is strong leverage effect in the conditional variance. The coefficients of the lagged residual (0.112084) and the lagged conditional variance (0.993974) were also highly statistically significant imply that it has a persistent shock.

The conditional variance of the conventional index of Japan (JP1) has very high statistically significant values for its ARCH (0.108389) and GARCH (0.993799) terms. This shows that it has strong volatility reaction to market shocks and persistence. The EGARCH coefficient (-0.072810) shows leverage effect implying that market information has strong impact on the volatility of the conditional variance. Similarly the ARCH and GARCH parameters for the conditional variance of Islamic index of Japan (JP) were highly statistically significant. This implies that the conditional variance is highly persistent to shocks. The asymmetric term (-0.063992 was also highly statistically significant implying leverage effect.

The Kuwait conventional index (Kwt1) was estimated using TARCH model. The asymmetric term shows leverage effect (0.072763). The GARCH (0.965224) and ARCH (0.270123) coefficients were highly statistically significant which implies persistent to volatility shocks. The conditional variance of the Islamic index of Kuwait (Kwt2) was highly persistent as indicated by the ARCH and GARCH terms. Its EGARCH coefficient revealed very low leverage though significant.

The ARCH (0.170819) and GARCH (0.982512) coefficients for conventional Malaysia (MLY1) were highly statistically significant. This shows strong volatility reaction to market and persistence. Though it's asymmetric term (-0.052220) was very low but it was highly statistically significant. Its leverage is stronger for bad news than for good news. The conditional variance of the Islamic index of Malaysia (MLY2) has very strong ARCH (0.097938) and GARCH (0.992137) effects. Its volatility is persistent. The EGARCH (-0.039516) parameter shows highly significant leverage.

The conditional variance of conventional stock of Turkey (TKY1) has highly statistically significant leverage effect though of low magnitude (-0.081568). As it appears bad news has greater impact on the volatility of the conditional variance than good news. The coefficients of the ARCH (0.143177) and GARCH (0.970972) were highly statistically significant which implies strong persistence and volatility reaction to market shocks. The Islamic index of Turkey (TKY2) was specified with TARCH model. Like its conventional counterpart it also has highly statistically significant ARCH (0.053806) and GARCH (0.868153) coefficients. There is evidence of leverage effect from its asymmetric term.

The conventional index of India (IND1) has very strong volatility reaction to market shocks and persistence resulting from its ARCH and GARCH terms. It also shows highly statistically significant leverage (0.115182). The Islamic index of India (IND2) has statistically significant ARCH (0.144588) and GARCH (0.984587) as well as leverage asymmetric term, The conventional index of China (CHN1) is a highly explosive series as the summation of its ARCH and GARCH coefficients were close to unity (0.96). Its ARCH and GARCH terms were highly statistically significant. This implies shocks to the conditional variance will be highly persistent. The EGARCH term (0.060928) was highly significant and positive imply strong evidence of leverage effect. The ARCH (0.037263) and GARCH coefficients of Islamic index of China (CHN2) were highly statistically significant and also have strong leverage effect. Its conditional variance was highly persistent to external shocks.

The ARCH (0.078642) and GARCH (0.993203) terms of conventional Taiwan Index (TWN1) was highly statistically significant. Since the sum of the ARCH and GARCH terms is very close to unity it could be concluded that the time series is highly responsive and persistent to shocks. Though its asymmetric term was statistically significant (-0.045823) but its low magnitude suggests it respond slowly to market information. The EGARCH coefficient of Islamic index of Taiwan (TWN2) was highly statistically significant meaning that there is strong leverage effect in the conditional variance. The coefficients of the lagged residual (0.003266) and the lagged conditional variance (0.959895) were also highly statistically significant imply that it has a persistent shock (see Table 4.12).

The conditional variance of the conventional index of Qatar (QTR1) has very high statistically significant values for its ARCH (0.096863) and GARCH (0.845329) terms. This shows that it has strong volatility reaction to market shocks and persistence. The TARCH coefficient (0.131638) shows leverage effect implying that market information has strong impact on the volatility of the conditional variance. Similarly the ARCH (0.071729) and GARCH (0.860437) parameters for the conditional variance of Islamic index of Qatar (QTR2) were highly statistically significant. This implies that the conditional variance is highly persistent to shocks. The asymmetric term (0.136629) was also highly statistically significant implying leverage effect.

Koutmos (1996), Koutmos and Booth (1995), and Booth, Martikainen and Tse (1997) reported similar results in their studies.

Table 4.14 gives a summary of the results obtained on volatility reaction to market, volatility persistence and the asymmetric (leverage effect) property of the conventional and Islamic stock indices.

Table 4.14: Volatility Persistence and Conditional Volatility Reaction to Market Shock

Stock Returns	Volatility Reaction to Market Shocks	Volatility Persistence	Asymmetric Property
	Ranking	**Ranking**	
US1	Low	High	Leverage effect exist
US2	Low	High	Leverage effect exist
EU1	Low	High	Leverage effect exist
EU2	Low	High	Leverage effect exist
CA1	Low	High	Leverage effect exist
CA2	Low	High	Leverage effect exist
JP1	Low	High	Leverage effect exist
JP2	Low	High	Leverage effect exist
KWT1	Low	High	Leverage effect exist
KWT2	Low	High	Leverage effect exist
MLY1	Low	High	Leverage effect exist
MLY2	Low	High	Leverage effect exist
TKY1	Low	High	Leverage effect exist
TKY2	Low	High	Leverage effect exist
IND1	Low	High	Leverage effect exist
IND2	Low	High	Leverage effect exist
CHN1	Low	High	Leverage effect exist
CHN2	Low	High	Leverage effect exist
TWN1	Low	High	Leverage effect exist
TWN2	Low	High	Leverage effect exist
QTR1	Low	High	Leverage effect exist
QTR2	Low	High	Leverage effect exist

4.8 Results of US Macroeconomic Variables

The literature on stocks market suggests that the volatility in stock indices is largely affected by underlying macroeconomic factors. In this section therefore, the results of the estimation of some selected macroeconomic variables on the conditional variances of the cross country stock indices is presented. The macroeconomic variables comprises of economic uncertainty index, federal funds rate, money supply, volatility fear index, consumer price index, Treasury bill and Brent oil price.

Table 4.15: Regression Results of Macroeconomic Variables

Variables	USI	US2	EU1	EU2	CA1	CA2
ARCH	0.184823 {0.0000}	0.089439 {0.0000}	0.102607 {0.0000}	0.939650 {0.1091}	0.068994 {0.0000}	0.061557 {0.0000}
GARCH	0.844659 {0.0000}	0.896764 {0.0000}	0.891625 {0.0000}	0.633353 {0.0000}	0.927615 {0.0000}	0.936290 {0.0000}
Dlog(eui)	-0.002544 {0.9499}	-0.024539 {0.6939}	-0.032857 {0.5470}	0.034838 {0.8331}	-0.074749 {0.1560}	-0.059671 {0.4828}
Dlog(ffr)	-0.048717 {0.8226}	-0.242810 {0.4105}	0.167666 {0.5429}	-0.443928 {0.7140}	-0.137721 {0.4313}	-0.009157 {0.9725}
Dlog(m2)	5.755797 {0.6926}	0.543249 {0.9794}	-6.309944 {0.7152}	135.0499 {0.4001}	1.931537 {0.8876}	2.512036 {0.9002}
Dlog(vfi)	0.258910 {0.1846}	0.041816 {0.8732}	0.017820 {0.9078}	-0.365731 {0.0982}	0.199632 {0.2571}	0.107816 {0.7157}
Dlog(cpi)	33.94814 {0.0000}	21.93973 {0.2341}	16.10389 {0.3322}	-168.5963 {0.0910}	-0.898624 {0.9518}	12.85400 {0.5868}
D(tb)	-1.051788 {0.0046}	-0.057964 {0.9371}	-0.901080 {0.1103}	-0.624499 {0.8583}	-0.962937 {0.0561}	-1.299691 {0.0763}
Dlog(oil)	0.901075 {0.0840}	-0.851014 {0.2235}	0.001515 {0.9982}	6.685324 {0.2103}	0.499560 {0.2110}	0.213895 {0.7386}

Values in { } are coefficients and [ ] corresponding p-Values

The regression results in Table 4.15 shows that both the ARCH and GARCH terms were highly statistically significant at 5 per cent for Dow Jones Industrial Average (US1) and CPI with the p-value {0.0000} had the highest impact on its volatility followed by Treasury Bill {0.0046} the proxy for risk free interest. Price of oil {0.0840} also had higher impact than the rest of the other macroeconomic variables who were largely statistically insignificant at 5 per cent given their probability values. For Dow Jones Islamic Market small cap index (US2) the ARCH and GARCH terms were highly statistically significant at 5 per cent whereas all the macroeconomic variables were found not significant in determining the volatility of its conditional variance.

In Europe the FTSE/ATHEX Top 20 Index (EU1) has highly statistically significant ARCH and GARCH terms at 5 per cent indicating persistent shocks. But none of the macroeconomic variables were found to be significant in determining its conditional variance. Dow Jones Islamic Market Europe Index (EU2) had two macroeconomic variables that were statistically significant: volatility fear index (VFI) - {0.0982} and consumer price index (CPI) proxy for inflation - {0.0910}. Though it's ARCH term was not significant, its GARCH term was, indicating persistent to shocks. Dow Jones Canada Index (CA1) was highly persistent to volatility shocks given its ARCH and GARCH coefficients. Amongst the seven macroeconomic variables only T-Bill {0.0561} was statistically significant in determining its volatility. Dow Jones Islamic Market Canada Index (CA2) has similar behavior like its conventional counterpart as only T-Bill was significant in affecting its volatility with the p-value {0.0763}.

Table 4.16: Regression Results of Macroeconomic Variables

Variables	JP1	JP2	KWT1	KWT2	MLY1	MLY2	TKY1	TKY2
ARCH	0.068854 {0.0000}	0.086912 {0.0802}	0.111159 {0.0000}	0.327795 {0.2292}	0.086542 {0.0000}	0.061120 {0.0000}	0.050713 {0.0000}	0.106142 {0.0000}
GARCH	0.929313 {0.0000}	0.586857 {0.0000}	0.871289 {0.0000}	0.586925 {0.0000}	0.903378 {0.0000}	0.929018 {0.0000}	0.935820 {0.0000}	0.868830 {0.0000}
Dlog(eui)	-0.116254 {0.0273}	-0.062786 {0.8305}	-0.067647 {0.4849}	-0.030635 {0.9618}	-0.051662 {0.1558}	-0.006769 {0.8848}	0.400979 {0.0887}	0.016055 {0.8589}
Dlog(ffr)	-0.229766 {0.2333}	0.298762 {0.7938}	-0.168700 {0.6490}	-2.827760 {0.5400}	-0.004174 {0.9773}	0.029762 {0.8175}	0.442563 {0.6278}	0.236784 {0.5137}
Dlog(m2)	9.009855 {0.5139}	-297.1630 {0.0602}	2.812534 {0.9061}	-97.66801 {0.8238}	-4.455712 {0.6586}	5.626703 {0.5026}	-12.94811 {0.7988}	-21.79403 {0.2420}
Dlog(vfi)	-0.007755 {0.9527}	-0.717765 {0.0007}	-0.201890 {0.4034}	-0.181710 {60.912}	0.115352 {0.4046}	0.080063 {0.6250}	1.230259 {0.1433}	-0.238720 {0.0000}
Dlog(cpi)	-13.37831 {0.3257}	-169.4948 {0.0016}	0.864417 {0.9620}	-416.4303 {0.2332}	8.488521 {0.4118}	5.193324 {0.6554}	75.68557 {0.1940}	13.75351 {0.6075}
D(tb)	-0.753430 {0.0946}	3.299778 {0.0554}	-0.083335 {0.9443}	11.48788 {0.2519}	-0.681449 {0.1110}	-0.066069 {0.9162}	-3.969568 {0.0719}	-1.408404 {0.1486}
Dlog(oil)	-0.257398 {0.5355}	0.770831 {0.8712}	0.156290 {0.8892}	-0.184252 {0.9900}	0.442004 {0.2696}	0.095787 {0.7994}	-0.113098 {0.9544}	0.687444 {0.4204}

Values in { } are coefficients and [ ] corresponding p-Values

The ARCH and GARCH coefficients for Dow Jones Japan Index USD (JP1) were statistically significant but amongst the macroeconomic variables only T-Bill {0.0946} was significant. But for Dow Jones Islamic Market Japan Index (JP2) the macroeconomic variables that were significant were vfi {0.0007}, CPI {0.0016} and tb {0.0554}. For FTSE DIFX Kuwait 15 Index (KWT1) none of the macroeconomic variables were significant though the ARCH and GARCH terms were highly significant. The same result was observed for FTSE DIFX Kuwait 15 (KWT2) Index that is none of the seven macroeconomic variables were significant as presented in Table 4.16.

In Malaysia both Dow Jones Malaysia Index USD (MLY1) and DJ Islamic Market Malaysia Titans 25 Index (MLY2) had none of the macroeconomic variable significant though the ARCH and GARCH terms were highly significant. Dow Jones Turkey Titans 20 Index TRY (TKY1) had very strong ARCH and GARCH coefficients indicating persistence to volatility shocks. T-Bill was found to be significant {0.0719} and also economic uncertainty index {0.0887}. DJ Islamic Market Turkey Index had highly statistically significant volatility fear index (VFI) with the p-value {0.0000}. So also the ARCH and GARCH terms were highly significant which implied persistence to shocks.

Table 4.17: Regression Results of Macroeconomic Variables

Variables	IND1	IND2	CHN1	CHN2	TWN1	TWN2	QTR1	QTR2
ARCH	0.094945 {0.0001}	0.085756 {0.0000}	0.053072 {0.0000}	0.064736 {0.0000}	0.038795 {0.0000}	0.032880 {0.0000}	0.215600 {0.0031}	0.149567 {0.0000}
GARCH	0.577662 {0.0000}	0.913848 {0.0000}	0.942932 {0.0000}	0.931094 {0.0000}	0.953883 {0.0000}	0.955549 {0.0000}	0.433768 {0.0000}	0.848966 {0.0000}
Dlog(eui)	0.136387 {0.3451}	-0.290231 {0.0058}	0.220118 {0.0087}	-0.092408 {0.1335}	-0.109004 {0.1418}	-0.160063 {0.0207}	0.523351 {0.1247}	-0.075347 {0.4949}
Dlog(ffr)	-0.104294 {0.6862}	0.737699 {0.0059}	-0.033478 {0.9046}	0.045597 {0.8263}	-0.163384 {0.5675}	-0.182406 {0.3851}	-1.968698 {0.2084}	-0.093217 {0.8107}
Dlog(m2)	76.39294 {0.3815}	4.451067 {0.8660}	-8.766183 {0.6472}	9.953794 {0.5625}	0.116153 {0.9946}	5.145941 {0.7002}	-513.7964 {0.0060}	-16.69484 {0.4526}
Dlog(vfi)	0.776264 {0.2960}	0.276201 {0.4656}	-0.161160 {0.5235}	0.522385 {0.0231}	1.131640 {0.0009}	-0.461002 {0.0300}	0.690649 {0.4397}	0.214599 {0.21459}
Dlog(cpi)	-139.7641 {0.0000}	95.55322 {0.0070}	-13.82363 {0.5071}	6.817049 {0.7045}	-4.081071 {0.8035}	-13.58964 {0.3424}	-242.7207 {0.0062}	-31.33174 {0.0414}
D(tb)	1.011243 {0.8786}	-1.268958 {0.0005}	-1.159239 {0.1425}	-0.783011 {0.3373}	-1.036281 {0.1121}	-0.364574 {0.6300}	-1.860499 {0.6946}	-2.405189 {0.1358}
Dlog(oil)	-3.827355 {0.1746}	1.166675 {0.1803}	0.035279 {0.9555}	1.640124 {0.0004}	0.461287 {0.5012}	0.146364 {0.7499}	2.692761 {0.7053}	1.031634 {0.4351}

Values in { } are coefficients and [ ] corresponding p-Values

Table 4.17 showed that FTSE All-World India Index GBP (IND1) had highly significant ARCH and GARCH terms though only CPI {0.0000} was highly statistically significant in determining its volatility. But for FTSE Shariah India Index (IND2), T-Bill {0.0005} and CPI {0.0070} were highly statistically significant. The other macroeconomic variables that were significant were FFR {0.0059} and EUI {0.0058}. Dow Jones China

Offshore 50 Index (CHN1) had highly statistically significant ARCH and GARCH terms implying persistence to shocks but amongst the macroeconomic variables only EUI {0.0087}was significant given is p-value. But as for Dow Jones Islamic market China/Hong Kong Titans Index (CHN2) the price of Brent oil (OIL) - {0.0004} was highly statistically significant in determining its volatility. It was also noted that VFI {0.0231} was weakly significant. VFI {0.0009} was highly statistically significant in determining the volatility of FTSE World Taiwan Index USD (TWN1) whereas the other macroeconomic variables were insignificant. In a similar note, VFI {0.0300} was also statistically significant for FTSE Shariah Taiwan index (TWN2) as well as the p-value of economic uncertainty index - EUI {0.0207}. Both indices had highly persistent ARCH and GARCH terms.

FTSE DIFX Qatar 10 Index has highly significant ARCH and GARCH terms indicating strong response to volatility shocks and persistence. Money supply (M2) had the highest impact on its conditional variance given the p-value {0.0060} and then CPI with p-value {0.0062}. The other macroeconomic variables were not statistically significant. CPI {0.0414} was the only variable that was statistically significant for FTSE DIFA Qatar 10 Sharia.

From the foregoing, it could be inferred that most of the partial regression coefficients of the US macroeconomic variables were not statistically significant in determining the conditional variances of the selected conventional and Islamic indices in this study. What appeared to have greater impact on the volatility of the stocks were the lagged squared residuals and the lagged conditional variances depicted in the ARCH and GARCH terms. It was also observed that the seven US macroeconomic variables chosen in this study have varying degrees of impact on each respective stock. This shows that each stock respond differently to the variables. This result is similar to the one obtained by Adaramola (2011), Rad (2011), Herve, et, al, (2011) Zakaria, *et al*. (2012), Alam (2013).

4.9 Results of Risk Measurement

Table 4.18 gives the ARCH in mean results which measures the risk associated with each of the stock indices. An average investor is interested not only in maximizing the return on his or investment, but also in minimizing the risk associated with such investment. The convention is that the higher the variance the higher the risk and the higher the volatility.

Table 4.18 Result of Risk Measurement

Conventional Stock Index				**Islamic Stock Indices**			
Variable	**Coefficient**	**Std. Error**	**Prob**	**Variable**	**Coefficient**	**Std. Error**	**Prob**
US1	0.017694	0.018687	0.3437	US2	0.022256	0.017077	0.1925
EU1	0.025984	0.017105	0.1287	EU2	0.027313	0.016875	0.1055
CA1	0.022039	0.015517	0.1555	CA2	0.021187	0.013234	0.1094
JP1	0.022464	0.015507	0.1474	JP2	0.028223	0.021234	0.1838
KWT1	0.036807	0.019375	0.0575	KWT2	0.002251	0.018623	0.9038
MLY1	0.044738	0.032350	0.1667	MLY2	-0.001775	0.033263	0.9574
TKY1	-0.002655	0.015364	0.8628	TKY2	0.006701	0.023212	0.7728
IND1	0.053693	0.048346	0.2667	IND2	0.014748	0.017321	0.3945
CHN1	0.010397	0.014181	0.4635	CHN2	0.009777	0.015936	0.5395
TWN1	-0.002420	0.022645	0.9149	TWN2	0.058478	0.036976	0.1138
QTR1	0.023486	0.016749	0.1609	QTR2	0.021370	0.016640	0.1990

Source: Computed by authors using Eviews9

As shown in Table 4.18 the variances of the conventional (0.017694) and Islamic (0.022256) indices of US were both statistically insignificant looking at their probability values which were more than 5 per cent. Similarly the coefficients of the conventional index of EU (0.025984) and its Islamic counterpart (0.027313) were not statistically significant. As indicated by the probability values, both the conventional (0.022039) and

Islamic (0.021187) indices of Canada were not statistically significant. Similar results were obtained for Japan, Kuwait, Malaysia, India, China and Qatar were the variance coefficients for the conventional and Islamic indices were found to be statistically insignificant meaning that the risk factors measured by the variances have no impact in investment choices.

There were however, some anomalies in the results which negates a priori expectation in the signs. Negative variances are meaningless because they are computed by taking the squares of the standard deviation. For instance, negative variance was noted for the coefficient of Islamic (-0.001775) index of Malaysia though the conventional (0.044738) index was positive but insignificant. In Turkey its conventional index (-0.002655) was negative which renders it meaningless whereas the Islamic index though positive but insignificant. A similar result was obtained for Taiwan with a negative variance coefficient of conventional index (-0.002420) and a positive but insignificant Islamic index (0.058478).

The results in Table 4.14 show that most of the coefficients of the ARCH in mean results though positive but were not statistically significant. This implies that for these stock indices there were no feedbacks from the conditional variances to the conditional means. In other words, the returns of these stocks indices were not directly affected by the risk factor. It seems that investors in the global markets of conventional and Islamic indices were not derived by risk factors but perhaps by other fundamentals such as macroeconomic variables of the host country or the internal and external factors associated with the companies listed in the index.

4.10 Results of Risk - Adjusted Return Performance

The risk-adjustment return performances of the stock indices were measured using Sharpe Ratio and Treynor Index as presented in Table 4.19.

Table 4.19: Result of Risk - Adjusted Return Performance

CONVENTIONAL INDEX	SHARPE RATIO	TREYNOR INDEX	ISLAMIC INDEX	SHARPE RATIO	TREYNOR INDEX
US1	-47.23	288.42.	US2	-68.65	139.16
EU1	-68.65	-66.01	EU2	-56.52	-49.14
CA1	-68.21	-66.01	CA2	-77.11	640.76
JP1	-44.9	64.18	JP2	-74.03	180.92
KWT1	-106.24	-46.70	KWT2	-102.6	5.83
MLY1	-57.69	-26.29	MLY2	-66.12	-61.52
TKY1	-39.27	0.84	TKY2	-60.19	8.14
IND1	-37.53	-44.37	IND2	-37.58	-33.16
CHN1	-39.25	-29.66	CHN2	-36.16	-20.47
TWN1	-72.51	66.71	TWN2	-73.67	-75.19
QTR1	-44.02	-498.53	QTR2	-42.72	0.83

Source: Computed by authors using Excel

The results of the risk-adjusted returns in Table 4.18 show that the Sharpe ratio for both the conventional and Islamic indices for US had negative values for the period 2006 – 2017. But US conventional Dow Jones was less negative and therefore performed better. Similarly the Treynor index shows that the conventional Dow Jones had higher returns than its Islamic counterpart in the US.

Both the Sharpe ratio and the Treynor index in Kuwait revealed that the Islamic index had better return performance than its conventional counterpart. In Malaysia all the performance ratios were negative though the conventional index was less negative than the Islamic one which is an indication of better performance. In Turkey whereas the Sharpe ratio showed the return performance of the conventional index was better, on the contrary the Treynor index showed that the Islamic index was better. A similar result was obtained for India. In China the return performance of the Islamic index was better as indicated by both ratios which are a similar result for Qatar. On the contrary, in Taiwan the performance of the conventional index was better in both cases.

The results for all indices in Table 4.19 indicates that there is mixed results in the return performances of both conventional and Islamic indices in the selected countries. It was clear that in some countries conventional indices out performed Islamic indices (US, Malaysia and Taiwan) whereas in others Islamic indices were better (EU, Kuwait, China and Qatar). The last category had inconclusive result this was because whereas the Sharpe ratio suggests a better performance of the conventional indices, the Treynor ratio suggests the contrary, that is the Islamic indices performed better (Canada, Japan, Turkey and India). Similar results were obtained by Jawadi, Jawadi & Louhichi (2014) and Ho *et al* (2013).

In summary, with the latest data and the increase in the number of indices in recent years, empirical evidence has indicated that conventional indices may not continue to achieve more superior return performances than other indices. Nevertheless, findings must be interpreted with caution due to the fact that the last decade has experience more crises than previous periods.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter provides summary, conclusion and recommendations as well as policy implications and lessons for Nigeria. It also gives the contribution of the study to knowledge and offers proposal for further research.

5.2 Summary

This thesis used time series to examine the performances of conventional and Islamic indices across eleven selected countries comprising the United States, European Union, Canada, China, India, Japan, Kuwait, Malaysia, Turkey, Taiwan, and Qatar. In each country the financial time series of a pair of the Dow Jones conventional and Islamic index was utilized except where the Dow Jones was not available as in EU, India, Kuwait, Taiwan and Qatar, the FTSE index was used. Apart from having the widest global coverage the Dow Jones and FTSE were the first indices to create Islamic indices as alternative investment portfolios to the conventional ones. Both indices use the Dollar as its basis point with one dollar equivalent to one basis point therefore the US became the country of emphasis. The study made use of the closing stock prices for the period January 2006 to December 2017 which were sourced from the official website of the Wall street Journal. The US macroeconomic variables data were sourced from FRED database of St. Louis Federal Reserve. The US macroeconomic data comprised of Brent oil price, US Economic Uncertainty Index (EPC), Federal Funds Rate (FFR), measure of volatility and fear index, US three months T-bills, US inflation rate, and Broad money supply (M2).

The first objective of the study is to determine the long-run relationship between conventional and Islamic indices, and the US macroeconomic variables. Johansen test for Cointegration and Vector Error Correction Model were used to achieve this. The results of the Johansen Cointegration suggest a long run relationship between the conventional and Islamic indices of the respective countries, the broad market index, represented by Dow Jones Industrial Average (US1) and macroeconomic variables of the US. The results shows that all the Islamic indices were cointegrated or have a long-run association with the Dow Jones Industrial average (broad market index), economic uncertainty index, federal funds rate, money supply, volatility fear index, consumer price index, treasury bill and Brent oil price. In all the cases the null hypothesis was rejected which implies that there was cointegration between the selected stock indices and the US macroeconomic variables. In order words they move in the same direction. Barbic & Condic-Jurkic (2011) are of the view that efficient market hypothesis is confirmed by the presence of cointegration relationship between macroeconomic variables and stock index. This implies that investors in the selected countries could be able to gain above average profit by using information on changes in macroeconomic fundamentals of the US. A similar result was obtained by Barbic & Condic-Jurkic (2011).

However, there is a great possibility that market participants are not in position to use profitably market inefficiencies because of high transaction costs, trading and reporting delays, higher cost of new information as well as pronounced uncertainty that are usually inherent to emerging markets. Finally, conclusions about the possibility of earning above average returns should be made with prudence, as no profitable trading rule was built in this study. The findings from the study showed that the speed of adjustment of the stock returns to equilibrium was slow. This implies that the stock market was highly volatile such that it takes long time for stock prices to equilibrate between positive and negative values.

The second objective is to examine the leverage effect (asymmetry), volatility reaction to the market and volatility persistence amongst conventional and Islamic indices. From the results obtained, it was very clear that all the stock indices had leverage effect (asymmetry). Leverage effect implies a negative correlation between volatilities and asset returns. This suggests that a fall in the price of a firm's stock causes the firm's debt to equity ratio to increase. With the existence of leverage effect amongst all the conventional and Islamic indices it implies that in all the stocks bad news (i.e. decrease in stock prices) seems to have a greater influence on the stock prices than good news (i.e., increase in stock price). When a huge decline in an equity price is not matched by a decline in the value of debt, the firm's debt to equity ratio will increase alongside with the financial risk of the firm's investors. Due to the higher risk, investors would expect the volatility of the stock return to rise also. Koutmos (1996), Koutmos and Booth (1995), and Booth, Martikainen & Tse (1997) reported similar result in their studies. The finding was contrary to the empirical expectation. It was expected that since Islamic indices screen high debt to equity ratio firms then they should minimize the leverage effect compared to their conventional counterparts who do not have any screening act against debt to equity ratio. This is because a company having a higher than the benchmark debt to equity ratio is excluded from the Islamic indices.

It was further reported that all the conventional and Islamic indices had low volatility reaction to market shocks as obtained from the coefficients of the ARCH terms but had very high volatility persistence as indicated by the GARCH terms. This implies that the conditional variances of the stocks were highly affected by the volatility persistence of shocks in the markets. By implication high volatility persistence leads to higher risk and probably higher returns to investors.

The third objective is to determine the effect of macroeconomic variables on the volatility of the conventional and Islamic indices. Most of the US macroeconomic variables were not statistically significant in determining the conditional variances of the selected conventional and Islamic indices in this study. What appeared to have greater impact on the volatility of the stocks were the lagged squared residuals and the lagged conditional variances depicted in the ARCH and GARCH terms. It was also observed that the seven US macroeconomic variables chosen in this study have varying degrees of impact on each respective stock. This shows that each stock respond differently to the variables. This result is similar to the ones obtained by Adaramola (2011), Rad (2011), Herve, et, al, (2011) Zakaria, *et al*. (2012), Alam (2013).

The fourth objective of the thesis was to examine the risk-adjusted return performance of Islamic and conventional stock indices. This was achieved through employing performance indicators of Sharpe ratio and Treynor index. The results for all indices indicates that there was mixed results in the return performances of both the conventional and Islamic indices in the selected countries. It was clear that in some instances conventional indices out performed Islamic indices and in others the reverse was the case. In summary, with the latest data and the increase in the number of indices in recent years, empirical evidence has indicated that conventional indices may not continue to achieve more superior return performances than other indices. Similar results were obtained by by Jawadi, Jawadi & Louhichi (2014) and Ho *et al* (2013).

5.3 Conclusion

From the summary of findings, it could be concluded that there is a long run relationship between the conventional and Islamic indices of the selected countries and US macroeconomic variables. The presence of leverage effect amongst all the indices suggests that bad news has greater influence on the price of the stocks than good news. When a substantial decline in an equity price is not matched by a decline in the value of debt, the firm's debt to equity ratio will increase alongside with the financial risk of the firm's investors.

However, the impact of the US macroeconomic variables on the volatility of the Dow Jones and FTSE in the selected countries were not statistically significant. This implies that perhaps other factors such as corporate policies and each country's macroeconomic factors may have a greater influence. In terms of risk, most of the coefficients of the ARCH in mean results though positive but were not statistically significant. This implies that for these stock indices there were no feedbacks from the conditional variances to the conditional means. In other words, the returns of these stocks indices were not directly affected by the risk factor. Finally in the risk-adjusted performance there was no clear result as to which index was more risky between the conventional and Islamic indices.

5.4 Recommendations

The study makes the following recommendations based on the findings:

The presence of long-run relationship implies that investors should be concerned with the movements of US macroeconomic variables as the yardstick for the expected returns of Dow Jones and FTSE in US, EU, Canada, China, India, Japan, Kuwait, Malaysia, Turkey, Taiwan, and Qatar.

Due to the low impact of the US macroeconomic variables on the stock returns, it is important for investors to also monitor changes in the monetary and fiscal policies as well as the corporate performances of the firms in each index. These may exact more influence on returns and volatility than the US macro-economic factors.

Thus, investors could reap the benefit of diversification by including both indices in their portfolios. Losses or low returns in one set of indices could be argument by gains or higher returns in the other. Therefore, in line with the Markowitz theory, diversification of investment is a means of hedging risk, it is relevant here for investors to make use of as an investment strategy.

5.5 Policy Implication

The result from this study has four policy implications for the Nigerian Stock Exchange (NSE) as it ushers Islamic equity indices such as NSE Lotus Islamic Index (NSE LII) into its floor.

First the study discovered the existence of a long run association between all the selected Islamic indices and the US macroeconomic indices comprising Dow Jones Industrial average (broad market index), Economic Uncertainty Index, Federal Funds Rate, Money Supply, Volatility Fear Index, Consumer Price Index, Treasury Bill and Brent Oil Price. This implies that shocks from any of these macroeconomic variables could trigger changes in the returns of Islamic indices in Nigeria such as NSE LII.[2]

[2] The NSE LII is the first equity index created by NSE in 2009 to track the performance of selected Shari'ah compliant and high-capped equities listed on its floor. It represent 15 of the leading Sharia certified stocks in the country including highly rated blue-chip companies such as Unilever, Nestle, GlaxoSmithKline and Cadbury who not only serve Nigeria's 170 million population, but the wider West African region. (www.lotuscapitallimited.com, www.islamicfinance.com). Since inception in 2009 the NSE LII has reported impressive performance, outperforming the All Share Index in the face of the recent financial meltdown (http://www.nse.com.ng).

Since stock market investors evaluate the performances of different markets using stock indices in an economy, the performance of Islamic indices such as NSE LII could have implication on investors' expectations on the Nigerian Sukuk (Islamic bond) and Islamic Banking. It is imperative for policy makers in Nigeria to be mindful of the correlation between stock market returns and external macroeconomic variables, especially of the US, in the formulation of its economic policies in order to douse the effect of external shocks on the economy External shocks such as the 2008 Global Financial Crises plunged the Nigerian economy in to recession that had serious implications on output, inflation and unemployment in the country. Zare (2017) stated that economic depressions due to stock market crash are more significant in developing countries than in the developed ones.[3]

Secondly, the study discovered the presence of leverage effect (Asymmetry) in both the conventional and Islamic indices examined for all the countries.[4] In this regard therefore, the NSE and other investors in Nigeria should expect similar volatility behavior and concomitant risk between the conventional and Islamic indices on its floors. This implies bad news (i.e. decrease in stock prices) will tend to have greater impact on the stock prices than good news (i.e., increase in stock price). Aguda (2016) reveals the presence of leverage effect in the Nigerian stock market whereby stock returns volatility increases with bad news but the volatility reduces with good or positive news.

[3] Al Masum (2014) states that in the past two decades many economies in the world experienced volatility (booms and depression); one of the major impacts of such volatility is the volatility in the stock market prices. Even the most successful corporations were not saved off these volatilities in spite of their proven records of excellent performance in terms of both profit (cash) generation and dividends pay-outs.

[4] The current domestic and international literature review shows that there exist various studies show- ing the symmetrical relationship between macroeconomic variables and the stock returns, but the studies showing asymmetrical relationship is limited in international literature (Chen, 2007).

Black (1976) explains that a fall in the price of a firm's stock will lead to a negative return on that stock, and this will increase the leverage (i.e. debt-equity ratio) of the firm. The firm becomes more risky with increased leverage because as the shareholders perceive the stream of their future cash flow to be relatively more risky thereby bringing about further increase in volatility. An investor requires higher return to compensate for the increased risk. An increase in risk premium of the market with increased volatility will lead to large negative returns which in turn will increase the future volatility of stock returns by more than proportionate (Aguda, 2016). In other words, the effect of bad news on the performance of any stock on the floor of the NSE could undermine the confidence and business expectation of existing and potential investors both local and international. This could result in the flight of hot money from the NSE which could jeopardize the capacity of the listed firms to raise capital in the stock market. Further, if a fall in stock price is not offset by a decrease in the value of its debt, the firm's debt to equity ratio will rise as well as its portfolio risk. The NSE should provide more adequate means of information diffusion into the market at zero cost to all participants.

Thirdly, the study observed that the seven US macroeconomic variables selected in this study have varying degrees of impact on each respective stock. This shows that each stock respond differently to the variables. This could probably imply that the robustness of each county's economy play crucial role in its capacity to absorb external shocks. In line with this, Adaramola (2011) asserted that macroeconomic variables have varying significant impact on stock prices of individual firms in Nigeria.[5] For instance, the fact that Nigeria relies on oil as its major means of foreign exchange expose it to greater risk

[5] He concluded that Nigerian stock market is very sensitive to domestic macroeconomic factors. However, the concern of this study is the US macroeconomic factors on global conventional and Islamic stock indices.

of transmission of external shocks in all facets of its economy. Therefore, Nigeria needs to get the fundamentals of its economy right to facilitate competitive business environment.

Kolapo (2018) observed that there is the presence of a long run relationship (co-integration) between macroeconomic fundamentals and stock market performance. This could be achieved through realistic monetary and fiscal policies as well as massive infrastructural development on the side of public sector. Whereas in the private sector there is need for the development of robust banks that have the capacity to provide long term finance and effective cooperate management strategies by companies listed on the stock to enable them compete globally. Investors in the Nigerian stock market should therefore be mindful of the trend of the global macroeconomic variables so that the risk of global economic meltdown as experienced between 2007 and 2009 can be reduced to its barest minimum.

Fourthly, it was clear from the study that in some countries conventional indices outperformed Islamic indices whereas in others the Islamic ones outperformed the conventional ones. This is good news for the NSE, the CBN and other stakeholders in the Nigerian economy. This result implies that both indices are competitive and therefore provide good alternative for diversification of portfolio which is the hallmark of the Markowitz theory. Based on this, it will be prudent for the NSE to create more Islamic indices such as NSE LII to provide investors with a variety of stocks to enrich their portfolios. Markowitz suggests that diversification of investments minimizes risk and increases returns.

5.5 Recommendations for Further Research

Examining the performance of conventional and Islamic indices is an interesting area in financial economics. Many scholars have delved in this area, yet the nature of global dynamics is posing new challenges and emerging issues. Though this study has used multiple econometric techniques to determine the individual performances of 22 selected conventional and Islamic indices across ten countries and the EU region, more could be achieved by employing different methods. For instance, this study employed a linear model; other studies could specify non-linear models and compare the results obtained in this study.

Again the combination of high frequency data and low frequency data may have affected the results even though Eviews 9 has a way of harmonizing this, nevertheless, more robust results could be achieved if data of same frequency could be sourced. Researchers could revisit the results obtained by using more recent data or extend the period beyond the one considered here.

Another possible extension could be considering other sets of macroeconomic variables that could have greater impact on the volatilities and returns of stock indices. Employing such techniques could give better perspectives from the one taken in this study.

Finally there is need for other scholars to source additional information on the macroeconomic peculiarities of each country as this will give greater insight on the response of local stocks to external shocks.

REFERENCES

Abdullah, F., Mohamed, S. & Hassan, T. (2007). Investigation of Performance of Malaysian Islamic Unit Fund Trusts, comparison with conventional unit fund trusts. *Managerial Finance, 33: 142-153.*

Abugri, BA. (2002). Stock Return Volatility in Emerging Market: The Relative Effects Of Country and Global Factors. PhD thesis, University of Texas-Pan American.

Adaramola, A.O. (2011). The Impact of Macroeconomic Indicators on Stock Prices in Nigeria.*Developing Country Studies, 1(2), 1-15*

Aggarwal, R., Inclan, C., and Leal, R. (999). Volatility in Emerging Stock Markets. *The Journal of Financial and Quantitative Analysis, 34(1), 33-55*

Aguda, N.A. (2016). A Test of Asymmetric Volatilityin the Nigerian Stock Exchange. *International Journal of Economics, Finance and Management Sciences 4(5), 263 – 268*

Ahlgren, N., & Antell, J. (2010). Stock market linkages and financial contagion: A cobreaking analysis. *The Quarterly Review of Economics and Finance*, *50*(2), 157-166.

Ahmed, S. (2008). Aggregate Economic Variables and Stock Market in India, *International Research Journal of Finance and Economics, (14), 14-64.*

Ajmi. A.N., Hammoudeh, S., Nguyen, D.K., and Sarafrazi, S. (2014). How Strong Are The Causal Relationships between Islamic Stock Markets and Conventional Financial Systems? Evidence from Linear and Nonlinear Tests. *Journal of International Financial Markets, Institutions & Money28,213– 227*

Aka, J. (2009). Shari'ah Investing: Through Bull and Bear Markets? SEI investments (Middle East), October 2009. Retrieved Dec 4th, 2015 at www.seic.com/ enME/about/Middle East/SEI-Shariah-BullAndBearMarkets.pdf

Akbar, M., Ali, S., and Khan, M. F. (2012). The Relationship of Stock Prices and Macroeconomic Variables revisited: Evidence from Karachi Stock Exchange, *African Journal of Business. Management, 6 (4), 1315-1322*

Al Masum, A. (2014). Dividend Policy and Its Impact on Stock Price – A Study on Commercial Banks Listed in Dhaka Stock Exchange. *Global Disclosure of Economics and Business, 3(1), 9-17.*

Albaity, M.S and Mudor, H. (2012). Return Performnace, Cointegration and Short run Dynamics of Islamic and Non-Islamic Indices: Evidence from the US and Malaysia During the Subprime Crises. Atlantic Review of Economics 1

Albaity, M.S. and Ahmad, R. (2011). Return performance, leverage effect, and volatility spillover in Islamic stock indices evidence from DJIMI, FTSEGII and KLSI. *Investment Management and Financial Innovations, 8(3),161 – 171*

Alexander, C (2001). Market Models: A Guide to Financial Data Analysis. Wiley

Al-Rifai, T. (2012). Why have shari'ah compliant indexes outperformed conventional indexes since the crisis? Business Islamica.

AL-Shubiri, F. N. (2013). Analysis of the relationship between economic forces and abnormal stock return: empirical evidence. *Polish Journal of Management Studies*, *8*.

Altay, E. (2003). *The effect of macroeconomic factors on asset returns: A comparative analysis of the German and the Turkish stock markets in an APT framework*. Universitäts-und Landesbibliothek Sachsen-Anhalt.

Al-Zoubi, H.A and Maghyereh, A.I. (2007). The Relative Risk Performance Of Islamic Finance: A New Guide to Less Risky Investments. *International Journal of Theoretical and Applied Finance, 10(2), 235-249*

Arshad , S .and Raza, S.A.R. (2013). Interactions between Islamic Stock Indices And Business Cycles: Focusing On Asia Pacific.*Australian Journal of Basic and Applied Sciences, 7(9), 1-9*

Arshad, S., & Rizvi, S. A. R. (2013). The impact of global financial shocks to Islamic indices: speculative influence or fundamental changes?. *Journal of Islamic Finance*, *2*(1).

Ata, H. A., & Buğan, M. F. (2015). Comparison of the performances Islamic and conventional market indices and their causal relationship. *International Journal of Business Management and Economic Research (IJBMER)*, *6*(6), 455-62.

Attari, Muhammad and Safdar, Luqman (2013), The Relationship between Macroeconomic Volatility and the Stock Market Volatility: Empirical Evidence from Pakistan. *Pakistan Journal of Commerce and Social Sciences 7 (2), 309-320.*

Barbic, T and Condic-Jurkic, I. (2011). Relationship Between Macroeconomic Fundamentals And Stock Market Indices In Selected Cee Countries. *EKONOMSKI PREGLED, 62 (3-4): 113-133*

Bartram, S. M. & Bodnar, G. M. 2009. No Place to Hide: The Global Crisis in Equity Markets in 2008/09. *Journal of international Money and Finance,8(8), 1246-1292*

Bekaert, G & Wu, G. (2000). Asymmetric volatility and risk in equity markets. *Review of Financial studies, 13(1),1-42.*

Bennett, P., & Kelleher, J. (1988). The international transmission of stock prices disruption in October 1987. *Quarterly Review, 13(Sum), 17-33.*

Black, F. (1976). Studies of stock market volatility changes. 1976 Proceedings of the American Statistical Association Bisiness and Economic Statistics Section.

Bodie, Zvi, Kane, Alex & Marcus, Alan J. (2011). Investments and Portfolio Management, *McGraw-Hill Irwin,* 9th Edition.

Booth, G. G., Martikainen, T., & Tse, Y. (1997). Price and volatility spillovers in Scandinavian stock markets. *Journal of Banking & Finance*, *21*(6), 811-823.

Boujelbene Abbes, M. 2012. Risk and Return of Islamic and Conventional Indices. International *Journal of Euro-Mediterranean Studies, 5(1), 1-23.*

Brahmasrene, T., & Jiranyakul, K. (2007). Cointegration and causality between stock index and macroeconomic variables in an emerging market. Academy of Accounting & Financial Studies Journal, 11(3).

Brandes Institute (2011). Volatility: Implications for Value and Glamour Stocks. Retrieved on 10/06/2016 from www.brandes.com

Brooks, C. (2008). *Introductory Econometrics for Finance* (2nd Ed.), New York: Cambridge University Press.

Burgstaller, J. (2002). *Are stock returns a leading indicator for real macroeconomic developments?* (No. 0207). Working Paper.

Caner, S., & Önder*, Z. (2005). Sources of volatility in stock returns in emerging markets. *Applied Economics*, *37*(8), 929-941.

Case, S. (2009). "Dow Jones Averages." Microsoft Encarta 2009 [DVD]. Redmond, WA: Microsoft Corporation, 2008.

Chapra, M. U. (2008). The Global Financial Crisis: Can Islamic Finance Help Minimize the Severity and Frequency of Such a Crisis In The Future? Paper presented at the Forum on the Global financial Crisis, Islamic Development Bank 25th October, Jeddah.

Charles, A., Pop, A., & Darné, O. (2011). Is the Islamic Finance model more resilient than the conventional finance model? Evidence from sudden changes in the volatility of Dow Jones indexes. In *International Conference of the French Finance Association (AFFI)*. May 11-13, 2011. Available at SSRN: http://ssrn.com/ abstract= 1836751

Chen *et al*. (1986), Economic Forecast And Stock Market, *The Journal Of Business,* (59)3, 383-403.

Clare and Thomas (2015). Financial Market Indices:Facilitating Innovation, Monitoring Markets. CASS Business School London http://www.indexindustry.org/wp-content/uploads/2015/05/Financial-Market-Indices-Facilitation-Innovation-Monitoring-Markets.pdf

Coleman, A.K (2009). Portfolio Theory. Presentation at Regional Course on Optimising Reserves and Foreign Exchange Management for Income Generation organized by WAIFEM, May 11 – 15, Accra, Ghana

Coleman, B. (2021). Definition of Investment Risk.

David, A. (1997). Fluctuating Confidence in Stock Markets: Implications for Returns and Volatility. *Journal of Financial and Quantitative Analysis 32(4), 427-462*

Derigs, U., & Marzban, S. (2008). Review and Analysis of Current Shariah-Compliant Equity Screening Practices. *International Journal of Islamic and Middle Eastern Finance and Management, 1*(4), 285-303.

Dewi, M. K., & Ferdian, I. R. (2009). Islamic finance: A therapy for healing the global financial crisis. *Challenges of Globalising Financial System*.

Dharani, M & Natarajan, P. (2008). Equanimity of Risk and Return Relationship between Shariah Index and General Index in India. *Journal of Economics and Behavioral Studies*, 2(5), 213-22.

Domowitz, I, Glen, J & Madhavan, A (2001). Liquidity, Volatility And Equity Trading Costs Across Countries and Over Time, *International Finance*, 4(2), 221-255.

EL Khamlichi, A., Sakar, A., Arouri, M and Teulon, F. (2014). Are Islamic Equity Indices More Efficient Than Their Conventional Counterparts? Evidence from Major Global Index Families. *The Journal of Applied Business Research 30(4),1137-1150*

EL Mosaid, F and Boutti, R. (2014). Sukuk and Bond Performance in Malaysia. *International Journal of Economics and Finance, 6(2), 226 – 234*

El-Gamal, M. A. (2006). Islamic Finance: Law, Economics and Practice. Cambridge University Press.

Elton, E.J. and Gruber, M.J. (2006). Modern Portfolio Theory and Investment Analysis 5th ED. Replika Press Pvt. Ltd India

Engle, RF & Ng, VK .(1993). Measuring and Testing the Impact of News on Volatility. *Journal of Finance*, 48(5), 1-31.

Fama, E. F. (1981). Stock returns, real activity, inflation, and money. *The American economic review*, *71*(4), 545-565.

Fleifel, B. A. (2009). *Risk management in Islamic banking and finance: The Arab finance house example* (Doctoral dissertation, University of North Carolina Wilmington).

FTSE (2016). FTSE Fact Sheet www.ftse.com/Analytics/.../DownloadSingleIssue?...

Gan, C., Lee, M., Yong, H. and Zhang, J. (2006). Macroeconomic Variables and Stock Market Interactions: New Zealand Evidence. *Investment Management and Financial Innovations, 3 (4), 89-101*.

Girard, E., & Hassan, M. K. (2008). Is there a Cost to Faith-Based Investing: Evidence from FTSE Islamic Indices. *The Journal of Investing*, *17*(4), 112-121.

Global Islamic Finance Forum report (GIFF) (2012). Islamic finance industry enters 2013 with new strength. Retrieved on 06/01/2016

Granger, C. W. (2002). Some comments on risk. *Journal of Applied Econometrics*, *17*(5), 447-456.

Granger, C. W., Huangb, B. N., & Yang, C. W. (2000). A bivariate causality between stock prices and exchange rates: evidence from recent Asianflu☆. *The Quarterly Review of Economics and Finance*, *40*(3), 337-354.

Grouard, M. H., Levy, S. É. B. A. S. T. I. E. N., & Lubochinsky, C. (2003). Stock market volatility: from empirical data to their interpretation. *FSR, Banque de France*, *2*, 57-74.

Guyot, A. (2011). Efficiency and dynamics of Islamic investment: Evidence of geopolitical effects on Dow Jones Islamic market indexes. *Emerging Markets Finance and Trade, 47*(6), 24-45.

Hakim, S and Rashidian, M. (2004). Risk & Return of Islamic Stock Market Indexes. Paper presented at the International Seminar of Nonbank Financial Institutions: Islamic Alternatives, Kuala Lumpur, Malaysia.

Hakim, S., & Rashidian, M. (2002, October). Risk and return of Islamic stock market indexes. In *9th Economic Research Forum Annual Conference in Sharjah, UAE* (pp. 26-28).

Hamao, Y., R. Masulis and Ng, V. (1990).Correlations in Price Changes and Volatility Across Hangovers. *Journal of Finance, 46(1),159-178.*

Harvey, C.R. and Becaert, G. (1997). Emerging Equity Market Volatility. *Journal of Financial Economics 43(1), 29-77*

Harvey, C.R., Geert B., and Lundland, C. T. (2005). Liquidity and Expected Returns: Lessons from Emerging Markets. AFA 2004 San Diego Meetings; EFA 2003 *Annual Conference Paper* No. 690

Hasan, M., & Dridi, J. (2011). The effects of the global crisis on Islamic and conventional banks: A comparative study. *Journal of International Commerce, Economics and Policy*, *2*(02), 163-200.

Hashim, N. (2008). The FTSE global Islamic and the risk dilemma. *AIUB Business and Economics Working Paper Series*, *8*.

Hassan, K. M., & Girard, E. (2010). Faith-based ethical investing: The case of Dow Jones Islamic indexes. *Islamic Economic Studies*, *17*(2).

Hassan, M. K., Rabbani, M. R., & Ali, M. A. M. (2020). Challenges for the Islamic Finance and banking in post COVID era and the role of Fintech. *Journal of Economic Cooperation & Development*, *41*(3), 93-116.

Hautcoeur, P. C. (2006). Why and how to measure stock market fluctuations? The early history of stock market indices, with special reference to the French case.

Hayat, R & Kraeussl, R (2011). Risk and Return Characteristics of Islamic Equity Funds. *Emerging Markets Review*, *12(2), 189-203.*

Hesse, H., & Frank, N. (2009). Financial spillovers to emerging markets during the global financial crisis. *IMF Working Papers*, 1-20.

Ho, C. S. F., Abd Rahman, N. A., Yusuf, N. H. M., & Zamzamin, Z. (2014). Performance of global Islamic versus conventional share indices: International evidence. *Pacific-Basin Finance Journal*, *28*, 110-121.

Hoepner, A.G.F., Rammal, H.G., and Rezec, M. (2011). Islamic Mutual Funds' Financial Performance and International Investment Style: evidence from 20 countries. *European Journal of Finance*. *17 (9–10), 829–850*.

Hooi, H.L., Parsva, P., 2012. Performance of Islamic Indices in Malaysia FTSE Market: Empirical Evidence From CAPM. *Journal of Applied Science*, *12 (12), 1274–1281*.

http://www.economictimes.com/definition/investment-risk

Humpe, A., & Macmillan, P. (2009). Can macroeconomic variables explain long-term stock market movements? A comparison of the US and Japan. *Applied financial economics*, *19*(2), 111-119.

Hussain, M., Shahmoradi, A., & Turk, R. (2016). An overview of Islamic finance. *Journal of International Commerce, Economics and Policy*, *7*(01), 1650003.

Hussein, K. A. (2007). Islamic investment: evidence from Dow Jones and FTSE indices. *Islamic Economics and Finance*, *387*.

Hussein, K. and M. Omran, (2005). Ethical Investment Revisited: Evidence from Dow Jones Islamic Indexes. *The Journal of Investing, 14(3), 105-124.*

Hussein, K.A.(2004). Ethical Investment: Empirical Evidence from FTSE Islamic Index. *Journal of Islamic Economics, 12 (1), 21–40.*

Hussin, M. Y. M., Muhammad, F., Hussin, M. A., & Razak, A. A. (2012). The relationship between oil price, exchange rate and Islamic stock market in Malaysia. *Research Journal of Finance and Accounting*, *3*(5), 83-92.

Islamic Finance & Investment. (2014). *Principles of Islamic Finance.* Retrieved on 27/12/2015 from http://www.mcca.com.au/about-us/

Jawadi, F., Jawadi, N., & Louhichi, W. (2014). Conventional and Islamic stock price performance: An empirical investigation. *International Economics*, *137*, 73-87.

Karamustafa, O., & Kucukkale, Y. (2003). Long run relationships between stock market returns and macroeconomic performance: evidence from Turkey. Global Finance Journal, 10(1), 91-101.

Karim, B.A.,Kassim, N.A.M. and Arip, M.A. (2010). The Subprime Crisis and Islamic Stock Markets Integration. *International Journal of Islamic and Middle Eastern Finance and Management 3(4), 363-371*.

Karunanayake, I., Valadkhani, A. & O'brien, M. J. (2010). Financial Crises and International Stock Market Volatility Transmission. *Australian Economic Papers, 49(3), 209-221.*

Kenneth W. C., Izan, H.Y., and Yihui L. (2011). Volatility And Stock Price Indexes. *Applied Economics*, *45*(22), 3255-3262.

Khathatay, M. H. and S. Nisar, 2007. Shariah Compliant Equity Investments: An Assessment of Current Screening Norms. *Islamic Economic Studies, 15(1), 47-76*.

Khositkulporn, P. (2013). *The factors affecting stock market volatility and contagion: Thailand and South-East Asia evidence* (Doctoral dissertation, Victoria University).

King, M. A., & Wadhwani, S. (1990). Transmission of volatility between stock markets. *The Review of Financial Studies*, *3*(1), 5-33.

Kok, S., Giorgioni, G., & Laws, J. (2009). Performance of Shariah-compliant indices in London and NY stock markets and their potential for diversification. *International Journal of Monetary Economics and Finance, 2*(3), 398-408.

Kolapo, F.T., Oke, M.O., and Olaniyan, O.T (2018).Unravelling the Impact ofMacroeconomic Fundamentals on Stock Market Performance in Nigeria: An Ardl-bound Testing Approach. *Journal of Economics, Management and Trade 21(3), 1-15*

Koutmos, G. (1996). Modeling the Dynamic Interdependence of Major European Stock Markets. *Journal of Business Finance & Accounting*, 23 (7), 975-988.

Koutmos, G., & Booth, G. G. (1995). Asymmetric volatility transmission in international stock markets. *Journal of international Money and Finance, 14(6), 747-762*.

Kumar, K. K., & Mukhopadyay, C. (2002). Equity market interlinkages: Transmission of volatility-A case of US and India. *NSE, India Research paper, Source: www. nseindia. com*.

Kupiec, P., & Studies, O. E. (1991). *Stock market volatility in OECD countries: recent trends, consequences for the real economy, and proposals for reform*. Federal Reserve Board.

Levišauskaite, K. (2010). Investment Analysis and Portfolio Management, Leonardo da Vinci Programme Project, Vytautas Magnus University Kaunas, Lithuania

Listyaningsih, E. and Krishnamurti, C. (2014). How Volatile Are Sharia Stocks Relative to Other Stocks? :Evidence From Jakarta Islamic Index. The 21st Annual Global Finance Conference Dubai, UAE – March 31- April 2.

Mahmood, W. M., & Mohd Dinniah, N. (2007). Stock returns and macroeconomic influences: Evidence from the six Asian-Pacific countries. *Financial Economics and Futures Market Research Paper*.

Majid Shabri Abd., M., Kameel Mydin Meera, A., & Azmi Omar, M. (2008). Interdependence of ASEAN-5 stock markets from the US and Japan. *Global Economic Review*, *37*(2), 201-225.

Malik, F., Ewing, B., and Payne, J. (2005). Measuring Volatility Persistence In The Presence of Sudden Changes in the Variance of Canadian Stock Returns. *Canadian Journal of Economics, 38(3),1037 - 1056.*

Mandimika, Nz., & Chinzara, Z. (2010). *Risk-return tradeoff and the behaviour of volatility on the South African stock market: Evidence from both aggregate and disaggregate data* (No. 198). Economic Research Southern Africa.

Maysami, R. C., Howe, L. C., & Rahmat, M. A. (2005). Relationship between macroeconomic variables and stock market indices: Cointegration evidence from stock exchange of Singapore's all-S sector Indices. *Jurnal Pengurusan (UKM Journal of Management), 24*.

Merdad, H,J. (2012). Two Essays in Islamic Finance and Investment. University of New Orleans Theses and Dissertations. Paper 1467

Merdad, H., Hassan, M.K. and Alhenawi, Y.(2010). Islamic Versus Conventional Mutual Funds Performance in Saudi Arabia: A Case Study. JKAU: *Islamic. Econ. 23 (2), 157–193*

Miniaoui, H., Sayani, H., & Chaibi, A. (2015). The impact of financial crisis on Islamic and conventional indices of the GCC countries. *Journal of Applied Business Research (JABR)*, *31*(2), 357-370.

Mookerjee, R., & Yu, Q. (1997). Macroeconomic variables and stock prices in a small open economy: The case of Singapore. *Pacific-Basin Finance Journal*, *5*(3), 377-388.

Mukherjee, T. K., & Naka, A. (1995). Dynamic relations between macroeconomic variables and the Japanese stock market: an application of a vector error correction model. *Journal of financial Research*, *18*(2), 223-237.

Naik, Pramod Kumar and Padhip, Puja (2012) The Impact of Macroeconomic Fundamentals on Stock Prices Revisited: Evidence from Indian Data, Eurasian *Journal of Business and Economics,* 5 (10), 25-44

Nasseh, A., & Strauss, J. (2000). Stock prices and domestic and international macroeconomic activity: a cointegration approach. *The quarterly review of economics and finance*, *40*(2), 229-245.

Nazlioglu, S., Hammoudeh, S., & Gupta, R. (2015). Volatility transmission between Islamic and conventional equity markets: Evidence from causality-in-variance test. *Applied Economics*, *47*(46), 4996-5011.

Neumark, D., Tinsley, P. A., & Tosini, S. (1991). After-hours stock prices and post-crash hangovers. *The Journal of Finance*, *46*(1), 159-178.

Nihalani, S. (2009). Dow Jones Islamic Market Indexes Quarterly Newsletter

October 1987. *Federal Reserve Bank of New York Quarterly Review, 13:17-33*.

Omisore, I., Yusuf, N. and Christopher, N. (2012).The Modern Portfolio Theory as an Investment Decision Tool. *Journal of Accounting and Taxation, 4(2),19-28*

Otweyo, E. S. (2017). *Market Factors That Affect Returns For Companies Quoted At The Nairobi Securities Exchange* (Doctoral dissertation).

Pal, K. and Mittal, R. (2011). Impact of Macroeconomic Indicators on Indian Indian Capital Markets, *Journal of Risk Finance, 12 (2),* 84-97.

Pethe, A. and Karnik, A. (2000). Do Indian Stock Market Maters? Stock Market Indices and Macroeconomic Variables, *Economic and Political Weekly*, 35 (5), 349-356.

Pranata, N. (2015). Conventional and Islamic Indices in Indonesia: A Comparison on Performance, Volatility, and The Determinants. *Indonesian Capital Market Review*, *7*(2).

Pryymachenko, I. (2003). Stock price volatility and its determinants on the emerging financial market of Ukraine. *Unpublished Thesis*.

Rahman, A. (2009). The relevance of Islamic finance principles to the global financial crisis. *Islamic Finance Project, Harvard Law School, Panel Discussion*, *16*, 2009.

Rahman, A. A., & Sidek, N. Z. M. (2011). Spill-over effect of us Sub-prime crisis on ASEAN-5 stock markets. In *Business and social science research conference* (p. 334). World Business Institute Australia Dubai, UAE.

Rahman, A. Abdul, Noor, Z. Mohd Sidek and Fauziah H. T. (2009). Macroeconomic Determinants of Malaysian Stock Market, *African Journal of Business Management*, 3 (3), 95-106.

Ratanapakorn, O. and Sharma, S. C. (2007). Dynamics analysis between the US Stock Return and the Macroeconomics Variables, *Applied Financial Economics*, 17 (4), 369-377.

Ray, P. and Vani, V. (2003). What moves Indian Stock Market: A study on a linkage with Real Economy in the post reform era, *Working Paper,* National Institute of Management, Kolkata, 1-19.

Reddy, K. and Fu, M. (2014). Does Shariah Compliant Stocks Perform Better than the Conventional Stocks? A Comparative Study of Stocks Listed on the Australian Stock Exchange. *Asian Journal of Finance & Accounting 6(2), 155 – 170*

Ridwan, M, A. (2009). *Analysis of Islamic stock indices* (Master's thesis, University of Waterloo).

Rizvi, S. A. S.(2012)“Are Islamic Equity Indices a Safer Haven in Times of Crisis. In *An Empirical Proof Via Investigation of Global Indices Using Multivariate GARCH DCC.” International Islamic Capital Market Conference, Indonesia*.

Robert, D.G. (2008). Effect of Macroeconomic Variables on Stock Market Returns for four Emerging Economies: Brazil, Russia, India and China. *International Business & Economics Research Journal*, 7 (3), 1-8.

Rose, P.S. (2000). Money and Capital Markets. 7th Edition. USA: Irwin McGraw – Hill.

Saadaoui, A. and Boujelbene, Y. (2015). Volatility Transmission Between Dow Jones Stock Index and Emerging Islamic Stock Index: Case of Subprime Financial Crises. *Journal of Emerging Economies and Islamic Research 3(1), 1-9*

Saiti, B., Bacha, O. I., & Masih, M. (2016). Testing the conventional and Islamic financial market contagion: evidence from wavelet analysis. *Emerging Markets Finance and Trade*, *52*(8), 1832-1849.

Shahzad, S. J. H., Ferrer, R., Ballester, L., & Umar, Z. (2017). Risk transmission between Islamic and conventional stock markets: A return and volatility spillover analysis. *International Review of Financial Analysis*, *52*, 9-26.

Shubbar, S. A. (2010). Empirical performance of Islamic stock market indices in 2008 credit crisis (Master's thesis, University of Twente).

Taylor, S. J. (2008). *Modelling financial time series*. world scientific.

Trabelsi, L., Bahloul, S., & Mathlouthi, F. (2020). Performance analysis of Islamic and conventional portfolios: The emerging markets case. *Borsa Istanbul Review*, *20*(1), 48-54.

Veal, A.J (2005). Business Research Methods: A Managerial Approach, 2nd Ed, Pearson Education Australia/Addison Wesley

Walenkamp, M.(2008).Forecasting Stock Index Volatility. (Master's thesis Mathematisch Instituut, Universiteit Leiden)

Wong W K,.Agarwal, A. and Du, J. (2005). Financial Integration for India Stock Market, A Fractional Cointegration Approach. National University of Singapore Working Paper No. WP0501.

Wongbangpo, P., & Sharma, S. C. (2002). Stock market and macroeconomic fundamental dynamic interactions: ASEAN-5 countries. *Journal of asian Economics*, *13*(1), 27-51.

Yahya, M.M.H., Anis, Y.Y., Muhammad, F., Abdul, A.R., Hashim, E., and Fakhzan, N.M. (2013). The Integration of Islamic Stock Markets: Does a Problem for Investors? *Labuan e-Journal of Muamalat and Society 7:17-27*

Zare, M. (2017). Factors Affecting the Long-Run Stock Prices Performance in Iran. *American Journal of Economics 7(3), 125-130*

APPENDIX I

Johansen Cointegration Tests Results

Date: 06/08/18 Time: 15:48
Sample (adjusted): 5/15/2006 7/05/2017
Included observations: 2908 after adjustments
Trend assumption: Linear deterministic trend
Series: US2 US1 VFI TB CPI EUI FFR M2 OIL
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.099053	720.7195	197.3709	0.0001
At most 1 *	0.049981	417.3886	159.5297	0.0000
At most 2 *	0.037343	268.2860	125.6154	0.0000
At most 3 *	0.025347	157.6131	95.75366	0.0000
At most 4 *	0.013561	82.95485	69.81889	0.0031
At most 5	0.007989	43.24918	47.85613	0.1266
At most 6	0.004758	19.92311	29.79707	0.4281
At most 7	0.001984	6.053926	15.49471	0.6892
At most 8	9.60E-05	0.279210	3.841466	0.5972

Trace test indicates 5 cointegrating eqn(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 *	0.099053	303.3308	58.43354	0.0000
At most 1 *	0.049981	149.1026	52.36261	0.0000
At most 2 *	0.037343	110.6729	46.23142	0.0000
At most 3 *	0.025347	74.65822	40.07757	0.0000
At most 4 *	0.013561	39.70567	33.87687	0.0090
At most 5	0.007989	23.32606	27.58434	0.1600
At most 6	0.004758	13.86919	21.13162	0.3759
At most 7	0.001984	5.774717	14.26460	0.6423
At most 8	9.60E-05	0.279210	3.841466	0.5972

Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 06/07/18 Time: 13:09
Sample (adjusted): 11/27/2006 7/05/2017
Included observations: 2768 after adjustments
Trend assumption: Linear deterministic trend
Series: EU2 EU1 US1 VFI TB CPI EUI FFR M2 OIL
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.114046	836.3132	239.2354	0.0001
At most 1 *	0.054809	501.1347	197.3709	0.0001
At most 2 *	0.043423	345.1085	159.5297	0.0000
At most 3 *	0.029127	222.2255	125.6154	0.0000
At most 4 *	0.017553	140.4041	95.75366	0.0000
At most 5 *	0.013274	91.38511	69.81889	0.0004
At most 6 *	0.011148	54.39569	47.85613	0.0107
At most 7	0.004497	23.36422	29.79707	0.2286
At most 8	0.003636	10.88839	15.49471	0.2184
At most 9	0.000291	0.804300	3.841466	0.3698

Trace test indicates 7 cointegrating eqn(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 *	0.114046	335.1785	64.50472	0.0001
At most 1 *	0.054809	156.0261	58.43354	0.0000
At most 2 *	0.043423	122.8831	52.36261	0.0000
At most 3 *	0.029127	81.82136	46.23142	0.0000
At most 4 *	0.017553	49.01899	40.07757	0.0038
At most 5 *	0.013274	36.98942	33.87687	0.0206
At most 6 *	0.011148	31.03146	27.58434	0.0173
At most 7	0.004497	12.47583	21.13162	0.5014
At most 8	0.003636	10.08409	14.26460	0.2065
At most 9	0.000291	0.804300	3.841466	0.3698

Max-eigenvalue test indicates 7 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 06/07/18 Time: 13:44
Sample (adjusted): 5/15/2006 7/05/2017
Included observations: 2908 after adjustments
Trend assumption: Linear deterministic trend
Series: CA2 CA1 US1 VFI TB CPI EUI FFR M2 OIL
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.100618	773.9467	239.2354	0.0000
At most 1 *	0.050703	465.5603	197.3709	0.0001
At most 2 *	0.039194	314.2454	159.5297	0.0000
At most 3 *	0.025512	197.9766	125.6154	0.0000
At most 4 *	0.018121	122.8240	95.75366	0.0002
At most 5	0.011998	69.64402	69.81889	0.0516
At most 6	0.004781	34.54231	47.85613	0.4724
At most 7	0.003843	20.60683	29.79707	0.3826
At most 8	0.003046	9.410532	15.49471	0.3288
At most 9	0.000185	0.539243	3.841466	0.4627

Trace test indicates 5 cointegrating eqn(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 *	0.100618	308.3863	64.50472	0.0001
At most 1 *	0.050703	151.3149	58.43354	0.0000
At most 2 *	0.039194	116.2688	52.36261	0.0000
At most 3 *	0.025512	75.15260	46.23142	0.0000
At most 4 *	0.018121	53.17997	40.07757	0.0010
At most 5 *	0.011998	35.10171	33.87687	0.0356
At most 6	0.004781	13.93548	27.58434	0.8271
At most 7	0.003843	11.19630	21.13162	0.6277
At most 8	0.003046	8.871288	14.26460	0.2970
At most 9	0.000185	0.539243	3.841466	0.4627

Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 06/07/18 Time: 13:53

Sample (adjusted): 5/15/2006 7/05/2017
Included observations: 2908 after adjustments
Trend assumption: Linear deterministic trend
Series: CHN2 CHN1 US1 VFI TB CPI EUI FFR M2 OIL
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.099639	815.2894	239.2354	0.0001
At most 1 *	0.056986	510.0677	197.3709	0.0001
At most 2 *	0.038492	339.4438	159.5297	0.0000
At most 3 *	0.027875	225.2979	125.6154	0.0000
At most 4 *	0.021096	143.0870	95.75366	0.0000
At most 5 *	0.012815	81.08336	69.81889	0.0048
At most 6	0.008634	43.57532	47.85613	0.1192
At most 7	0.003904	18.35858	29.79707	0.5397
At most 8	0.002138	6.983714	15.49471	0.5795
At most 9	0.000261	0.759663	3.841466	0.3834

Trace test indicates 6 cointegrating eqn(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 *	0.099639	305.2217	64.50472	0.0001
At most 1 *	0.056986	170.6239	58.43354	0.0000
At most 2 *	0.038492	114.1459	52.36261	0.0000
At most 3 *	0.027875	82.21095	46.23142	0.0000
At most 4 *	0.021096	62.00363	40.07757	0.0001
At most 5 *	0.012815	37.50804	33.87687	0.0176
At most 6	0.008634	25.21674	27.58434	0.0975
At most 7	0.003904	11.37487	21.13162	0.6099
At most 8	0.002138	6.224051	14.26460	0.5846
At most 9	0.000261	0.759663	3.841466	0.3834

Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 06/07/18 Time: 17:15
Sample (adjusted): 1/01/2010 6/15/2017
Included observations: 1945 after adjustments
Trend assumption: Linear deterministic trend
Series: IND2 IND1 US1 VFI TB CPI EUI FFR M2 OIL
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.072467	420.2817	239.2354	0.0000
At most 1 *	0.036297	273.9645	197.3709	0.0000
At most 2 *	0.030747	202.0547	159.5297	0.0000
At most 3 *	0.025609	141.3129	125.6154	0.0039
At most 4	0.018159	90.85373	95.75366	0.1037
At most 5	0.012195	55.20910	69.81889	0.4103
At most 6	0.009588	31.34482	47.85613	0.6480
At most 7	0.003785	12.60688	29.79707	0.9087
At most 8	0.002683	5.231857	15.49471	0.7837
At most 9	3.46E-06	0.006726	3.841466	0.9341

Trace test indicates 4 cointegrating eqn(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 *	0.072467	146.3172	64.50472	0.0000
At most 1 *	0.036297	71.90983	58.43354	0.0015
At most 2 *	0.030747	60.74178	52.36261	0.0056
At most 3 *	0.025609	50.45921	46.23142	0.0167
At most 4	0.018159	35.64463	40.07757	0.1453
At most 5	0.012195	23.86428	33.87687	0.4655
At most 6	0.009588	18.73795	27.58434	0.4350
At most 7	0.003785	7.375019	21.13162	0.9377
At most 8	0.002683	5.225131	14.26460	0.7132
At most 9	3.46E-06	0.006726	3.841466	0.9341

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 06/07/18 Time: 17:28
Sample (adjusted): 5/15/2006 7/05/2017

Included observations: 2908 after adjustments
Trend assumption: Linear deterministic trend
Series: JP2 JP1 US1 VFI TB CPI EUI FFR M2 OIL
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.099971	786.3816	239.2354	0.0000
At most 1 *	0.051578	480.0865	197.3709	0.0001
At most 2 *	0.036368	326.0905	159.5297	0.0000
At most 3 *	0.026564	218.3615	125.6154	0.0000
At most 4 *	0.017038	140.0676	95.75366	0.0000
At most 5 *	0.014756	90.09344	69.81889	0.0005
At most 6	0.007604	46.86213	47.85613	0.0618
At most 7	0.004788	24.66439	29.79707	0.1738
At most 8	0.003375	10.70706	15.49471	0.2301
At most 9	0.000301	0.875889	3.841466	0.3493

Trace test indicates 6 cointegrating eqn(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 *	0.099971	306.2951	64.50472	0.0001
At most 1 *	0.051578	153.9960	58.43354	0.0000
At most 2 *	0.036368	107.7289	52.36261	0.0000
At most 3 *	0.026564	78.29393	46.23142	0.0000
At most 4 *	0.017038	49.97417	40.07757	0.0028
At most 5 *	0.014756	43.23131	33.87687	0.0029
At most 6	0.007604	22.19774	27.58434	0.2104
At most 7	0.004788	13.95733	21.13162	0.3685
At most 8	0.003375	9.831172	14.26460	0.2232
At most 9	0.000301	0.875889	3.841466	0.3493

Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 06/07/18 Time: 17:40
Sample (adjusted): 8/29/2006 7/09/2014
Included observations: 2052 after adjustments

Trend assumption: Linear deterministic trend
Series: KWT2 KWT1 US1 VFI TB CPI EUI FFR M2
OIL
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.115134	723.5732	239.2354	0.0000
At most 1 *	0.076228	472.5735	197.3709	0.0001
At most 2 *	0.043599	309.8707	159.5297	0.0000
At most 3 *	0.036904	218.3974	125.6154	0.0000
At most 4 *	0.030613	141.2368	95.75366	0.0000
At most 5 *	0.014391	77.43674	69.81889	0.0109
At most 6	0.010860	47.69246	47.85613	0.0518
At most 7	0.007441	25.28659	29.79707	0.1514
At most 8	0.004409	9.960247	15.49471	0.2838
At most 9	0.000435	0.893316	3.841466	0.3446

Trace test indicates 6 cointegrating eqn(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 *	0.115134	250.9998	64.50472	0.0001
At most 1 *	0.076228	162.7028	58.43354	0.0000
At most 2 *	0.043599	91.47323	52.36261	0.0000
At most 3 *	0.036904	77.16066	46.23142	0.0000
At most 4 *	0.030613	63.80005	40.07757	0.0000
At most 5	0.014391	29.74428	33.87687	0.1440
At most 6	0.010860	22.40587	27.58434	0.2003
At most 7	0.007441	15.32634	21.13162	0.2667
At most 8	0.004409	9.066931	14.26460	0.2806
At most 9	0.000435	0.893316	3.841466	0.3446

Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 06/07/18 Time: 17:54
Sample (adjusted): 1/08/2008 7/05/2017
Included observations: 2477 after adjustments
Trend assumption: Linear deterministic trend

Series: MLY2 MLY1 US1 VFI TB CPI EUI FFR M2
OIL
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.064032	578.8148	239.2354	0.0000
At most 1 *	0.040763	414.9025	197.3709	0.0000
At most 2 *	0.036230	311.8174	159.5297	0.0000
At most 3 *	0.028999	220.4093	125.6154	0.0000
At most 4 *	0.021699	147.5175	95.75366	0.0000
At most 5 *	0.017714	93.17705	69.81889	0.0002
At most 6 *	0.012108	48.90584	47.85613	0.0397
At most 7	0.004168	18.73103	29.79707	0.5124
At most 8	0.003233	8.386291	15.49471	0.4250
At most 9	0.000147	0.364020	3.841466	0.5463

Trace test indicates 7 cointegrating eqn(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 *	0.064032	163.9123	64.50472	0.0000
At most 1 *	0.040763	103.0852	58.43354	0.0000
At most 2 *	0.036230	91.40805	52.36261	0.0000
At most 3 *	0.028999	72.89180	46.23142	0.0000
At most 4 *	0.021699	54.34047	40.07757	0.0007
At most 5 *	0.017714	44.27121	33.87687	0.0020
At most 6 *	0.012108	30.17481	27.58434	0.0227
At most 7	0.004168	10.34474	21.13162	0.7117
At most 8	0.003233	8.022272	14.26460	0.3765
At most 9	0.000147	0.364020	3.841466	0.5463

Max-eigenvalue test indicates 7 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 06/07/18 Time: 18:05
Sample (adjusted): 5/15/2006 7/05/2017
Included observations: 2908 after adjustments
Trend assumption: Linear deterministic trend
Series: TKY2 TKY1 US1 VFI TB CPI EUI FFR M2 OIL
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.101315	760.2918	239.2354	0.0000
At most 1 *	0.048771	449.6517	197.3709	0.0001
At most 2 *	0.037724	304.2499	159.5297	0.0000
At most 3 *	0.026474	192.4268	125.6154	0.0000
At most 4 *	0.015702	114.4032	95.75366	0.0014
At most 5	0.011489	68.37990	69.81889	0.0648
At most 6	0.006382	34.77678	47.85613	0.4598
At most 7	0.003729	16.15813	29.79707	0.7012
At most 8	0.001765	5.294103	15.49471	0.7768
At most 9	5.37E-05	0.156240	3.841466	0.6926

Trace test indicates 5 cointegrating eqn(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 *	0.101315	310.6401	64.50472	0.0001
At most 1 *	0.048771	145.4018	58.43354	0.0000
At most 2 *	0.037724	111.8231	52.36261	0.0000
At most 3 *	0.026474	78.02363	46.23142	0.0000
At most 4 *	0.015702	46.02326	40.07757	0.0096
At most 5	0.011489	33.60312	33.87687	0.0539
At most 6	0.006382	18.61865	27.58434	0.4445
At most 7	0.003729	10.86403	21.13162	0.6609
At most 8	0.001765	5.137862	14.26460	0.7243
At most 9	5.37E-05	0.156240	3.841466	0.6926

Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 06/07/18 Time: 18:10

Sample (adjusted): 10/24/2008 5/12/2017
Included observations: 2231 after adjustments
Trend assumption: Linear deterministic trend
Series: TWN2 TWN1 US1 VFI TB CPI EUI FFR M2 OIL
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.059633	498.8559	239.2354	0.0000
At most 1 *	0.040791	361.6823	197.3709	0.0000
At most 2 *	0.035217	268.7702	159.5297	0.0000
At most 3 *	0.027739	188.7831	125.6154	0.0000
At most 4 *	0.018414	126.0234	95.75366	0.0001
At most 5 *	0.017550	84.55774	69.81889	0.0021
At most 6	0.009263	45.05494	47.85613	0.0895
At most 7	0.007221	24.29240	29.79707	0.1884
At most 8	0.003017	8.124929	15.49471	0.4521
At most 9	0.000620	1.383370	3.841466	0.2395

Trace test indicates 6 cointegrating eqn(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 *	0.059633	137.1736	64.50472	0.0000
At most 1 *	0.040791	92.91217	58.43354	0.0000
At most 2 *	0.035217	79.98708	52.36261	0.0000
At most 3 *	0.027739	62.75964	46.23142	0.0004
At most 4 *	0.018414	41.46571	40.07757	0.0347
At most 5 *	0.017550	39.50281	33.87687	0.0096
At most 6	0.009263	20.76254	27.58434	0.2908
At most 7	0.007221	16.16747	21.13162	0.2152
At most 8	0.003017	6.741559	14.26460	0.5201
At most 9	0.000620	1.383370	3.841466	0.2395

Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 06/07/18 Time: 18:16
Sample (adjusted): 8/29/2006 10/14/2014
Included observations: 2121 after adjustments
Trend assumption: Linear deterministic trend
Series: QTR2 QTR1 US1 VFI TB CPI EUI FFR M2 OIL
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.255048	1211.533	239.2354	0.0001
At most 1 *	0.104149	587.0341	197.3709	0.0001
At most 2 *	0.051689	353.7633	159.5297	0.0000
At most 3 *	0.044753	241.1961	125.6154	0.0000
At most 4 *	0.031041	144.0863	95.75366	0.0000
At most 5 *	0.014166	77.20525	69.81889	0.0114
At most 6	0.009956	46.94422	47.85613	0.0608
At most 7	0.008156	25.72203	29.79707	0.1372
At most 8	0.003930	8.352891	15.49471	0.4285
At most 9	8.91E-07	0.001890	3.841466	0.9622

Trace test indicates 6 cointegrating eqn(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 *	0.255048	624.4988	64.50472	0.0001
At most 1 *	0.104149	233.2708	58.43354	0.0000
At most 2 *	0.051689	112.5672	52.36261	0.0000
At most 3 *	0.044753	97.10981	46.23142	0.0000
At most 4 *	0.031041	66.88102	40.07757	0.0000
At most 5	0.014166	30.26104	33.87687	0.1273
At most 6	0.009956	21.22219	27.58434	0.2630
At most 7	0.008156	17.36914	21.13162	0.1553
At most 8	0.003930	8.351001	14.26460	0.3442
At most 9	8.91E-07	0.001890	3.841466	0.9622

Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX II

VECM RESULTS

Dependent Variable: D(US2)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 06/09/18 Time: 12:47
Sample (adjusted): 5/15/2006 7/06/2017
Included observations: 2909 after adjustments
D(US2) = C(1)*(US2(-1) + 0.24047029258*US1(-1) - 18.0566511696*EUI(
-1) + 2795.32595258*FFR(-1) + 1.34956552766*M2(-1) +
435.273602912*VFI(-1) - 60576.6080641*CPI(-1) - 3253.46871416
*TB(-1) + 76.1005060079*OIL(-1) + 25600.355212) + C(2)*D(US2(-1))
+ C(3)*D(US2(-2)) + C(4)*D(US2(-3)) + C(5)*D(US2(-4)) + C(6)*D(US2(
-5)) + C(7)*D(US2(-6)) + C(8)*D(US2(-7)) + C(9)*D(US2(-8)) + C(10)
*D(US1(-1)) + C(11)*D(US1(-2)) + C(12)*D(US1(-3)) + C(13)*D(US1(
-4)) + C(14)*D(US1(-5)) + C(15)*D(US1(-6)) + C(16)*D(US1(-7)) +
C(17)*D(US1(-8)) + C(18)*D(EUI(-1)) + C(19)*D(EUI(-2)) + C(20)
*D(EUI(-3)) + C(21)*D(EUI(-4)) + C(22)*D(EUI(-5)) + C(23)*D(EUI(-6))
+
C(24)*D(EUI(-7)) + C(25)*D(EUI(-8)) + C(26)*D(FFR(-1)) + C(27)
*D(FFR(-2)) + C(28)*D(FFR(-3)) + C(29)*D(FFR(-4)) + C(30)*D(FFR(-
5))
+ C(31)*D(FFR(-6)) + C(32)*D(FFR(-7)) + C(33)*D(FFR(-8)) + C(34)
*D(M2(-1)) + C(35)*D(M2(-2)) + C(36)*D(M2(-3)) + C(37)*D(M2(-4)) +
C(38)*D(M2(-5)) + C(39)*D(M2(-6)) + C(40)*D(M2(-7)) + C(41)*D(M2(
-8)) + C(42)*D(VFI(-1)) + C(43)*D(VFI(-2)) + C(44)*D(VFI(-3)) + C(45)
*D(VFI(-4)) + C(46)*D(VFI(-5)) + C(47)*D(VFI(-6)) + C(48)*D(VFI(-7))
+
C(49)*D(VFI(-8)) + C(50)*D(CPI(-1)) + C(51)*D(CPI(-2)) +
C(52)*D(CPI(
-3)) + C(53)*D(CPI(-4)) + C(54)*D(CPI(-5)) + C(55)*D(CPI(-6)) + C(56)
*D(CPI(-7)) + C(57)*D(CPI(-8)) + C(58)*D(TB(-1)) + C(59)*D(TB(-2)) +
C(60)*D(TB(-3)) + C(61)*D(TB(-4)) + C(62)*D(TB(-5)) + C(63)*D(TB(-
6))
+ C(64)*D(TB(-7)) + C(65)*D(TB(-8)) + C(66)*D(OIL(-1)) +
C(67)*D(OIL(
-2)) + C(68)*D(OIL(-3)) + C(69)*D(OIL(-4)) + C(70)*D(OIL(-5)) + C(71)
*D(OIL(-6)) + C(72)*D(OIL(-7)) + C(73)*D(OIL(-8)) + C(74)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.000113	0.000271	-0.414521	0.6785
C(2)	-0.041567	0.018270	-2.275145	0.0230
C(3)	0.013219	0.018273	0.723394	0.4695
C(4)	-0.024361	0.018262	-1.333975	0.1823
C(5)	-0.016278	0.018266	-0.891181	0.3729
C(6)	-0.025924	0.018273	-1.418732	0.1561

C(7)	-0.029458	0.018303	-1.609437	0.1076
C(8)	0.001040	0.018313	0.056797	0.9547
C(9)	0.033662	0.018332	1.836279	0.0664
C(10)	-0.004470	0.010979	-0.407138	0.6839
C(11)	0.012552	0.011025	1.138479	0.2550
C(12)	0.004615	0.011032	0.418280	0.6758
C(13)	-0.006237	0.011020	-0.565957	0.5715
C(14)	0.010147	0.011021	0.920747	0.3573
C(15)	-0.020969	0.011043	-1.898872	0.0577
C(16)	-0.006652	0.011033	-0.602930	0.5466
C(17)	0.141149	0.010998	12.83358	0.0000
C(18)	-0.004236	0.031291	-0.135367	0.8923
C(19)	-0.051287	0.036078	-1.421564	0.1553
C(20)	0.005184	0.039365	0.131697	0.8952
C(21)	-0.010235	0.040913	-0.250157	0.8025
C(22)	0.009519	0.040869	0.232923	0.8158
C(23)	0.026121	0.039209	0.666208	0.5053
C(24)	0.005601	0.035878	0.156119	0.8760
C(25)	-0.004758	0.030849	-0.154236	0.8774
C(26)	18.95808	21.81569	0.869011	0.3849
C(27)	-6.940064	21.57846	-0.321620	0.7478
C(28)	21.57235	22.04953	0.978359	0.3280
C(29)	8.810598	22.72501	0.387705	0.6983
C(30)	28.18034	22.58909	1.247519	0.2123
C(31)	3.168973	21.94983	0.144373	0.8852
C(32)	27.92123	21.40234	1.304587	0.1921
C(33)	15.09709	21.47313	0.703069	0.4821
C(34)	-0.825370	0.714344	-1.155424	0.2480
C(35)	1.135580	0.970092	1.170590	0.2419
C(36)	-1.265746	0.936348	-1.351791	0.1766
C(37)	1.036561	0.890076	1.164575	0.2443
C(38)	-0.697029	0.892830	-0.780696	0.4350
C(39)	-1.640558	0.938839	-1.747433	0.0807
C(40)	1.467331	0.977484	1.501131	0.1334
C(41)	0.283362	0.723239	0.391796	0.6952
C(42)	0.041498	0.111681	0.371576	0.7102
C(43)	0.065816	0.104681	0.628736	0.5296
C(44)	0.029801	0.097142	0.306775	0.7590
C(45)	0.015211	0.088943	0.171018	0.8642
C(46)	0.010410	0.079899	0.130295	0.8963
C(47)	-0.014402	0.069558	-0.207047	0.8360
C(48)	-0.023619	0.056975	-0.414556	0.6785
C(49)	-0.010696	0.040495	-0.264127	0.7917
C(50)	1939.944	1470.702	1.319059	0.1873
C(51)	63.08891	1467.226	0.042999	0.9657
C(52)	2315.515	1463.526	1.582148	0.1137
C(53)	-1105.965	1467.679	-0.753547	0.4512
C(54)	659.4467	1469.086	0.448882	0.6536

C(55)	-1884.774	1467.683	-1.284183	0.1992
C(56)	20.34926	1500.527	0.013561	0.9892
C(57)	-2083.636	1500.888	-1.388269	0.1652
C(58)	-43.08012	42.02240	-1.025170	0.3054
C(59)	-1.338501	42.18380	-0.031730	0.9747
C(60)	16.83339	42.23036	0.398609	0.6902
C(61)	3.675343	42.14744	0.087202	0.9305
C(62)	-29.92299	42.14893	-0.709935	0.4778
C(63)	-9.820154	42.15428	-0.232957	0.8158
C(64)	9.119308	42.08128	0.216707	0.8285
C(65)	-36.87536	42.15749	-0.874705	0.3818
C(66)	2.240148	0.953897	2.348418	0.0189
C(67)	1.019445	0.959670	1.062287	0.2882
C(68)	-0.679410	0.963705	-0.704999	0.4809
C(69)	0.921672	0.963984	0.956107	0.3391
C(70)	-0.487377	0.964162	-0.505493	0.6133
C(71)	0.634224	0.966307	0.656338	0.5117
C(72)	0.371716	0.966007	0.384797	0.7004
C(73)	0.958626	0.964736	0.993667	0.3205
C(74)	2.822435	2.003481	1.408765	0.1590

R-squared	0.082978	Mean dependent var	1.938842
Adjusted R-squared	0.059365	S.D. dependent var	81.18765
S.E. of regression	78.74092	Akaike info criterion	11.59531
Sum squared resid	17577375	Schwarz criterion	11.74732
Log likelihood	-16791.38	Hannan-Quinn criter.	11.65007
F-statistic	3.514100	Durbin-Watson stat	2.000231
Prob(F-statistic)	0.000000		

Dependent Variable: D(EU2)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 06/09/18 Time: 17:30
Sample (adjusted): 11/27/2006 7/06/2017
Included observations: 2769 after adjustments
D(EU2) = C(1)*(EU2(-1) - 0.363889912626*EU1(-1) - 0.129430868565
*US1(-1) - 81.9920021565*VFI(-1) + 1585.03499616*TB(-1) -
23603.2435014*CPI(-1) + 4.58327521603*EUI(-1) - 1361.32240447
*FFR(-1) + 0.560203271566*M2(-1) - 3.48197525545*OIL(-1) +
21201.4371867) + C(2)*D(EU2(-1)) + C(3)*D(EU2(-2)) + C(4)*D(EU2(
-3)) + C(5)*D(EU2(-4)) + C(6)*D(EU2(-5)) + C(7)*D(EU2(-6)) + C(8)
*D(EU2(-7)) + C(9)*D(EU2(-8)) + C(10)*D(EU1(-1)) + C(11)*D(EU1(-
2))
+ C(12)*D(EU1(-3)) + C(13)*D(EU1(-4)) + C(14)*D(EU1(-5)) + C(15)
*D(EU1(-6)) + C(16)*D(EU1(-7)) + C(17)*D(EU1(-8)) + C(18)*D(US1(
-1)) + C(19)*D(US1(-2)) + C(20)*D(US1(-3)) + C(21)*D(US1(-4)) +
C(22)*D(US1(-5)) + C(23)*D(US1(-6)) + C(24)*D(US1(-7)) + C(25)

*D(US1(-8)) + C(26)*D(VFI(-1)) + C(27)*D(VFI(-2)) + C(28)*D(VFI(-
3)) +
C(29)*D(VFI(-4)) + C(30)*D(VFI(-5)) + C(31)*D(VFI(-6)) +
C(32)*D(VFI(
-7)) + C(33)*D(VFI(-8)) + C(34)*D(TB(-1)) + C(35)*D(TB(-2)) + C(36)
*D(TB(-3)) + C(37)*D(TB(-4)) + C(38)*D(TB(-5)) + C(39)*D(TB(-6)) +
C(40)*D(TB(-7)) + C(41)*D(TB(-8)) + C(42)*D(CPI(-1)) + C(43)*D(CPI(
-2)) + C(44)*D(CPI(-3)) + C(45)*D(CPI(-4)) + C(46)*D(CPI(-5)) + C(47)
*D(CPI(-6)) + C(48)*D(CPI(-7)) + C(49)*D(CPI(-8)) + C(50)*D(EUI(-1))
+
C(51)*D(EUI(-2)) + C(52)*D(EUI(-3)) + C(53)*D(EUI(-4)) +
C(54)*D(EUI(
-5)) + C(55)*D(EUI(-6)) + C(56)*D(EUI(-7)) + C(57)*D(EUI(-8)) + C(58)
*D(FFR(-1)) + C(59)*D(FFR(-2)) + C(60)*D(FFR(-3)) + C(61)*D(FFR(-
4))
+ C(62)*D(FFR(-5)) + C(63)*D(FFR(-6)) + C(64)*D(FFR(-7)) + C(65)
*D(FFR(-8)) + C(66)*D(M2(-1)) + C(67)*D(M2(-2)) + C(68)*D(M2(-3))
+
C(69)*D(M2(-4)) + C(70)*D(M2(-5)) + C(71)*D(M2(-6)) + C(72)*D(M2(
-7)) + C(73)*D(M2(-8)) + C(74)*D(OIL(-1)) + C(75)*D(OIL(-2)) + C(76)
*D(OIL(-3)) + C(77)*D(OIL(-4)) + C(78)*D(OIL(-5)) + C(79)*D(OIL(-
6)) +
C(80)*D(OIL(-7)) + C(81)*D(OIL(-8)) + C(82)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.58E-05	0.000682	0.023158	0.9815
C(2)	-0.045483	0.019290	-2.357805	0.0185
C(3)	0.003513	0.019344	0.181584	0.8559
C(4)	-0.037169	0.019310	-1.924833	0.0544
C(5)	0.020178	0.019325	1.044129	0.2965
C(6)	-0.029164	0.019319	-1.509619	0.1313
C(7)	-0.050891	0.019312	-2.635149	0.0085
C(8)	0.015315	0.019335	0.792099	0.4284
C(9)	0.015234	0.019290	0.789707	0.4298
C(10)	0.013314	0.011038	1.206192	0.2278
C(11)	-0.008259	0.011047	-0.747669	0.4547
C(12)	0.000530	0.011038	0.048017	0.9617
C(13)	0.009529	0.011030	0.863882	0.3877
C(14)	-0.000165	0.011051	-0.014967	0.9881
C(15)	0.002414	0.011030	0.218826	0.8268
C(16)	0.006660	0.011040	0.603252	0.5464
C(17)	0.017444	0.011035	1.580781	0.1140
C(18)	0.006985	0.004944	1.412999	0.1578
C(19)	-0.008753	0.004973	-1.760005	0.0785
C(20)	0.006236	0.004977	1.252992	0.2103
C(21)	0.002778	0.004975	0.558517	0.5765
C(22)	0.003492	0.004975	0.702019	0.4827

C(23)	0.001150	0.004976	0.231127	0.8172
C(24)	0.002481	0.004964	0.499841	0.6172
C(25)	0.001922	0.004946	0.388609	0.6976
C(26)	0.007728	0.052429	0.147407	0.8828
C(27)	-0.002919	0.048758	-0.059859	0.9523
C(28)	-0.021750	0.044957	-0.483809	0.6286
C(29)	-0.016010	0.040903	-0.391418	0.6955
C(30)	-0.017531	0.036517	-0.480090	0.6312
C(31)	-0.017828	0.031593	-0.564301	0.5726
C(32)	-0.009770	0.025710	-0.379992	0.7040
C(33)	-0.002510	0.018148	-0.138308	0.8900
C(34)	-35.85540	18.98631	-1.888487	0.0591
C(35)	-0.006077	19.07235	-0.000319	0.9997
C(36)	13.55542	19.08580	0.710236	0.4776
C(37)	6.200161	19.11772	0.324315	0.7457
C(38)	5.407486	19.08526	0.283333	0.7769
C(39)	-37.34258	19.07880	-1.957282	0.0504
C(40)	2.301433	19.06193	0.120735	0.9039
C(41)	-5.394582	19.08936	-0.282596	0.7775
C(42)	755.3083	672.1120	1.123783	0.2612
C(43)	821.1925	670.4775	1.224788	0.2208
C(44)	346.6525	668.3512	0.518668	0.6040
C(45)	407.2716	669.5501	0.608276	0.5431
C(46)	905.6107	670.1326	1.351390	0.1767
C(47)	805.9203	669.9230	1.203004	0.2291
C(48)	798.4448	686.6936	1.162738	0.2450
C(49)	213.3749	686.9643	0.310606	0.7561
C(50)	-0.001264	0.014290	-0.088481	0.9295
C(51)	0.004891	0.016447	0.297415	0.7662
C(52)	0.003079	0.017887	0.172144	0.8633
C(53)	0.002263	0.018555	0.121959	0.9029
C(54)	-0.019526	0.018515	-1.054562	0.2917
C(55)	0.006670	0.017758	0.375615	0.7072
C(56)	-0.006981	0.016252	-0.429552	0.6676
C(57)	-0.006906	0.013960	-0.494681	0.6209
C(58)	10.13443	9.812077	1.032853	0.3018
C(59)	27.50040	9.725925	2.827536	0.0047
C(60)	-9.121573	9.924320	-0.919113	0.3581
C(61)	18.66620	10.22130	1.826205	0.0679
C(62)	4.834838	10.15630	0.476043	0.6341
C(63)	-2.822029	9.868862	-0.285953	0.7749
C(64)	9.276539	9.647550	0.961544	0.3364
C(65)	-0.044007	9.691427	-0.004541	0.9964
C(66)	-0.400138	0.320786	-1.247369	0.2124
C(67)	0.112890	0.434728	0.259681	0.7951
C(68)	0.296976	0.420076	0.706957	0.4797
C(69)	0.377668	0.399028	0.946470	0.3440
C(70)	-0.263404	0.400632	-0.657472	0.5109

C(71)	-0.176808	0.421348	-0.419624	0.6748
C(72)	-0.115021	0.438149	-0.262516	0.7929
C(73)	0.239750	0.324132	0.739669	0.4596
C(74)	-0.131029	0.433185	-0.302480	0.7623
C(75)	0.210928	0.435844	0.483952	0.6285
C(76)	-0.309282	0.437833	-0.706392	0.4800
C(77)	-0.099142	0.437628	-0.226544	0.8208
C(78)	-0.292274	0.438103	-0.667135	0.5047
C(79)	-0.629889	0.439117	-1.434445	0.1516
C(80)	-0.185082	0.438926	-0.421671	0.6733
C(81)	1.150382	0.438491	2.623503	0.0088
C(82)	-0.374078	0.908098	-0.411936	0.6804

R-squared	0.031993	Mean dependent var	0.179144
Adjusted R-squared	0.002812	S.D. dependent var	35.08375
S.E. of regression	35.03439	Akaike info criterion	9.979704
Sum squared resid	3298047.	Schwarz criterion	10.15520
Log likelihood	-13734.90	Hannan-Quinn criter.	10.04309
F-statistic	1.096362	Durbin-Watson stat	1.997374
Prob(F-statistic)	0.262751		

Dependent Variable: D(CA2)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 06/10/18 Time: 14:50
Sample (adjusted): 5/15/2006 7/06/2017
Included observations: 2909 after adjustments
D(CA2) = C(1)*(CA2(-1) - 13.4909837395*CA1(-1) + 0.488734209128
*US1(-1) - 16.1202375045*EUI(-1) + 1924.79958326*FFR(-1) -
0.21109680379*M2(-1) + 279.879963989*VFI(-1) + 9822.75030494
*CPI(-1) - 2108.18358802*TB(-1) + 46.0477975459*OIL(-1) -
18864.8718932) + C(2)*D(CA2(-1)) + C(3)*D(CA2(-2)) + C(4)*D(CA2(
-3)) + C(5)*D(CA2(-4)) + C(6)*D(CA2(-5)) + C(7)*D(CA2(-6)) + C(8)
*D(CA2(-7)) + C(9)*D(CA2(-8)) + C(10)*D(CA1(-1)) + C(11)*D(CA1(-
2))
+ C(12)*D(CA1(-3)) + C(13)*D(CA1(-4)) + C(14)*D(CA1(-5)) + C(15)
*D(CA1(-6)) + C(16)*D(CA1(-7)) + C(17)*D(CA1(-8)) + C(18)*D(US1(
-1)) + C(19)*D(US1(-2)) + C(20)*D(US1(-3)) + C(21)*D(US1(-4)) +
C(22)*D(US1(-5)) + C(23)*D(US1(-6)) + C(24)*D(US1(-7)) + C(25)
*D(US1(-8)) + C(26)*D(EUI(-1)) + C(27)*D(EUI(-2)) + C(28)*D(EUI(-3))
+ C(29)*D(EUI(-4)) + C(30)*D(EUI(-5)) + C(31)*D(EUI(-6)) + C(32)
*D(EUI(-7)) + C(33)*D(EUI(-8)) + C(34)*D(FFR(-1)) + C(35)*D(FFR(-2))
+ C(36)*D(FFR(-3)) + C(37)*D(FFR(-4)) + C(38)*D(FFR(-5)) + C(39)
*D(FFR(-6)) + C(40)*D(FFR(-7)) + C(41)*D(FFR(-8)) + C(42)*D(M2(-1))
+ C(43)*D(M2(-2)) + C(44)*D(M2(-3)) + C(45)*D(M2(-4)) + C(46)*D(M2(
-5)) + C(47)*D(M2(-6)) + C(48)*D(M2(-7)) + C(49)*D(M2(-8)) + C(50)
*D(VFI(-1)) + C(51)*D(VFI(-2)) + C(52)*D(VFI(-3)) + C(53)*D(VFI(-4)) +

C(54)*D(VFI(-5)) + C(55)*D(VFI(-6)) + C(56)*D(VFI(-7)) + C(57)*D(VFI(
-8)) + C(58)*D(CPI(-1)) + C(59)*D(CPI(-2)) + C(60)*D(CPI(-3)) + C(61)
*D(CPI(-4)) + C(62)*D(CPI(-5)) + C(63)*D(CPI(-6)) + C(64)*D(CPI(-7)) +
C(65)*D(CPI(-8)) + C(66)*D(TB(-1)) + C(67)*D(TB(-2)) + C(68)*D(TB(
-3)) + C(69)*D(TB(-4)) + C(70)*D(TB(-5)) + C(71)*D(TB(-6)) + C(72)
*D(TB(-7)) + C(73)*D(TB(-8)) + C(74)*D(OIL(-1)) + C(75)*D(OIL(-2)) +
C(76)*D(OIL(-3)) + C(77)*D(OIL(-4)) + C(78)*D(OIL(-5)) +
C(79)*D(OIL(
-6)) + C(80)*D(OIL(-7)) + C(81)*D(OIL(-8)) + C(82)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-6.99E-07	0.000182	-0.003830	0.9969
C(2)	0.062213	0.039776	1.564091	0.1179
C(3)	-0.004017	0.039795	-0.100942	0.9196
C(4)	0.016893	0.039663	0.425924	0.6702
C(5)	0.062964	0.039603	1.589875	0.1120
C(6)	-0.029606	0.039695	-0.745852	0.4558
C(7)	-0.036152	0.039757	-0.909321	0.3633
C(8)	0.027954	0.039809	0.702203	0.4826
C(9)	-0.028313	0.039819	-0.711042	0.4771
C(10)	-0.264649	0.225358	-1.174351	0.2404
C(11)	0.079281	0.225461	0.351637	0.7251
C(12)	-0.041555	0.224664	-0.184963	0.8533
C(13)	-0.164825	0.224304	-0.734829	0.4625
C(14)	-0.068029	0.224284	-0.303319	0.7617
C(15)	-0.160801	0.224688	-0.715661	0.4743
C(16)	-0.128756	0.225354	-0.571351	0.5678
C(17)	0.234383	0.225297	1.040325	0.2983
C(18)	-0.002237	0.004744	-0.471631	0.6372
C(19)	0.006814	0.004759	1.431685	0.1523
C(20)	0.002032	0.004763	0.426638	0.6697
C(21)	-0.006613	0.004756	-1.390494	0.1645
C(22)	0.000168	0.004757	0.035341	0.9718
C(23)	-0.003350	0.004763	-0.703415	0.4819
C(24)	0.002728	0.004754	0.573721	0.5662
C(25)	0.006495	0.004738	1.370973	0.1705
C(26)	-0.022109	0.013657	-1.618878	0.1056
C(27)	0.013396	0.015693	0.853610	0.3934
C(28)	0.012602	0.017088	0.737452	0.4609
C(29)	0.005728	0.017718	0.323265	0.7465
C(30)	0.011475	0.017651	0.650104	0.5157
C(31)	0.013530	0.016919	0.799680	0.4240
C(32)	0.018741	0.015476	1.210947	0.2260
C(33)	-0.001523	0.013311	-0.114393	0.9089
C(34)	9.625848	9.377336	1.026501	0.3047
C(35)	-12.25526	9.300994	-1.317629	0.1877
C(36)	-11.17816	9.501697	-1.176438	0.2395

C(37)	11.05800	9.786592	1.129913	0.2586
C(38)	18.75524	9.730875	1.927395	0.0540
C(39)	-0.117804	9.475200	-0.012433	0.9901
C(40)	7.210339	9.256230	0.778971	0.4361
C(41)	-12.45214	9.280855	-1.341702	0.1798
C(42)	0.489539	0.308508	1.586794	0.1127
C(43)	-0.763535	0.419219	-1.821326	0.0687
C(44)	-0.056352	0.404661	-0.139257	0.8893
C(45)	0.166872	0.384377	0.434137	0.6642
C(46)	0.531658	0.385539	1.379001	0.1680
C(47)	-0.303355	0.405482	-0.748133	0.4544
C(48)	-0.399004	0.422402	-0.944607	0.3449
C(49)	0.074347	0.312304	0.238059	0.8119
C(50)	-0.030370	0.048222	-0.629796	0.5289
C(51)	-0.025732	0.045158	-0.569814	0.5688
C(52)	-0.030362	0.041892	-0.724758	0.4687
C(53)	-0.023386	0.038351	-0.609797	0.5420
C(54)	-0.001002	0.034452	-0.029089	0.9768
C(55)	0.003007	0.029993	0.100259	0.9201
C(56)	0.008179	0.024567	0.332915	0.7392
C(57)	0.003734	0.017455	0.213947	0.8306
C(58)	276.7325	635.2139	0.435652	0.6631
C(59)	471.1413	633.2745	0.743976	0.4570
C(60)	46.28816	631.3921	0.073311	0.9416
C(61)	904.2703	632.4658	1.429754	0.1529
C(62)	1650.071	633.0653	2.606478	0.0092
C(63)	1475.088	633.4903	2.328509	0.0200
C(64)	461.4660	647.8896	0.712260	0.4764
C(65)	-827.6532	648.3328	-1.276587	0.2019
C(66)	-4.496433	18.12303	-0.248106	0.8041
C(67)	-5.339302	18.19157	-0.293504	0.7692
C(68)	54.91524	18.20659	3.016230	0.0026
C(69)	-20.32438	18.19122	-1.117263	0.2640
C(70)	-26.59310	18.20831	-1.460493	0.1443
C(71)	-3.387920	18.22604	-0.185884	0.8525
C(72)	11.23093	18.20181	0.617023	0.5373
C(73)	71.96923	18.20047	3.954252	0.0001
C(74)	0.148642	0.411895	0.360874	0.7182
C(75)	-0.266128	0.413602	-0.643439	0.5200
C(76)	-0.558715	0.415595	-1.344373	0.1789
C(77)	-0.867343	0.415512	-2.087406	0.0369
C(78)	0.182112	0.415753	0.438030	0.6614
C(79)	0.086457	0.416289	0.207686	0.8355
C(80)	0.817298	0.416043	1.964453	0.0496
C(81)	-0.072566	0.416020	-0.174430	0.8615
C(82)	0.245461	0.858254	0.286001	0.7749

R-squared	0.042097	Mean dependent var	-0.158054

Adjusted R-squared	0.014651	S.D. dependent var	34.17567
S.E. of regression	33.92440	Akaike info criterion	9.913929
Sum squared resid	3253495.	Schwarz criterion	10.08237
Log likelihood	-14337.81	Hannan-Quinn criter.	9.974612
F-statistic	1.533801	Durbin-Watson stat	1.990454
Prob(F-statistic)	0.001728		

Dependent Variable: D(CHN2)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 06/10/18 Time: 14:58
Sample (adjusted): 5/15/2006 7/06/2017
Included observations: 2909 after adjustments
D(CHN2) = C(1)*(CHN2(-1) - 0.387329146169*CHN1(-1) + 0.190167175511*US1(-1) - 8.19535158901*EUI(-1) + 810.821676742 *FFR(-1) + 0.395479521634*M2(-1) + 154.720547727*VFI(-1) - 12515.1274288*CPI(-1) - 997.950203313*TB(-1) + 27.4182531053 *OIL(-1) + 1662.30509341) + C(2)*D(CHN2(-1)) + C(3)*D(CHN2(-2)) + C(4)*D(CHN2(-3)) + C(5)*D(CHN2(-4)) + C(6)*D(CHN2(-5)) + C(7) *D(CHN2(-6)) + C(8)*D(CHN2(-7)) + C(9)*D(CHN2(-8)) + C(10) *D(CHN1(-1)) + C(11)*D(CHN1(-2)) + C(12)*D(CHN1(-3)) + C(13) *D(CHN1(-4)) + C(14)*D(CHN1(-5)) + C(15)*D(CHN1(-6)) + C(16) *D(CHN1(-7)) + C(17)*D(CHN1(-8)) + C(18)*D(US1(-1)) + C(19) *D(US1(-2)) + C(20)*D(US1(-3)) + C(21)*D(US1(-4)) + C(22)*D(US1(-5)) + C(23)*D(US1(-6)) + C(24)*D(US1(-7)) + C(25)*D(US1(-8)) + C(26)*D(EUI(-1)) + C(27)*D(EUI(-2)) + C(28)*D(EUI(-3)) + C(29)*D(EUI(-4)) + C(30)*D(EUI(-5)) + C(31)*D(EUI(-6)) + C(32)*D(EUI(-7)) + C(33) *D(EUI(-8)) + C(34)*D(FFR(-1)) + C(35)*D(FFR(-2)) + C(36)*D(FFR(-3)) + C(37)*D(FFR(-4)) + C(38)*D(FFR(-5)) + C(39)*D(FFR(-6)) + C(40) *D(FFR(-7)) + C(41)*D(FFR(-8)) + C(42)*D(M2(-1)) + C(43)*D(M2(-2)) + C(44)*D(M2(-3)) + C(45)*D(M2(-4)) + C(46)*D(M2(-5)) + C(47)*D(M2(-6)) + C(48)*D(M2(-7)) + C(49)*D(M2(-8)) + C(50)*D(VFI(-1)) + C(51) *D(VFI(-2)) + C(52)*D(VFI(-3)) + C(53)*D(VFI(-4)) + C(54)*D(VFI(-5)) + C(55)*D(VFI(-6)) + C(56)*D(VFI(-7)) + C(57)*D(VFI(-8)) + C(58)*D(CPI(-1)) + C(59)*D(CPI(-2)) + C(60)*D(CPI(-3)) + C(61)*D(CPI(-4)) + C(62) *D(CPI(-5)) + C(63)*D(CPI(-6)) + C(64)*D(CPI(-7)) + C(65)*D(CPI(-8)) + C(66)*D(TB(-1)) + C(67)*D(TB(-2)) + C(68)*D(TB(-3)) + C(69)*D(TB(- 4)) + C(70)*D(TB(-5)) + C(71)*D(TB(-6)) + C(72)*D(TB(-7)) + C(73)*D(TB(-8)) + C(74)*D(OIL(-1)) + C(75)*D(OIL(-2)) + C(76)*D(OIL(-3)) + C(77) *D(OIL(-4)) + C(78)*D(OIL(-5)) + C(79)*D(OIL(-6)) + C(80)*D(OIL(-7)) + C(81)*D(OIL(-8)) + C(82)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	9.29E-05	0.000219	0.423111	0.6722

C(2)	-0.041947	0.018758	-2.236276	0.0254
C(3)	0.004925	0.018806	0.261859	0.7934
C(4)	0.010504	0.018740	0.560528	0.5752
C(5)	-0.010927	0.018749	-0.582817	0.5601
C(6)	-0.037135	0.018768	-1.978630	0.0480
C(7)	-0.052382	0.018822	-2.782950	0.0054
C(8)	0.007562	0.018859	0.400994	0.6885
C(9)	-0.009834	0.018864	-0.521311	0.6022
C(10)	0.007064	0.006478	1.090510	0.2756
C(11)	0.000969	0.006491	0.149353	0.8813
C(12)	0.003723	0.006510	0.571913	0.5674
C(13)	0.002714	0.006483	0.418713	0.6755
C(14)	-0.001146	0.006504	-0.176234	0.8601
C(15)	-0.005398	0.006504	-0.830021	0.4066
C(16)	-0.001311	0.006482	-0.202318	0.8397
C(17)	0.005071	0.006461	0.784844	0.4326
C(18)	0.001396	0.003150	0.443190	0.6577
C(19)	0.006385	0.003165	2.017120	0.0438
C(20)	0.000859	0.003169	0.271125	0.7863
C(21)	-0.001079	0.003162	-0.341284	0.7329
C(22)	0.010574	0.003159	3.346867	0.0008
C(23)	0.010992	0.003170	3.467590	0.0005
C(24)	0.000226	0.003170	0.071344	0.9431
C(25)	0.004663	0.003157	1.476903	0.1398
C(26)	-0.025652	0.009024	-2.842561	0.0045
C(27)	-0.013735	0.010396	-1.321145	0.1866
C(28)	-0.008403	0.011319	-0.742393	0.4579
C(29)	-0.006128	0.011736	-0.522154	0.6016
C(30)	-0.007063	0.011694	-0.603961	0.5459
C(31)	-0.000864	0.011200	-0.077163	0.9385
C(32)	0.001406	0.010254	0.137107	0.8910
C(33)	-0.001963	0.008821	-0.222583	0.8239
C(34)	-14.96195	6.255610	-2.391766	0.0168
C(35)	-8.913112	6.193417	-1.439127	0.1502
C(36)	18.96544	6.313382	3.004006	0.0027
C(37)	12.25308	6.519781	1.879370	0.0603
C(38)	1.788981	6.489181	0.275687	0.7828
C(39)	15.63334	6.313330	2.476244	0.0133
C(40)	7.615422	6.164956	1.235276	0.2168
C(41)	-30.02548	6.185098	-4.854487	0.0000
C(42)	0.095058	0.204588	0.464633	0.6422
C(43)	0.115595	0.277776	0.416143	0.6773
C(44)	-0.661765	0.268656	-2.463242	0.0138
C(45)	0.070399	0.255116	0.275949	0.7826
C(46)	0.246928	0.255795	0.965335	0.3345
C(47)	-0.282053	0.268546	-1.050297	0.2937
C(48)	0.836300	0.278864	2.998951	0.0027
C(49)	-0.645829	0.206629	-3.125545	0.0018

C(50)	-0.008347	0.032067	-0.260309	0.7946
C(51)	-0.011769	0.030027	-0.391946	0.6951
C(52)	-0.012017	0.027844	-0.431591	0.6661
C(53)	-0.014824	0.025477	-0.581859	0.5607
C(54)	-0.019755	0.022874	-0.863665	0.3878
C(55)	-0.006519	0.019900	-0.327576	0.7433
C(56)	-0.002179	0.016289	-0.133774	0.8936
C(57)	0.000226	0.011565	0.019564	0.9844
C(58)	982.5400	421.0174	2.333728	0.0197
C(59)	-502.5103	420.4508	-1.195170	0.2321
C(60)	365.2593	420.0295	0.869604	0.3846
C(61)	-464.8341	420.5762	-1.105232	0.2692
C(62)	755.2317	421.0408	1.793726	0.0730
C(63)	-727.1357	420.6168	-1.728737	0.0840
C(64)	-104.2841	430.0881	-0.242471	0.8084
C(65)	156.7554	430.3408	0.364259	0.7157
C(66)	-26.69419	12.15017	-2.197021	0.0281
C(67)	-12.02141	12.17905	-0.987057	0.3237
C(68)	-40.35347	12.19801	-3.308201	0.0010
C(69)	-1.439720	12.17465	-0.118256	0.9059
C(70)	-1.590391	12.15454	-0.130848	0.8959
C(71)	-11.34092	12.17254	-0.931681	0.3516
C(72)	-10.99506	12.16183	-0.904063	0.3660
C(73)	9.963444	12.15476	0.819715	0.4124
C(74)	-0.550200	0.272112	-2.021963	0.0433
C(75)	0.134675	0.273414	0.492570	0.6224
C(76)	-0.498496	0.274861	-1.813631	0.0698
C(77)	0.204198	0.275218	0.741948	0.4582
C(78)	0.095647	0.275279	0.347456	0.7283
C(79)	-0.090489	0.275931	-0.327941	0.7430
C(80)	0.244471	0.275882	0.886143	0.3756
C(81)	-0.323435	0.275885	-1.172358	0.2412
C(82)	0.455123	0.568851	0.800075	0.4237

R-squared	0.062111	Mean dependent var	0.207913
Adjusted R-squared	0.035238	S.D. dependent var	22.87594
S.E. of regression	22.46928	Akaike info criterion	9.089958
Sum squared resid	1427263.	Schwarz criterion	9.258400
Log likelihood	-13139.34	Hannan-Quinn criter.	9.150641
F-statistic	2.311301	Durbin-Watson stat	2.003618
Prob(F-statistic)	0.000000		

Dependent Variable: D(IND2)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 06/10/18 Time: 15:06
Sample (adjusted): 1/01/2010 6/16/2017
Included observations: 1946 after adjustments
D(IND2) = C(1)*(IND2(-1) - 1.76992375791*IND1(-1) - 0.577336928391 *US1(-1) + 20.2210906253*EUI(-1) - 67322.2857425*FFR(-1) + 0.484875627709*M2(-1) - 12.1417312577*VFI(-1) + 73081.0888479 *CPI(-1) + 69538.0020669*TB(-1) - 57.5269713801*OIL(-1) - 67652.6595148) + C(2)*D(IND2(-1)) + C(3)*D(IND2(-2)) + C(4) *D(IND2(-3)) + C(5)*D(IND2(-4)) + C(6)*D(IND2(-5)) + C(7)*D(IND2(-6)) + C(8)*D(IND2(-7)) + C(9)*D(IND2(-8)) + C(10)*D(IND1(-1)) + C(11) *D(IND1(-2)) + C(12)*D(IND1(-3)) + C(13)*D(IND1(-4)) + C(14) *D(IND1(-5)) + C(15)*D(IND1(-6)) + C(16)*D(IND1(-7)) + C(17) *D(IND1(-8)) + C(18)*D(US1(-1)) + C(19)*D(US1(-2)) + C(20)*D(US1(-3)) + C(21)*D(US1(-4)) + C(22)*D(US1(-5)) + C(23)*D(US1(-6)) + C(24)*D(US1(-7)) + C(25)*D(US1(-8)) + C(26)*D(EUI(-1)) + C(27) *D(EUI(-2)) + C(28)*D(EUI(-3)) + C(29)*D(EUI(-4)) + C(30)*D(EUI(-5)) + C(31)*D(EUI(-6)) + C(32)*D(EUI(-7)) + C(33)*D(EUI(-8)) + C(34) *D(FFR(-1)) + C(35)*D(FFR(-2)) + C(36)*D(FFR(-3)) + C(37)*D(FFR(-4)) + C(38)*D(FFR(-5)) + C(39)*D(FFR(-6)) + C(40)*D(FFR(-7)) + C(41) *D(FFR(-8)) + C(42)*D(M2(-1)) + C(43)*D(M2(-2)) + C(44)*D(M2(-3)) + C(45)*D(M2(-4)) + C(46)*D(M2(-5)) + C(47)*D(M2(-6)) + C(48)*D(M2(-7)) + C(49)*D(M2(-8)) + C(50)*D(VFI(-1)) + C(51)*D(VFI(-2)) + C(52) *D(VFI(-3)) + C(53)*D(VFI(-4)) + C(54)*D(VFI(-5)) + C(55)*D(VFI(-6)) + C(56)*D(VFI(-7)) + C(57)*D(VFI(-8)) + C(58)*D(CPI(-1)) + C(59)*D(CPI(-2)) + C(60)*D(CPI(-3)) + C(61)*D(CPI(-4)) + C(62)*D(CPI(-5)) + C(63) *D(CPI(-6)) + C(64)*D(CPI(-7)) + C(65)*D(CPI(-8)) + C(66)*D(TB(-1)) + C(67)*D(TB(-2)) + C(68)*D(TB(-3)) + C(69)*D(TB(-4)) + C(70)*D(TB(-5)) + C(71)*D(TB(-6)) + C(72)*D(TB(-7)) + C(73)*D(TB(-8)) + C(74)*D(OIL(-1)) + C(75)*D(OIL(-2)) + C(76)*D(OIL(-3)) + C(77)*D(OIL(-4)) + C(78) *D(OIL(-5)) + C(79)*D(OIL(-6)) + C(80)*D(OIL(-7)) + C(81)*D(OIL(-8)) + C(82)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.000139	0.000337	0.411701	0.6806
C(2)	0.044327	0.023137	1.915864	0.0555
C(3)	0.003607	0.023184	0.155570	0.8764
C(4)	-0.001350	0.023162	-0.058303	0.9535

C(5)	-0.023512	0.023109	-1.017412	0.3091
C(6)	0.034525	0.023035	1.498760	0.1341
C(7)	-0.038134	0.023102	-1.650677	0.0990
C(8)	0.027976	0.023145	1.208720	0.2269
C(9)	-0.018603	0.023120	-0.804640	0.4211
C(10)	-0.025561	0.046935	-0.544616	0.5861
C(11)	-0.043068	0.047059	-0.915180	0.3602
C(12)	0.054616	0.047043	1.160983	0.2458
C(13)	0.042548	0.046955	0.906143	0.3650
C(14)	0.074929	0.046844	1.599542	0.1099
C(15)	-0.019222	0.046797	-0.410760	0.6813
C(16)	-0.017594	0.046665	-0.377035	0.7062
C(17)	-0.048570	0.046712	-1.039779	0.2986
C(18)	-0.002200	0.006245	-0.352266	0.7247
C(19)	0.006297	0.006248	1.007855	0.3137
C(20)	-0.005932	0.006253	-0.948725	0.3429
C(21)	0.016220	0.006209	2.612467	0.0091
C(22)	0.001975	0.006221	0.317569	0.7508
C(23)	0.002567	0.006228	0.412145	0.6803
C(24)	0.003541	0.006206	0.570600	0.5683
C(25)	0.002192	0.006194	0.353869	0.7235
C(26)	0.019437	0.018074	1.075447	0.2823
C(27)	-0.012156	0.020717	-0.586770	0.5574
C(28)	-0.006038	0.022250	-0.271374	0.7861
C(29)	-0.011822	0.022932	-0.515536	0.6062
C(30)	0.034099	0.022767	1.497737	0.1344
C(31)	-0.006757	0.021864	-0.309056	0.7573
C(32)	-0.024891	0.020082	-1.239427	0.2153
C(33)	-0.009136	0.017099	-0.534282	0.5932
C(34)	36.51941	45.03914	0.810837	0.4176
C(35)	60.89845	47.74388	1.275524	0.2023
C(36)	39.49086	48.38255	0.816221	0.4145
C(37)	49.39568	48.58980	1.016585	0.3095
C(38)	44.58688	48.56230	0.918138	0.3587
C(39)	28.12654	48.01907	0.585737	0.5581
C(40)	-36.57830	46.20912	-0.791582	0.4287
C(41)	11.11579	42.84328	0.259452	0.7953
C(42)	-0.342521	0.361098	-0.948554	0.3430
C(43)	0.184123	0.488595	0.376842	0.7063
C(44)	-0.079637	0.467230	-0.170445	0.8647
C(45)	0.487610	0.439375	1.109782	0.2672
C(46)	0.144455	0.440788	0.327720	0.7432
C(47)	-0.863104	0.469478	-1.838432	0.0662
C(48)	0.748371	0.493371	1.516850	0.1295
C(49)	0.048758	0.365320	0.133467	0.8938
C(50)	0.305229	0.514079	0.593739	0.5528
C(51)	0.125931	0.517851	0.243179	0.8079
C(52)	0.409755	0.521074	0.786366	0.4318

C(53)	0.838189	0.524198	1.598993	0.1100
C(54)	0.669350	0.525292	1.274246	0.2027
C(55)	0.693393	0.520827	1.331331	0.1832
C(56)	0.301807	0.501609	0.601678	0.5475
C(57)	0.295606	0.494807	0.597417	0.5503
C(58)	437.7599	990.7394	0.441852	0.6586
C(59)	-764.9385	1028.107	-0.744026	0.4570
C(60)	-319.3609	1050.752	-0.303936	0.7612
C(61)	-1018.511	1054.114	-0.966224	0.3341
C(62)	316.0139	1053.068	0.300089	0.7641
C(63)	-2123.584	1051.666	-2.019256	0.0436
C(64)	-1084.024	1052.663	-1.029792	0.3032
C(65)	697.2340	1051.126	0.663321	0.5072
C(66)	92.16790	97.24514	0.947789	0.3434
C(67)	-30.23255	96.90870	-0.311969	0.7551
C(68)	-60.74085	96.81992	-0.627359	0.5305
C(69)	-37.13249	96.95085	-0.383003	0.7018
C(70)	-14.95365	96.60158	-0.154797	0.8770
C(71)	-82.68319	96.59417	-0.855985	0.3921
C(72)	-47.31356	94.84539	-0.498849	0.6179
C(73)	-16.83546	93.89367	-0.179303	0.8577
C(74)	-0.209934	0.569554	-0.368594	0.7125
C(75)	0.146223	0.571575	0.255825	0.7981
C(76)	-0.620404	0.592494	-1.047107	0.2952
C(77)	0.901113	0.592966	1.519670	0.1288
C(78)	0.538642	0.594387	0.906215	0.3649
C(79)	0.003167	0.595559	0.005318	0.9958
C(80)	-0.486902	0.595168	-0.818091	0.4134
C(81)	0.099345	0.593749	0.167319	0.8671
C(82)	-0.454008	1.108751	-0.409477	0.6822

R-squared	0.041127	Mean dependent var	0.315730
Adjusted R-squared	-0.000541	S.D. dependent var	33.11315
S.E. of regression	33.12210	Akaike info criterion	9.879503
Sum squared resid	2044946.	Schwarz criterion	10.11436
Log likelihood	-9530.756	Hannan-Quinn criter.	9.965857
F-statistic	0.987021	Durbin-Watson stat	1.992842
Prob(F-statistic)	0.512793		

Dependent Variable: D(JP2)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 06/10/18 Time: 15:08
Sample (adjusted): 5/15/2006 7/06/2017
Included observations: 2909 after adjustments
D(JP2) = C(1)*(JP2(-1) - 83.4875681421*JP1(-1) + 4.84355478441*US1(
-1) - 144.616610314*EUI(-1) + 19451.4624151*FFR(-1) -
2.34490018336*M2(-1) + 2736.24802132*VFI(-1) + 51949.14808*CPI(

-1) - 22002.7520488*TB(-1) + 474.99150805*OIL(-1) - 143571.119605
) + C(2)*D(JP2(-1)) + C(3)*D(JP2(-2)) + C(4)*D(JP2(-3)) + C(5)*D(JP2(
-4)) + C(6)*D(JP2(-5)) + C(7)*D(JP2(-6)) + C(8)*D(JP2(-7)) + C(9)
*D(JP2(-8)) + C(10)*D(JP1(-1)) + C(11)*D(JP1(-2)) + C(12)*D(JP1(-3))
+ C(13)*D(JP1(-4)) + C(14)*D(JP1(-5)) + C(15)*D(JP1(-6)) + C(16)
*D(JP1(-7)) + C(17)*D(JP1(-8)) + C(18)*D(US1(-1)) + C(19)*D(US1(-2))
+ C(20)*D(US1(-3)) + C(21)*D(US1(-4)) + C(22)*D(US1(-5)) + C(23)
*D(US1(-6)) + C(24)*D(US1(-7)) + C(25)*D(US1(-8)) + C(26)*D(EUI(-
1))
+ C(27)*D(EUI(-2)) + C(28)*D(EUI(-3)) + C(29)*D(EUI(-4)) + C(30)
*D(EUI(-5)) + C(31)*D(EUI(-6)) + C(32)*D(EUI(-7)) + C(33)*D(EUI(-8))
+
C(34)*D(FFR(-1)) + C(35)*D(FFR(-2)) + C(36)*D(FFR(-3)) + C(37)
*D(FFR(-4)) + C(38)*D(FFR(-5)) + C(39)*D(FFR(-6)) + C(40)*D(FFR(-
7))
+ C(41)*D(FFR(-8)) + C(42)*D(M2(-1)) + C(43)*D(M2(-2)) + C(44)
*D(M2(-3)) + C(45)*D(M2(-4)) + C(46)*D(M2(-5)) + C(47)*D(M2(-6)) +
C(48)*D(M2(-7)) + C(49)*D(M2(-8)) + C(50)*D(VFI(-1)) + C(51)*D(VFI(
-2)) + C(52)*D(VFI(-3)) + C(53)*D(VFI(-4)) + C(54)*D(VFI(-5)) + C(55)
*D(VFI(-6)) + C(56)*D(VFI(-7)) + C(57)*D(VFI(-8)) + C(58)*D(CPI(-1))
+
C(59)*D(CPI(-2)) + C(60)*D(CPI(-3)) + C(61)*D(CPI(-4)) +
C(62)*D(CPI(
-5)) + C(63)*D(CPI(-6)) + C(64)*D(CPI(-7)) + C(65)*D(CPI(-8)) + C(66)
*D(TB(-1)) + C(67)*D(TB(-2)) + C(68)*D(TB(-3)) + C(69)*D(TB(-4)) +
C(70)*D(TB(-5)) + C(71)*D(TB(-6)) + C(72)*D(TB(-7)) + C(73)*D(TB(-
8))
+ C(74)*D(OIL(-1)) + C(75)*D(OIL(-2)) + C(76)*D(OIL(-3)) + C(77)
*D(OIL(-4)) + C(78)*D(OIL(-5)) + C(79)*D(OIL(-6)) + C(80)*D(OIL(-7))
+
C(81)*D(OIL(-8)) + C(82)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-3.93E-06	7.41E-06	-0.530153	0.5960
C(2)	-0.157683	0.018798	-8.388367	0.0000
C(3)	-0.096253	0.018988	-5.069206	0.0000
C(4)	-0.058104	0.019052	-3.049787	0.0023
C(5)	-0.033256	0.019259	-1.726775	0.0843
C(6)	-0.017893	0.019281	-0.927990	0.3535
C(7)	-0.028362	0.019258	-1.472740	0.1409
C(8)	-0.018682	0.019168	-0.974646	0.3298
C(9)	-0.030566	0.018062	-1.692272	0.0907
C(10)	0.743253	0.042613	17.44185	0.0000
C(11)	0.045741	0.044842	1.020054	0.3078
C(12)	0.024403	0.044795	0.544768	0.5860
C(13)	0.092602	0.044764	2.068688	0.0387
C(14)	0.118791	0.044764	2.653738	0.0080

C(15)	-0.046641	0.044565	-1.046586	0.2954
C(16)	0.039363	0.044668	0.881240	0.3783
C(17)	-0.016920	0.044735	-0.378219	0.7053
C(18)	-0.002782	0.001884	-1.476902	0.1398
C(19)	0.001383	0.001891	0.731395	0.4646
C(20)	0.001154	0.001893	0.609551	0.5422
C(21)	0.002557	0.001891	1.352295	0.1764
C(22)	0.002063	0.001892	1.090553	0.2756
C(23)	0.000921	0.001893	0.486668	0.6265
C(24)	0.004125	0.001891	2.181663	0.0292
C(25)	0.003449	0.001884	1.830675	0.0673
C(26)	0.001625	0.005408	0.300403	0.7639
C(27)	-0.008608	0.006225	-1.382842	0.1668
C(28)	-0.009147	0.006794	-1.346391	0.1783
C(29)	-0.009418	0.007045	-1.336881	0.1814
C(30)	-0.010576	0.007025	-1.505329	0.1324
C(31)	-0.016445	0.006735	-2.441592	0.0147
C(32)	-0.006754	0.006156	-1.097067	0.2727
C(33)	-0.008555	0.005292	-1.616603	0.1061
C(34)	4.641515	3.726662	1.245489	0.2131
C(35)	0.534460	3.696524	0.144584	0.8850
C(36)	4.114467	3.775349	1.089824	0.2759
C(37)	9.399962	3.885471	2.419259	0.0156
C(38)	-1.695189	3.863443	-0.438777	0.6609
C(39)	6.820921	3.755262	1.816364	0.0694
C(40)	1.946264	3.667290	0.530709	0.5957
C(41)	1.826968	3.678913	0.496605	0.6195
C(42)	-0.081959	0.122763	-0.667619	0.5044
C(43)	0.080754	0.166718	0.484378	0.6282
C(44)	-0.219251	0.161037	-1.361499	0.1735
C(45)	0.030843	0.153022	0.201557	0.8403
C(46)	0.208363	0.153354	1.358710	0.1743
C(47)	-0.045695	0.161096	-0.283651	0.7767
C(48)	-0.094859	0.167565	-0.566100	0.5714
C(49)	0.006446	0.123823	0.052060	0.9585
C(50)	0.010994	0.019152	0.574041	0.5660
C(51)	0.015170	0.017933	0.845918	0.3977
C(52)	0.008439	0.016638	0.507218	0.6120
C(53)	0.007487	0.015234	0.491445	0.6231
C(54)	-0.002375	0.013687	-0.173531	0.8622
C(55)	-0.010299	0.011919	-0.864082	0.3876
C(56)	-0.010462	0.009764	-1.071486	0.2840
C(57)	-0.003932	0.006936	-0.566828	0.5709
C(58)	-15.45182	252.4545	-0.061206	0.9512
C(59)	412.6070	251.7079	1.639230	0.1013
C(60)	-16.12205	251.1374	-0.064196	0.9488
C(61)	120.2795	251.6391	0.477984	0.6327
C(62)	-26.66770	251.7175	-0.105943	0.9156

C(63)	236.5614	251.2576	0.941509	0.3465
C(64)	424.8560	257.1211	1.652358	0.0986
C(65)	7.880808	257.3782	0.030620	0.9756
C(66)	5.978243	7.204931	0.829743	0.4068
C(67)	-5.382839	7.230450	-0.744468	0.4567
C(68)	-10.53265	7.239388	-1.454909	0.1458
C(69)	1.068067	7.223179	0.147867	0.8825
C(70)	2.666282	7.229401	0.368811	0.7123
C(71)	-5.303279	7.235759	-0.732926	0.4637
C(72)	-5.333141	7.228971	-0.737746	0.4607
C(73)	-6.827604	7.240736	-0.942943	0.3458
C(74)	0.115505	0.163717	0.705518	0.4805
C(75)	-0.223254	0.164451	-1.357569	0.1747
C(76)	0.353890	0.165229	2.141808	0.0323
C(77)	-0.014073	0.165243	-0.085167	0.9321
C(78)	-0.232733	0.165224	-1.408587	0.1591
C(79)	0.168410	0.165559	1.017221	0.3091
C(80)	-0.317547	0.165619	-1.917339	0.0553
C(81)	-0.219482	0.165411	-1.326892	0.1847
C(82)	0.203031	0.341307	0.594862	0.5520

R-squared	0.146719	Mean dependent var	0.045820
Adjusted R-squared	0.122270	S.D. dependent var	14.38116
S.E. of regression	13.47331	Akaike info criterion	8.067081
Sum squared resid	513185.3	Schwarz criterion	8.235523
Log likelihood	-11651.57	Hannan-Quinn criter.	8.127764
F-statistic	6.001148	Durbin-Watson stat	2.008106
Prob(F-statistic)	0.000000		

Dependent Variable: D(KWT2)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 06/10/18 Time: 15:12
Sample (adjusted): 8/29/2006 7/09/2014
Included observations: 2052 after adjustments
D(KWT2) = C(1)*(KWT2(-1) - 0.845873517233*KWT1(-1) - 0.108184272228*US1(-1) + 3.23421402135*EUI(-1) - 703.923023791 *FFR(-1) + 0.124819856669*M2(-1) - 47.6696022785*VFI(-1) + 776.647032278*CPI(-1) + 582.705668029*TB(-1) - 2.90356018415 *OIL(-1) + 480.422391136) + C(2)*D(KWT2(-1)) + C(3)*D(KWT2(-2)) + C(4)*D(KWT2(-3)) + C(5)*D(KWT2(-4)) + C(6)*D(KWT2(-5)) + C(7) *D(KWT2(-6)) + C(8)*D(KWT2(-7)) + C(9)*D(KWT2(-8)) + C(10) *D(KWT1(-1)) + C(11)*D(KWT1(-2)) + C(12)*D(KWT1(-3)) + C(13) *D(KWT1(-4)) + C(14)*D(KWT1(-5)) + C(15)*D(KWT1(-6)) + C(16) *D(KWT1(-7)) + C(17)*D(KWT1(-8)) + C(18)*D(US1(-1)) + C(19) *D(US1(-2)) + C(20)*D(US1(-3)) + C(21)*D(US1(-4)) + C(22)*D(US1(-5)) + C(23)*D(US1(-6)) + C(24)*D(US1(-7)) + C(25)*D(US1(-8)) +

C(26)*D(EUI(-1)) + C(27)*D(EUI(-2)) + C(28)*D(EUI(-3)) +
C(29)*D(EUI(
-4)) + C(30)*D(EUI(-5)) + C(31)*D(EUI(-6)) + C(32)*D(EUI(-7)) + C(33)
*D(EUI(-8)) + C(34)*D(FFR(-1)) + C(35)*D(FFR(-2)) + C(36)*D(FFR(-
3))
+ C(37)*D(FFR(-4)) + C(38)*D(FFR(-5)) + C(39)*D(FFR(-6)) + C(40)
*D(FFR(-7)) + C(41)*D(FFR(-8)) + C(42)*D(M2(-1)) + C(43)*D(M2(-2))
+
C(44)*D(M2(-3)) + C(45)*D(M2(-4)) + C(46)*D(M2(-5)) + C(47)*D(M2(
-6)) + C(48)*D(M2(-7)) + C(49)*D(M2(-8)) + C(50)*D(VFI(-1)) + C(51)
*D(VFI(-2)) + C(52)*D(VFI(-3)) + C(53)*D(VFI(-4)) + C(54)*D(VFI(-5))
+
C(55)*D(VFI(-6)) + C(56)*D(VFI(-7)) + C(57)*D(VFI(-8)) +
C(58)*D(CPI(
-1)) + C(59)*D(CPI(-2)) + C(60)*D(CPI(-3)) + C(61)*D(CPI(-4)) + C(62)
*D(CPI(-5)) + C(63)*D(CPI(-6)) + C(64)*D(CPI(-7)) + C(65)*D(CPI(-8))
+
C(66)*D(TB(-1)) + C(67)*D(TB(-2)) + C(68)*D(TB(-3)) + C(69)*D(TB(-
4))
+ C(70)*D(TB(-5)) + C(71)*D(TB(-6)) + C(72)*D(TB(-7)) + C(73)*D(TB(
-8)) + C(74)*D(OIL(-1)) + C(75)*D(OIL(-2)) + C(76)*D(OIL(-3)) + C(77)
*D(OIL(-4)) + C(78)*D(OIL(-5)) + C(79)*D(OIL(-6)) + C(80)*D(OIL(-7))
+
C(81)*D(OIL(-8)) + C(82)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.010498	0.002676	-3.922623	0.0001
C(2)	-0.008695	0.021889	-0.397240	0.6912
C(3)	0.010747	0.021817	0.492594	0.6224
C(4)	0.069959	0.021589	3.240489	0.0012
C(5)	0.003237	0.021667	0.149420	0.8812
C(6)	-0.052484	0.021775	-2.410283	0.0160
C(7)	-0.066357	0.021778	-3.046924	0.0023
C(8)	-0.018142	0.021879	-0.829192	0.4071
C(9)	0.060130	0.021776	2.761343	0.0058
C(10)	0.084536	0.025392	3.329247	0.0009
C(11)	-0.018097	0.025543	-0.708493	0.4787
C(12)	0.011387	0.025478	0.446930	0.6550
C(13)	-0.012005	0.025487	-0.471034	0.6377
C(14)	-0.107407	0.025517	-4.209285	0.0000
C(15)	-0.082178	0.025416	-3.233282	0.0012
C(16)	0.080553	0.025374	3.174649	0.0015
C(17)	0.147798	0.025636	5.765186	0.0000
C(18)	-0.034683	0.013297	-2.608248	0.0092
C(19)	0.014072	0.013443	1.046810	0.2953
C(20)	0.000920	0.013445	0.068393	0.9455
C(21)	0.000904	0.013475	0.067077	0.9465

C(22)	-0.004104	0.013467	-0.304721	0.7606
C(23)	0.016812	0.013531	1.242420	0.2142
C(24)	-0.008060	0.013502	-0.596986	0.5506
C(25)	-0.008566	0.013424	-0.638069	0.5235
C(26)	-0.014327	0.035840	-0.399760	0.6894
C(27)	0.036414	0.040799	0.892513	0.3722
C(28)	-0.029842	0.044546	-0.669929	0.5030
C(29)	-0.020215	0.046283	-0.436777	0.6623
C(30)	0.001256	0.046234	0.027159	0.9783
C(31)	-0.027930	0.044295	-0.630543	0.5284
C(32)	-0.050663	0.040313	-1.256751	0.2090
C(33)	-0.075607	0.034886	-2.167229	0.0303
C(34)	-32.17092	23.44863	-1.371974	0.1702
C(35)	37.49356	23.02309	1.628520	0.1036
C(36)	3.855341	23.59450	0.163400	0.8702
C(37)	74.45028	24.29051	3.064994	0.0022
C(38)	17.23871	24.02202	0.717621	0.4731
C(39)	78.02445	23.23633	3.357865	0.0008
C(40)	-12.94761	22.72001	-0.569877	0.5688
C(41)	113.8958	22.81061	4.993108	0.0000
C(42)	1.454728	0.865819	1.680176	0.0931
C(43)	-2.186460	1.184769	-1.845474	0.0651
C(44)	-0.309133	1.147983	-0.269284	0.7877
C(45)	1.175830	1.092918	1.075864	0.2821
C(46)	-2.370831	1.097853	-2.159515	0.0309
C(47)	4.284412	1.146975	3.735403	0.0002
C(48)	-1.620199	1.192367	-1.358809	0.1744
C(49)	-0.006596	0.880003	-0.007495	0.9940
C(50)	-0.442927	0.119957	-3.692377	0.0002
C(51)	-0.395915	0.111937	-3.536936	0.0004
C(52)	-0.309347	0.103503	-2.988788	0.0028
C(53)	-0.153704	0.094412	-1.628019	0.1037
C(54)	-0.105222	0.084372	-1.247131	0.2125
C(55)	-0.063128	0.072891	-0.866058	0.3866
C(56)	-0.122536	0.059147	-2.071732	0.0384
C(57)	-0.107470	0.041614	-2.582532	0.0099
C(58)	-2120.959	1629.496	-1.301605	0.1932
C(59)	-606.5980	1621.049	-0.374201	0.7083
C(60)	-3534.844	1610.296	-2.195151	0.0283
C(61)	3.342985	1616.068	0.002069	0.9983
C(62)	-1661.844	1616.021	-1.028355	0.3039
C(63)	2999.476	1614.524	1.857808	0.0633
C(64)	318.9319	1663.626	0.191709	0.8480
C(65)	1701.355	1664.084	1.022397	0.3067
C(66)	16.83179	44.28194	0.380105	0.7039
C(67)	5.958461	44.20489	0.134792	0.8928
C(68)	-59.40220	44.23246	-1.342955	0.1794
C(69)	-71.44966	44.16408	-1.617823	0.1059

C(70)	-58.13152	44.12449	-1.317443	0.1878
C(71)	153.2347	44.13029	3.472324	0.0005
C(72)	133.5782	44.22537	3.020397	0.0026
C(73)	229.2192	44.34793	5.168656	0.0000
C(74)	0.183850	1.065884	0.172486	0.8631
C(75)	0.503919	1.074352	0.469045	0.6391
C(76)	1.186193	1.079743	1.098588	0.2721
C(77)	0.100214	1.080025	0.092788	0.9261
C(78)	0.393200	1.080071	0.364050	0.7159
C(79)	-1.006748	1.080907	-0.931392	0.3518
C(80)	-0.385621	1.079373	-0.357264	0.7209
C(81)	-1.364733	1.076699	-1.267516	0.2051
C(82)	-0.217142	2.312187	-0.093912	0.9252

R-squared	0.131529	Mean dependent var	-1.205517
Adjusted R-squared	0.095820	S.D. dependent var	83.87538
S.E. of regression	79.75574	Akaike info criterion	11.63496
Sum squared resid	12531127	Schwarz criterion	11.85980
Log likelihood	-11855.46	Hannan-Quinn criter.	11.71741
F-statistic	3.683375	Durbin-Watson stat	2.004183
Prob(F-statistic)	0.000000		

Dependent Variable: D(MLY2)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 06/10/18 Time: 15:15
Sample (adjusted): 1/08/2008 7/06/2017
Included observations: 2478 after adjustments
D(MLY2) = C(1)*(MLY2(-1) + 148.142017039*MLY1(-1) + 0.577295113801
*US1(-1) - 45.1958699529*EUI(-1) - 121088.862646*FFR(-1) +
5.0013708606*M2(-1) - 548.822868998*VFI(-1) - 422311.729881*CPI(
-1) + 148282.537177*TB(-1) - 53.5509439722*OIL(-1) +
372047.235762) + C(2)*D(MLY2(-1)) + C(3)*D(MLY2(-2)) + C(4)
*D(MLY2(-3)) + C(5)*D(MLY2(-4)) + C(6)*D(MLY2(-5)) +
C(7)*D(MLY2(
-6)) + C(8)*D(MLY2(-7)) + C(9)*D(MLY2(-8)) + C(10)*D(MLY1(-1)) +
C(11)*D(MLY1(-2)) + C(12)*D(MLY1(-3)) + C(13)*D(MLY1(-4)) +
C(14)
*D(MLY1(-5)) + C(15)*D(MLY1(-6)) + C(16)*D(MLY1(-7)) + C(17)
*D(MLY1(-8)) + C(18)*D(US1(-1)) + C(19)*D(US1(-2)) + C(20)*D(US1(
-3)) + C(21)*D(US1(-4)) + C(22)*D(US1(-5)) + C(23)*D(US1(-6)) +
C(24)*D(US1(-7)) + C(25)*D(US1(-8)) + C(26)*D(EUI(-1)) + C(27)
*D(EUI(-2)) + C(28)*D(EUI(-3)) + C(29)*D(EUI(-4)) + C(30)*D(EUI(-5))
+
C(31)*D(EUI(-6)) + C(32)*D(EUI(-7)) + C(33)*D(EUI(-8)) + C(34)
*D(FFR(-1)) + C(35)*D(FFR(-2)) + C(36)*D(FFR(-3)) + C(37)*D(FFR(-
4))

+ C(38)*D(FFR(-5)) + C(39)*D(FFR(-6)) + C(40)*D(FFR(-7)) + C(41)
*D(FFR(-8)) + C(42)*D(M2(-1)) + C(43)*D(M2(-2)) + C(44)*D(M2(-3)) +
C(45)*D(M2(-4)) + C(46)*D(M2(-5)) + C(47)*D(M2(-6)) + C(48)*D(M2(
-7)) + C(49)*D(M2(-8)) + C(50)*D(VFI(-1)) + C(51)*D(VFI(-2)) + C(52)
*D(VFI(-3)) + C(53)*D(VFI(-4)) + C(54)*D(VFI(-5)) + C(55)*D(VFI(-6))
+
C(56)*D(VFI(-7)) + C(57)*D(VFI(-8)) + C(58)*D(CPI(-1)) +
C(59)*D(CPI(
-2)) + C(60)*D(CPI(-3)) + C(61)*D(CPI(-4)) + C(62)*D(CPI(-5)) + C(63)
*D(CPI(-6)) + C(64)*D(CPI(-7)) + C(65)*D(CPI(-8)) + C(66)*D(TB(-1)) +
C(67)*D(TB(-2)) + C(68)*D(TB(-3)) + C(69)*D(TB(-4)) + C(70)*D(TB(-
5))
+ C(71)*D(TB(-6)) + C(72)*D(TB(-7)) + C(73)*D(TB(-8)) +
C(74)*D(OIL(
-1)) + C(75)*D(OIL(-2)) + C(76)*D(OIL(-3)) + C(77)*D(OIL(-4)) + C(78)
*D(OIL(-5)) + C(79)*D(OIL(-6)) + C(80)*D(OIL(-7)) + C(81)*D(OIL(-8))
+
C(82)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-2.96E-05	9.60E-06	-3.079369	0.0021
C(2)	0.063848	0.020259	3.151558	0.0016
C(3)	0.040680	0.020207	2.013177	0.0442
C(4)	-0.004969	0.020205	-0.245901	0.8058
C(5)	0.025346	0.020140	1.258458	0.2083
C(6)	0.000102	0.020151	0.005043	0.9960
C(7)	-0.011565	0.020060	-0.576525	0.5643
C(8)	0.014684	0.020020	0.733464	0.4633
C(9)	0.002353	0.019924	0.118093	0.9060
C(10)	0.054746	0.077524	0.706176	0.4801
C(11)	-0.140192	0.077871	-1.800295	0.0719
C(12)	0.070763	0.077756	0.910063	0.3629
C(13)	-0.046110	0.077809	-0.592600	0.5535
C(14)	0.019222	0.077883	0.246812	0.8051
C(15)	0.133871	0.077772	1.721314	0.0853
C(16)	-0.004288	0.077681	-0.055203	0.9560
C(17)	-0.020601	0.077409	-0.266135	0.7902
C(18)	-0.000447	0.001169	-0.382696	0.7020
C(19)	-0.000198	0.001173	-0.168573	0.8661
C(20)	0.000361	0.001175	0.306983	0.7589
C(21)	-0.001224	0.001174	-1.042543	0.2973
C(22)	-0.002502	0.001170	-2.138450	0.0326
C(23)	0.001354	0.001173	1.154313	0.2485
C(24)	0.001936	0.001171	1.652635	0.0985
C(25)	0.001842	0.001166	1.580103	0.1142
C(26)	-0.004259	0.003277	-1.299772	0.1938
C(27)	-0.005735	0.003808	-1.505913	0.1322

C(28)	0.000148	0.004164	0.035439	0.9717
C(29)	0.000224	0.004339	0.051661	0.9588
C(30)	0.001143	0.004330	0.263876	0.7919
C(31)	0.006579	0.004145	1.587075	0.1126
C(32)	0.005186	0.003772	1.374887	0.1693
C(33)	-0.000106	0.003228	-0.032792	0.9738
C(34)	3.922711	2.729214	1.437304	0.1508
C(35)	-0.498592	2.620261	-0.190283	0.8491
C(36)	1.355270	2.639764	0.513406	0.6077
C(37)	3.909341	2.612310	1.496507	0.1347
C(38)	1.312540	2.584988	0.507755	0.6117
C(39)	5.555491	2.521813	2.202975	0.0277
C(40)	1.499032	2.444450	0.613239	0.5398
C(41)	-1.440604	2.452041	-0.587512	0.5569
C(42)	0.017892	0.073194	0.244451	0.8069
C(43)	0.045158	0.099312	0.454707	0.6494
C(44)	-0.087358	0.096266	-0.907463	0.3643
C(45)	-0.053305	0.091850	-0.580355	0.5617
C(46)	-0.026400	0.092165	-0.286436	0.7746
C(47)	0.056736	0.096404	0.588526	0.5562
C(48)	0.069514	0.100119	0.694314	0.4876
C(49)	-0.102372	0.074402	-1.375930	0.1690
C(50)	0.031446	0.089057	0.353098	0.7240
C(51)	-0.027511	0.089828	-0.306264	0.7594
C(52)	0.010690	0.090904	0.117599	0.9064
C(53)	-0.142150	0.091081	-1.560705	0.1187
C(54)	0.088891	0.091322	0.973382	0.3305
C(55)	0.012055	0.090625	0.133015	0.8942
C(56)	0.077119	0.087230	0.884088	0.3767
C(57)	-0.022923	0.085542	-0.267970	0.7887
C(58)	188.2318	163.5658	1.150802	0.2499
C(59)	-154.7894	162.8285	-0.950628	0.3419
C(60)	372.1179	162.5371	2.289434	0.0221
C(61)	104.0706	162.6673	0.639776	0.5224
C(62)	-329.0840	160.4244	-2.051334	0.0403
C(63)	174.8888	160.6204	1.088833	0.2763
C(64)	-297.1959	161.0518	-1.845344	0.0651
C(65)	-125.9471	161.4080	-0.780302	0.4353
C(66)	-2.201231	5.276012	-0.417215	0.6766
C(67)	12.45249	5.277473	2.359556	0.0184
C(68)	13.05636	5.220661	2.500901	0.0125
C(69)	1.465845	5.261267	0.278611	0.7806
C(70)	15.60711	5.281783	2.954895	0.0032
C(71)	-2.546806	5.274624	-0.482841	0.6293
C(72)	-0.807670	5.247839	-0.153905	0.8777
C(73)	33.49041	5.244808	6.385440	0.0000
C(74)	-0.126000	0.102802	-1.225660	0.2204
C(75)	0.165760	0.103441	1.602459	0.1092

C(76)	-0.085055	0.106540	-0.798337	0.4248
C(77)	-0.095482	0.106317	-0.898087	0.3692
C(78)	-0.173111	0.106038	-1.632531	0.1027
C(79)	0.077630	0.106281	0.730429	0.4652
C(80)	0.283578	0.106223	2.669644	0.0076
C(81)	0.142164	0.106324	1.337086	0.1813
C(82)	0.206173	0.215334	0.957456	0.3384

R-squared	0.064335	Mean dependent var	-0.080670
Adjusted R-squared	0.032704	S.D. dependent var	7.901163
S.E. of regression	7.770888	Akaike info criterion	6.971177
Sum squared resid	144686.5	Schwarz criterion	7.163610
Log likelihood	-8555.289	Hannan-Quinn criter.	7.041071
F-statistic	2.033912	Durbin-Watson stat	1.998161
Prob(F-statistic)	0.000000		

Dependent Variable: D(TKY2)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 06/10/18 Time: 15:21
Sample (adjusted): 5/15/2006 7/06/2017
Included observations: 2909 after adjustments
D(TKY2) = C(1)*(TKY2(-1) + 10.4685148866*TKY1(-1) + 0.0427427197131
*US1(-1) - 26.0930352733*EUI(-1) + 2533.35911256*FFR(-1) +
4.9614603199*M2(-1) + 541.890704909*VFI(-1) - 138673.043133*CPI(
-1) - 2567.80895767*TB(-1) + 109.134566839*OIL(-1) +
66099.5434194) + C(2)*D(TKY2(-1)) + C(3)*D(TKY2(-2)) + C(4)
*D(TKY2(-3)) + C(5)*D(TKY2(-4)) + C(6)*D(TKY2(-5)) +
C(7)*D(TKY2(
-6)) + C(8)*D(TKY2(-7)) + C(9)*D(TKY2(-8)) + C(10)*D(TKY1(-1)) +
C(11)*D(TKY1(-2)) + C(12)*D(TKY1(-3)) + C(13)*D(TKY1(-4)) + C(14)
*D(TKY1(-5)) + C(15)*D(TKY1(-6)) + C(16)*D(TKY1(-7)) + C(17)
*D(TKY1(-8)) + C(18)*D(US1(-1)) + C(19)*D(US1(-2)) + C(20)*D(US1(
-3)) + C(21)*D(US1(-4)) + C(22)*D(US1(-5)) + C(23)*D(US1(-6)) +
C(24)*D(US1(-7)) + C(25)*D(US1(-8)) + C(26)*D(EUI(-1)) + C(27)
*D(EUI(-2)) + C(28)*D(EUI(-3)) + C(29)*D(EUI(-4)) + C(30)*D(EUI(-5))
+
C(31)*D(EUI(-6)) + C(32)*D(EUI(-7)) + C(33)*D(EUI(-8)) + C(34)
*D(FFR(-1)) + C(35)*D(FFR(-2)) + C(36)*D(FFR(-3)) + C(37)*D(FFR(-
4))
+ C(38)*D(FFR(-5)) + C(39)*D(FFR(-6)) + C(40)*D(FFR(-7)) + C(41)
*D(FFR(-8)) + C(42)*D(M2(-1)) + C(43)*D(M2(-2)) + C(44)*D(M2(-3)) +
C(45)*D(M2(-4)) + C(46)*D(M2(-5)) + C(47)*D(M2(-6)) + C(48)*D(M2(
-7)) + C(49)*D(M2(-8)) + C(50)*D(VFI(-1)) + C(51)*D(VFI(-2)) + C(52)
*D(VFI(-3)) + C(53)*D(VFI(-4)) + C(54)*D(VFI(-5)) + C(55)*D(VFI(-6))
+

C(56)*D(VFI(-7)) + C(57)*D(VFI(-8)) + C(58)*D(CPI(-1)) + C(59)*D(CPI(
-2)) + C(60)*D(CPI(-3)) + C(61)*D(CPI(-4)) + C(62)*D(CPI(-5)) + C(63)
*D(CPI(-6)) + C(64)*D(CPI(-7)) + C(65)*D(CPI(-8)) + C(66)*D(TB(-1)) +
C(67)*D(TB(-2)) + C(68)*D(TB(-3)) + C(69)*D(TB(-4)) + C(70)*D(TB(-5))
+ C(71)*D(TB(-6)) + C(72)*D(TB(-7)) + C(73)*D(TB(-8)) + C(74)*D(OIL(
-1)) + C(75)*D(OIL(-2)) + C(76)*D(OIL(-3)) + C(77)*D(OIL(-4)) + C(78)
*D(OIL(-5)) + C(79)*D(OIL(-6)) + C(80)*D(OIL(-7)) + C(81)*D(OIL(-8)) +
C(82)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.98E-05	0.000124	0.159441	0.8733
C(2)	-0.012636	0.018799	-0.672157	0.5015
C(3)	0.026201	0.019146	1.368501	0.1713
C(4)	0.010483	0.019391	0.540582	0.5888
C(5)	-0.026561	0.019392	-1.369702	0.1709
C(6)	-0.010382	0.019410	-0.534877	0.5928
C(7)	-0.044739	0.019462	-2.298820	0.0216
C(8)	0.000681	0.019459	0.035018	0.9721
C(9)	-0.005282	0.019399	-0.272298	0.7854
C(10)	-0.063357	0.072652	-0.872072	0.3832
C(11)	0.129976	0.072679	1.788353	0.0738
C(12)	0.021670	0.072530	0.298768	0.7651
C(13)	0.004259	0.072503	0.058740	0.9532
C(14)	-0.046582	0.072469	-0.642781	0.5204
C(15)	0.027084	0.072368	0.374263	0.7082
C(16)	-0.029257	0.071502	-0.409176	0.6824
C(17)	0.026250	0.070264	0.373599	0.7087
C(18)	0.001105	0.006173	0.179062	0.8579
C(19)	-0.008291	0.006200	-1.337282	0.1812
C(20)	0.001648	0.006203	0.265617	0.7906
C(21)	0.008110	0.006195	1.309035	0.1906
C(22)	0.007211	0.006200	1.163068	0.2449
C(23)	0.006117	0.006211	0.984819	0.3248
C(24)	-0.007885	0.006202	-1.271351	0.2037
C(25)	-0.008241	0.006174	-1.334927	0.1820
C(26)	0.030150	0.017663	1.706954	0.0879
C(27)	-0.023346	0.020355	-1.146945	0.2515
C(28)	-0.013236	0.022173	-0.596935	0.5506
C(29)	-0.024850	0.023031	-1.078998	0.2807
C(30)	0.004414	0.023004	0.191893	0.8478
C(31)	0.032715	0.022062	1.482849	0.1382
C(32)	0.029167	0.020204	1.443618	0.1490
C(33)	0.000598	0.017372	0.034453	0.9725

C(34)	-16.39168	12.22276	-1.341079	0.1800
C(35)	-2.714855	12.13737	-0.223677	0.8230
C(36)	30.20212	12.41440	2.432831	0.0150
C(37)	19.97725	12.81611	1.558761	0.1192
C(38)	9.161152	12.76499	0.717678	0.4730
C(39)	11.86230	12.41905	0.955170	0.3396
C(40)	-0.676982	12.12558	-0.055831	0.9555
C(41)	17.96589	12.14761	1.478964	0.1393
C(42)	0.414519	0.401502	1.032419	0.3020
C(43)	-1.074512	0.545291	-1.970531	0.0489
C(44)	0.950517	0.526648	1.804843	0.0712
C(45)	0.082758	0.500565	0.165329	0.8687
C(46)	-0.556719	0.501722	-1.109616	0.2673
C(47)	-0.341981	0.527112	-0.648783	0.5165
C(48)	-0.767208	0.548447	-1.398873	0.1620
C(49)	1.398482	0.405902	3.445364	0.0006
C(50)	-0.014360	0.063671	-0.225540	0.8216
C(51)	0.018420	0.059579	0.309175	0.7572
C(52)	0.002158	0.055172	0.039122	0.9688
C(53)	0.044496	0.050432	0.882299	0.3777
C(54)	0.020909	0.045222	0.462372	0.6439
C(55)	0.011825	0.039320	0.300740	0.7636
C(56)	-0.026254	0.032144	-0.816740	0.4141
C(57)	-0.005444	0.022837	-0.238401	0.8116
C(58)	238.3200	828.6407	0.287604	0.7737
C(59)	707.3153	826.7370	0.855551	0.3923
C(60)	606.5267	824.3197	0.735791	0.4619
C(61)	1714.029	826.1783	2.074647	0.0381
C(62)	-21.86918	827.1762	-0.026438	0.9789
C(63)	1024.137	826.7685	1.238722	0.2156
C(64)	-189.4201	844.3967	-0.224326	0.8225
C(65)	-851.4280	844.9482	-1.007669	0.3137
C(66)	51.08283	23.62534	2.162205	0.0307
C(67)	1.272060	23.72665	0.053613	0.9572
C(68)	17.09317	23.74667	0.719813	0.4717
C(69)	-19.43239	23.72504	-0.819067	0.4128
C(70)	9.281277	23.73189	0.391089	0.6958
C(71)	-8.998123	23.75892	-0.378726	0.7049
C(72)	11.21168	23.71824	0.472703	0.6365
C(73)	29.00465	23.75094	1.221200	0.2221
C(74)	1.030135	0.537763	1.915592	0.0555
C(75)	0.347989	0.540464	0.643871	0.5197
C(76)	-0.249423	0.543180	-0.459191	0.6461
C(77)	0.540861	0.543311	0.995491	0.3196
C(78)	0.847674	0.542860	1.561496	0.1185
C(79)	0.238242	0.544067	0.437890	0.6615
C(80)	0.210846	0.543732	0.387776	0.6982
C(81)	-0.334995	0.542885	-0.617065	0.5372

C(82)	0.472611	1.121534	0.421397	0.6735

R-squared	0.037512	Mean dependent var	0.665999
Adjusted R-squared	0.009934	S.D. dependent var	44.43075
S.E. of regression	44.20950	Akaike info criterion	10.44354
Sum squared resid	5525315.	Schwarz criterion	10.61198
Log likelihood	-15108.13	Hannan-Quinn criter.	10.50422
F-statistic	1.360237	Durbin-Watson stat	2.001588
Prob(F-statistic)	0.018914		

Dependent Variable: D(TWN2)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 06/11/18 Time: 13:27
Sample (adjusted): 10/24/2008 5/15/2017
Included observations: 2232 after adjustments
D(TWN2) = C(1)*(TWN2(-1) + 0.41557351561*TWN1(-1) +
0.101647557014*US1(-1) + 45.8596656174*EUI(-1) - 102429.519773
*FFR(-1) + 3.503833586*M2(-1) - 123.332796437*VFI(-1) -
106328.424092*CPI(-1) + 93380.6596703*TB(-1) - 35.184040865*OIL(
-1) + 73544.6303634) + C(2)*D(TWN2(-1)) + C(3)*D(TWN2(-2)) + C(4)
*D(TWN2(-3)) + C(5)*D(TWN2(-4)) + C(6)*D(TWN2(-5)) + C(7)
*D(TWN2(-6)) + C(8)*D(TWN2(-7)) + C(9)*D(TWN2(-8)) + C(10)
*D(TWN1(-1)) + C(11)*D(TWN1(-2)) + C(12)*D(TWN1(-3)) + C(13)
*D(TWN1(-4)) + C(14)*D(TWN1(-5)) + C(15)*D(TWN1(-6)) + C(16)
*D(TWN1(-7)) + C(17)*D(TWN1(-8)) + C(18)*D(US1(-1)) + C(19)
*D(US1(-2)) + C(20)*D(US1(-3)) + C(21)*D(US1(-4)) + C(22)*D(US1(
-5)) + C(23)*D(US1(-6)) + C(24)*D(US1(-7)) + C(25)*D(US1(-8)) +
C(26)*D(EUI(-1)) + C(27)*D(EUI(-2)) + C(28)*D(EUI(-3)) +
C(29)*D(EUI(
-4)) + C(30)*D(EUI(-5)) + C(31)*D(EUI(-6)) + C(32)*D(EUI(-7)) + C(33)
*D(EUI(-8)) + C(34)*D(FFR(-1)) + C(35)*D(FFR(-2)) + C(36)*D(FFR(-
3))
+ C(37)*D(FFR(-4)) + C(38)*D(FFR(-5)) + C(39)*D(FFR(-6)) + C(40)
*D(FFR(-7)) + C(41)*D(FFR(-8)) + C(42)*D(M2(-1)) + C(43)*D(M2(-2)) +
C(44)*D(M2(-3)) + C(45)*D(M2(-4)) + C(46)*D(M2(-5)) + C(47)*D(M2(
-6)) + C(48)*D(M2(-7)) + C(49)*D(M2(-8)) + C(50)*D(VFI(-1)) + C(51)
*D(VFI(-2)) + C(52)*D(VFI(-3)) + C(53)*D(VFI(-4)) + C(54)*D(VFI(-5))
+
C(55)*D(VFI(-6)) + C(56)*D(VFI(-7)) + C(57)*D(VFI(-8)) +
C(58)*D(CPI(
-1)) + C(59)*D(CPI(-2)) + C(60)*D(CPI(-3)) + C(61)*D(CPI(-4)) + C(62)
*D(CPI(-5)) + C(63)*D(CPI(-6)) + C(64)*D(CPI(-7)) + C(65)*D(CPI(-8)) +
C(66)*D(TB(-1)) + C(67)*D(TB(-2)) + C(68)*D(TB(-3)) + C(69)*D(TB(-
4))

+ C(70)*D(TB(-5)) + C(71)*D(TB(-6)) + C(72)*D(TB(-7)) + C(73)*D(TB(
-8)) + C(74)*D(OIL(-1)) + C(75)*D(OIL(-2)) + C(76)*D(OIL(-3)) + C(77)
*D(OIL(-4)) + C(78)*D(OIL(-5)) + C(79)*D(OIL(-6)) + C(80)*D(OIL(-7))
+
C(81)*D(OIL(-8)) + C(82)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.001038	0.000334	3.105770	0.0019
C(2)	0.032053	0.021614	1.482972	0.1382
C(3)	-0.044355	0.021596	-2.053812	0.0401
C(4)	-0.017140	0.021565	-0.794808	0.4268
C(5)	-0.030349	0.021604	-1.404764	0.1602
C(6)	-0.037287	0.021617	-1.724926	0.0847
C(7)	-0.042798	0.021689	-1.973241	0.0486
C(8)	0.043264	0.021718	1.992081	0.0465
C(9)	-0.035060	0.021679	-1.617220	0.1060
C(10)	0.020992	0.491088	0.042746	0.9659
C(11)	0.009452	0.492473	0.019193	0.9847
C(12)	-0.718708	0.492321	-1.459836	0.1445
C(13)	-0.271028	0.494325	-0.548279	0.5836
C(14)	-0.439860	0.493158	-0.891925	0.3725
C(15)	-1.297192	0.493975	-2.626028	0.0087
C(16)	-0.499488	0.494038	-1.011032	0.3121
C(17)	0.005240	0.494650	0.010594	0.9915
C(18)	-0.002430	0.011979	-0.202833	0.8393
C(19)	0.000389	0.011953	0.032560	0.9740
C(20)	-0.000893	0.011941	-0.074820	0.9404
C(21)	0.014768	0.011876	1.243575	0.2138
C(22)	-0.005702	0.011915	-0.478547	0.6323
C(23)	-0.002845	0.011902	-0.239073	0.8111
C(24)	-0.025121	0.011886	-2.113553	0.0347
C(25)	-0.019211	0.011805	-1.627374	0.1038
C(26)	-0.023586	0.033953	-0.694672	0.4873
C(27)	0.023423	0.038650	0.606021	0.5446
C(28)	0.004936	0.041728	0.118288	0.9059
C(29)	-0.008982	0.043203	-0.207910	0.8353
C(30)	0.000734	0.042831	0.017148	0.9863
C(31)	0.027571	0.040548	0.679977	0.4966
C(32)	0.070608	0.036516	1.933605	0.0533
C(33)	0.053804	0.030924	1.739877	0.0820
C(34)	29.78855	73.92327	0.402966	0.6870
C(35)	63.75553	73.53671	0.866989	0.3860
C(36)	-2.120221	71.49766	-0.029654	0.9763
C(37)	-19.41546	70.69756	-0.274627	0.7836
C(38)	28.12888	71.36870	0.394135	0.6935
C(39)	-15.80012	69.81591	-0.226311	0.8210
C(40)	-57.39932	67.40197	-0.851597	0.3945

C(41)	36.58211	58.86588	0.621448	0.5344
C(42)	0.946825	0.722633	1.310243	0.1903
C(43)	-1.460059	0.982176	-1.486556	0.1373
C(44)	-0.311941	0.941783	-0.331223	0.7405
C(45)	0.614854	0.881536	0.697480	0.4856
C(46)	-0.304432	0.882250	-0.345063	0.7301
C(47)	0.148221	0.938231	0.157979	0.8745
C(48)	0.547402	0.984401	0.556076	0.5782
C(49)	-0.108784	0.725565	-0.149930	0.8808
C(50)	0.385551	0.873632	0.441320	0.6590
C(51)	0.023920	0.878604	0.027225	0.9783
C(52)	-1.692908	0.891535	-1.898868	0.0577
C(53)	-0.109664	0.894462	-0.122604	0.9024
C(54)	0.288469	0.892676	0.323151	0.7466
C(55)	-0.715247	0.884778	-0.808391	0.4190
C(56)	-0.955330	0.833844	-1.145694	0.2520
C(57)	-1.094586	0.805936	-1.358155	0.1746
C(58)	-3408.978	1928.969	-1.767254	0.0773
C(59)	-1706.906	1970.312	-0.866313	0.3864
C(60)	357.3581	2001.011	0.178589	0.8583
C(61)	-1404.710	2001.718	-0.701752	0.4829
C(62)	-1005.227	1999.706	-0.502688	0.6152
C(63)	-1382.296	2000.586	-0.690945	0.4897
C(64)	597.0867	1995.720	0.299184	0.7648
C(65)	875.3397	1993.495	0.439098	0.6606
C(66)	-251.9016	115.9011	-2.173419	0.0299
C(67)	-52.52225	115.9412	-0.453008	0.6506
C(68)	-105.4116	115.6516	-0.911458	0.3622
C(69)	-67.31191	114.3534	-0.588631	0.5562
C(70)	161.4600	110.4474	1.461872	0.1439
C(71)	-241.5204	108.3213	-2.229667	0.0259
C(72)	138.8390	107.1179	1.296133	0.1951
C(73)	-28.65992	107.2205	-0.267299	0.7893
C(74)	0.199915	1.040569	0.192121	0.8477
C(75)	-0.766294	1.045133	-0.733202	0.4635
C(76)	-0.116092	1.084453	-0.107051	0.9148
C(77)	0.088243	1.082178	0.081542	0.9350
C(78)	-1.779534	1.084615	-1.640705	0.1010
C(79)	0.678757	1.089014	0.623277	0.5332
C(80)	-1.120879	1.087330	-1.030854	0.3027
C(81)	-1.077967	1.084281	-0.994177	0.3202
C(82)	3.191680	2.061658	1.548113	0.1217

R-squared	0.041558	Mean dependent var	2.226586
Adjusted R-squared	0.005449	S.D. dependent var	68.88279
S.E. of regression	68.69486	Akaike info criterion	11.33327
Sum squared resid	10145814	Schwarz criterion	11.54307
Log likelihood	-12565.93	Hannan-Quinn criter.	11.40988

F-statistic	1.150908	Durbin-Watson stat	1.998403
Prob(F-statistic)	0.172003		

Dependent Variable: D(QTR2)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 06/11/18 Time: 13:30
Sample (adjusted): 8/29/2006 10/15/2014
Included observations: 2122 after adjustments
D(QTR2) = C(1)*(QTR2(-1) - 1.33875973677*QTR1(-1) + 0.11655093705
*US1(-1) + 0.534980636176*EUI(-1) - 501.255334682*FFR(-1) -
0.169421752577*M2(-1) - 2.07898500422*VFI(-1) - 9154.52248036
*CPI(-1) + 287.34724779*TB(-1) + 1.87821417699*OIL(-1) +
9634.2245228) + C(2)*D(QTR2(-1)) + C(3)*D(QTR2(-2)) + C(4)
*D(QTR2(-3)) + C(5)*D(QTR2(-4)) + C(6)*D(QTR2(-5)) +
C(7)*D(QTR2(
-6)) + C(8)*D(QTR2(-7)) + C(9)*D(QTR2(-8)) + C(10)*D(QTR1(-1)) +
C(11)*D(QTR1(-2)) + C(12)*D(QTR1(-3)) + C(13)*D(QTR1(-4)) + C(14)
*D(QTR1(-5)) + C(15)*D(QTR1(-6)) + C(16)*D(QTR1(-7)) + C(17)
*D(QTR1(-8)) + C(18)*D(US1(-1)) + C(19)*D(US1(-2)) + C(20)*D(US1(
-3)) + C(21)*D(US1(-4)) + C(22)*D(US1(-5)) + C(23)*D(US1(-6)) +
C(24)*D(US1(-7)) + C(25)*D(US1(-8)) + C(26)*D(EUI(-1)) + C(27)
*D(EUI(-2)) + C(28)*D(EUI(-3)) + C(29)*D(EUI(-4)) + C(30)*D(EUI(-5))
+
C(31)*D(EUI(-6)) + C(32)*D(EUI(-7)) + C(33)*D(EUI(-8)) + C(34)
*D(FFR(-1)) + C(35)*D(FFR(-2)) + C(36)*D(FFR(-3)) + C(37)*D(FFR(-
4))
+ C(38)*D(FFR(-5)) + C(39)*D(FFR(-6)) + C(40)*D(FFR(-7)) + C(41)
*D(FFR(-8)) + C(42)*D(M2(-1)) + C(43)*D(M2(-2)) + C(44)*D(M2(-3)) +
C(45)*D(M2(-4)) + C(46)*D(M2(-5)) + C(47)*D(M2(-6)) + C(48)*D(M2(
-7)) + C(49)*D(M2(-8)) + C(50)*D(VFI(-1)) + C(51)*D(VFI(-2)) + C(52)
*D(VFI(-3)) + C(53)*D(VFI(-4)) + C(54)*D(VFI(-5)) + C(55)*D(VFI(-6))
+
C(56)*D(VFI(-7)) + C(57)*D(VFI(-8)) + C(58)*D(CPI(-1)) +
C(59)*D(CPI(
-2)) + C(60)*D(CPI(-3)) + C(61)*D(CPI(-4)) + C(62)*D(CPI(-5)) + C(63)
*D(CPI(-6)) + C(64)*D(CPI(-7)) + C(65)*D(CPI(-8)) + C(66)*D(TB(-1)) +
C(67)*D(TB(-2)) + C(68)*D(TB(-3)) + C(69)*D(TB(-4)) + C(70)*D(TB(-
5))
+ C(71)*D(TB(-6)) + C(72)*D(TB(-7)) + C(73)*D(TB(-8)) +
C(74)*D(OIL(
-1)) + C(75)*D(OIL(-2)) + C(76)*D(OIL(-3)) + C(77)*D(OIL(-4)) + C(78)
*D(OIL(-5)) + C(79)*D(OIL(-6)) + C(80)*D(OIL(-7)) + C(81)*D(OIL(-8))
+
C(82)

	Coefficient	Std. Error	t-Statistic	Prob.

C(1)	-0.211191	0.008272	-25.53051	0.0000
C(2)	0.035127	0.019379	1.812624	0.0700
C(3)	0.015934	0.019536	0.815634	0.4148
C(4)	-0.012631	0.019522	-0.646990	0.5177
C(5)	-0.076156	0.019471	-3.911206	0.0001
C(6)	-0.032309	0.019517	-1.655418	0.0980
C(7)	-0.009769	0.019614	-0.498074	0.6185
C(8)	-0.011932	0.019563	-0.609937	0.5420
C(9)	-0.061679	0.019394	-3.180380	0.0015
C(10)	-0.388080	0.029883	-12.98662	0.0000
C(11)	-0.293590	0.030310	-9.686258	0.0000
C(12)	-0.330761	0.030043	-11.00940	0.0000
C(13)	-0.351655	0.029925	-11.75104	0.0000
C(14)	-0.410916	0.029739	-13.81735	0.0000
C(15)	-0.291973	0.030277	-9.643401	0.0000
C(16)	-0.286240	0.030407	-9.413716	0.0000
C(17)	-0.237637	0.030714	-7.736970	0.0000
C(18)	-0.006014	0.014831	-0.405475	0.6852
C(19)	0.003360	0.014932	0.225008	0.8220
C(20)	-0.018636	0.014941	-1.247284	0.2124
C(21)	0.012404	0.014954	0.829500	0.4069
C(22)	0.032824	0.014959	2.194306	0.0283
C(23)	0.015780	0.015051	1.048454	0.2946
C(24)	0.007304	0.015018	0.486344	0.6268
C(25)	0.013034	0.014959	0.871298	0.3837
C(26)	0.120059	0.039583	3.033116	0.0025
C(27)	0.046967	0.045414	1.034193	0.3012
C(28)	0.051589	0.049804	1.035837	0.3004
C(29)	0.057550	0.051898	1.108908	0.2676
C(30)	0.027169	0.051859	0.523895	0.6004
C(31)	0.078617	0.049806	1.578470	0.1146
C(32)	0.050904	0.045486	1.119098	0.2632
C(33)	0.031791	0.039446	0.805936	0.4204
C(34)	-72.33347	26.82041	-2.696956	0.0071
C(35)	-27.61332	26.49583	-1.042176	0.2975
C(36)	-12.60754	27.06748	-0.465782	0.6414
C(37)	-110.8314	27.91151	-3.970812	0.0001
C(38)	-77.85765	27.61636	-2.819258	0.0049
C(39)	14.39531	26.79428	0.537253	0.5912
C(40)	-51.97222	26.16815	-1.986087	0.0472
C(41)	-49.37836	26.23571	-1.882105	0.0600
C(42)	-0.469720	0.974896	-0.481815	0.6300
C(43)	1.336628	1.331315	1.003991	0.3155
C(44)	-1.251356	1.290054	-0.970002	0.3322
C(45)	0.746779	1.230274	0.607003	0.5439
C(46)	-1.407158	1.236707	-1.137826	0.2553
C(47)	0.434073	1.288654	0.336842	0.7363
C(48)	-0.426899	1.335524	-0.319649	0.7493

C(49)	1.178267	0.986400	1.194513	0.2324
C(50)	-0.388096	0.048329	-8.030359	0.0000
C(51)	-0.354177	0.061497	-5.759286	0.0000
C(52)	-0.290700	0.068270	-4.258092	0.0000
C(53)	-0.254748	0.071176	-3.579106	0.0004
C(54)	-0.212084	0.070817	-2.994833	0.0028
C(55)	-0.173853	0.067037	-2.593403	0.0096
C(56)	-0.107356	0.058891	-1.822969	0.0685
C(57)	-0.090056	0.044390	-2.028749	0.0426
C(58)	1667.609	1846.476	0.903131	0.3666
C(59)	-652.0404	1839.252	-0.354514	0.7230
C(60)	1586.310	1831.458	0.866146	0.3865
C(61)	-1318.665	1828.018	-0.721363	0.4708
C(62)	-2646.917	1828.046	-1.447949	0.1478
C(63)	723.7618	1825.650	0.396441	0.6918
C(64)	-3032.390	1872.463	-1.619465	0.1055
C(65)	740.2897	1865.149	0.396906	0.6915
C(66)	28.89232	50.06485	0.577098	0.5639
C(67)	-25.07233	50.17590	-0.499689	0.6173
C(68)	72.55084	50.29223	1.442585	0.1493
C(69)	1.748220	50.21227	0.034817	0.9722
C(70)	-51.22214	50.22568	-1.019840	0.3079
C(71)	-1.776235	50.35293	-0.035276	0.9719
C(72)	-15.65167	50.30026	-0.311165	0.7557
C(73)	112.4073	50.34928	2.232549	0.0257
C(74)	0.950441	1.210883	0.784915	0.4326
C(75)	1.192053	1.219195	0.977738	0.3283
C(76)	0.088195	1.226348	0.071917	0.9427
C(77)	0.717024	1.226592	0.584566	0.5589
C(78)	0.854058	1.227593	0.695718	0.4867
C(79)	-0.980826	1.228810	-0.798192	0.4249
C(80)	0.904238	1.226249	0.737401	0.4610
C(81)	1.426426	1.221869	1.167413	0.2432
C(82)	3.669376	2.595947	1.413502	0.1577

R-squared	0.302277	Mean dependent var	1.559877
Adjusted R-squared	0.274573	S.D. dependent var	106.7538
S.E. of regression	90.92431	Akaike info criterion	11.89581
Sum squared resid	16865149	Schwarz criterion	12.11453
Log likelihood	-12539.45	Hannan-Quinn criter.	11.97588
F-statistic	10.91108	Durbin-Watson stat	1.692265
Prob(F-statistic)	0.000000		

APPENDIX III

Heteroscedasticity (ARCH) Tests

Heteroskedasticity Test: ARCH RTUS1

F-statistic	215.6905	Prob. F(5,2988)	0.0000
Obs*R-squared	794.0305	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 16:01
Sample (adjusted): 1/13/2006 7/05/2017
Included observations: 2994 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.364304	0.077418	4.705657	0.0000
RESID^2(-1)	0.053848	0.017823	3.021281	0.0025
RESID^2(-2)	0.317126	0.017656	17.96105	0.0000
RESID^2(-3)	-0.022853	0.018580	-1.229982	0.2188
RESID^2(-4)	0.143459	0.017656	8.125156	0.0000
RESID^2(-5)	0.225501	0.017823	12.65225	0.0000

R-squared	0.265207	Mean dependent var	1.285854
Adjusted R-squared	0.263978	S.D. dependent var	4.530827
S.E. of regression	3.887075	Akaike info criterion	5.555193
Sum squared resid	45146.75	Schwarz criterion	5.567226
Log likelihood	-8310.124	Hannan-Quinn criter.	5.559522
F-statistic	215.6905	Durbin-Watson stat	2.047809
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTUS2

F-statistic	129.0644	Prob. F(5,3116)	0.0000
Obs*R-squared	535.6348	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 16:16
Sample (adjusted): 1/12/2006 12/29/2017
Included observations: 3122 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	0.798477	0.118075	6.762482	0.0000
RESID^2(-1)	0.193707	0.017791	10.88790	0.0000
RESID^2(-2)	0.160877	0.018019	8.927959	0.0000
RESID^2(-3)	0.042240	0.018233	2.316753	0.0206
RESID^2(-4)	0.109730	0.018019	6.089584	0.0000
RESID^2(-5)	0.117128	0.017791	6.583483	0.0000

R-squared	0.171568	Mean dependent var	2.123421
Adjusted R-squared	0.170239	S.D. dependent var	6.461999
S.E. of regression	5.886315	Akaike info criterion	6.385057
Sum squared resid	107965.4	Schwarz criterion	6.396677
Log likelihood	-9961.075	Hannan-Quinn criter.	6.389229
F-statistic	129.0644	Durbin-Watson stat	2.017888
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTEU1

F-statistic	118.9537	Prob. F(5,2852)	0.0000
Obs*R-squared	493.1718	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 16:27
Sample (adjusted): 11/22/2006 11/03/2017
Included observations: 2858 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.666412	0.106606	6.251168	0.0000
RESID^2(-1)	0.088395	0.018306	4.828789	0.0000
RESID^2(-2)	0.113175	0.018281	6.190912	0.0000
RESID^2(-3)	0.137988	0.018221	7.573060	0.0000
RESID^2(-4)	0.102168	0.018281	5.588837	0.0000
RESID^2(-5)	0.210410	0.018306	11.49414	0.0000

R-squared	0.172558	Mean dependent var	1.917425
Adjusted R-squared	0.171108	S.D. dependent var	5.451016
S.E. of regression	4.962797	Akaike info criterion	6.043913
Sum squared resid	70242.91	Schwarz criterion	6.056421
Log likelihood	-8630.752	Hannan-Quinn criter.	6.048423
F-statistic	118.9537	Durbin-Watson stat	2.003694
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTEU2

F-statistic	184.9773	Prob. F(5,3117)	0.0000
Obs*R-squared	714.6220	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 16:37
Sample (adjusted): 1/11/2006 12/29/2017
Included observations: 3123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.542798	0.104959	5.171518	0.0000
RESID^2(-1)	0.024454	0.017115	1.428846	0.1531
RESID^2(-2)	0.165139	0.017052	9.684665	0.0000
RESID^2(-3)	0.134214	0.017139	7.831139	0.0000
RESID^2(-4)	0.085298	0.017050	5.002814	0.0000
RESID^2(-5)	0.294904	0.017113	17.23312	0.0000

R-squared	0.228825	Mean dependent var	1.839046
Adjusted R-squared	0.227588	S.D. dependent var	5.993008
S.E. of regression	5.267072	Akaike info criterion	6.162746
Sum squared resid	86471.96	Schwarz criterion	6.174362
Log likelihood	-9617.127	Hannan-Quinn criter.	6.166916
F-statistic	184.9773	Durbin-Watson stat	2.022902
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTCA1

F-statistic	232.8660	Prob. F(5,3118)	0.0000
Obs*R-squared	849.3898	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 17:21
Sample (adjusted): 1/10/2006 12/29/2017
Included observations: 3124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.569033	0.120197	4.734177	0.0000
RESID^2(-1)	0.200349	0.017054	11.74778	0.0000
RESID^2(-2)	0.052683	0.017409	3.026157	0.0025
RESID^2(-3)	0.135041	0.017266	7.821124	0.0000

RESID^2(-4)	0.044761	0.017409	2.571074	0.0102
RESID^2(-5)	0.305173	0.017054	17.89442	0.0000

R-squared	0.271892	Mean dependent var	2.174891
Adjusted R-squared	0.270724	S.D. dependent var	7.170853
S.E. of regression	6.123740	Akaike info criterion	6.464142
Sum squared resid	116925.6	Schwarz criterion	6.475756
Log likelihood	-10090.99	Hannan-Quinn criter.	6.468311
F-statistic	232.8660	Durbin-Watson stat	2.169826
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTCA2

F-statistic	214.8937	Prob. F(5,3118)	0.0000
Obs*R-squared	800.6357	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 17:25
Sample (adjusted): 1/10/2006 12/29/2017
Included observations: 3124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.844083	0.179830	4.693795	0.0000
RESID^2(-1)	0.141968	0.017130	8.287657	0.0000
RESID^2(-2)	0.061536	0.017259	3.565476	0.0004
RESID^2(-3)	0.158742	0.017059	9.305511	0.0000
RESID^2(-4)	0.079710	0.017259	4.618445	0.0000
RESID^2(-5)	0.291586	0.017130	17.02233	0.0000

R-squared	0.256285	Mean dependent var	3.174266
Adjusted R-squared	0.255093	S.D. dependent var	10.61095
S.E. of regression	9.158096	Akaike info criterion	7.269072
Sum squared resid	261508.9	Schwarz criterion	7.280686
Log likelihood	-11348.29	Hannan-Quinn criter.	7.273241
F-statistic	214.8937	Durbin-Watson stat	2.196071
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTJP1

F-statistic	232.7680	Prob. F(5,3117)	0.0000
Obs*R-squared	849.0560	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/15/18 Time: 10:44
Sample (adjusted): 1/11/2006 12/29/2017
Included observations: 3123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.569243	0.120240	4.734224	0.0000
RESID^2(-1)	0.200352	0.017057	11.74612	0.0000
RESID^2(-2)	0.052688	0.017412	3.025966	0.0025
RESID^2(-3)	0.135020	0.017269	7.818607	0.0000
RESID^2(-4)	0.044742	0.017412	2.569693	0.0102
RESID^2(-5)	0.305182	0.017057	17.89235	0.0000

R-squared	0.271872	Mean dependent var	2.175634
Adjusted R-squared	0.270704	S.D. dependent var	7.171764
S.E. of regression	6.124603	Akaike info criterion	6.464424
Sum squared resid	116921.0	Schwarz criterion	6.476041
Log likelihood	-10088.20	Hannan-Quinn criter.	6.468594
F-statistic	232.7680	Durbin-Watson stat	2.169859
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTJP2

F-statistic	146.5682	Prob. F(5,3117)	0.0000
Obs*R-squared	594.4823	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/15/18 Time: 10:47
Sample (adjusted): 1/11/2006 12/29/2017
Included observations: 3123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.624226	0.103249	6.045822	0.0000
RESID^2(-1)	0.030138	0.017906	1.683121	0.0925
RESID^2(-2)	0.274980	0.017624	15.60271	0.0000
RESID^2(-3)	0.116414	0.018180	6.403402	0.0000
RESID^2(-4)	0.179377	0.017624	10.17794	0.0000
RESID^2(-5)	0.022700	0.017906	1.267730	0.2050

R-squared	0.190356	Mean dependent var	1.663155

Adjusted R-squared	0.189057	S.D. dependent var	5.837948
S.E. of regression	5.257209	Akaike info criterion	6.158997
Sum squared resid	86148.42	Schwarz criterion	6.170614
Log likelihood	-9611.274	Hannan-Quinn criter.	6.163167
F-statistic	146.5682	Durbin-Watson stat	2.002709
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTKWT1

F-statistic	67.37918	Prob. F(5,2227)	0.0000
Obs*R-squared	293.4162	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 17:32
Sample (adjusted): 6/16/2006 1/06/2015
Included observations: 2233 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.040454	0.172632	6.027007	0.0000
RESID^2(-1)	0.186836	0.021190	8.817214	0.0000
RESID^2(-2)	0.060972	0.021090	2.891077	0.0039
RESID^2(-3)	0.088769	0.021045	4.217994	0.0000
RESID^2(-4)	0.210601	0.021090	9.986001	0.0000
RESID^2(-5)	-0.007457	0.021190	-0.351910	0.7249

R-squared	0.131400	Mean dependent var	2.261713
Adjusted R-squared	0.129450	S.D. dependent var	7.918259
S.E. of regression	7.387995	Akaike info criterion	6.840273
Sum squared resid	121555.2	Schwarz criterion	6.855619
Log likelihood	-7631.165	Hannan-Quinn criter.	6.845876
F-statistic	67.37918	Durbin-Watson stat	1.998686
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTKWT2

F-statistic	141.0390	Prob. F(5,2049)	0.0000
Obs*R-squared	526.1704	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares

Date: 04/14/18 Time: 17:36
Sample (adjusted): 8/24/2006 7/09/2014
Included observations: 2055 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.808974	0.393673	4.595121	0.0000
RESID^2(-1)	0.582184	0.022090	26.35475	0.0000
RESID^2(-2)	-0.307812	0.025548	-12.04848	0.0000
RESID^2(-3)	0.171737	0.026164	6.563969	0.0000
RESID^2(-4)	-0.038007	0.025548	-1.487670	0.1370
RESID^2(-5)	0.011603	0.022090	0.525249	0.5995

R-squared	0.256044	Mean dependent var	3.117557
Adjusted R-squared	0.254229	S.D. dependent var	19.97942
S.E. of regression	17.25384	Akaike info criterion	8.536862
Sum squared resid	609977.1	Schwarz criterion	8.553294
Log likelihood	-8765.626	Hannan-Quinn criter.	8.542887
F-statistic	141.0390	Durbin-Watson stat	2.000535
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTMLY1

F-statistic	39.54222	Prob. F(5,3116)	0.0000
Obs*R-squared	186.2727	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 17:41
Sample (adjusted): 1/12/2006 12/29/2017
Included observations: 3122 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.520888	0.060009	8.680099	0.0000
RESID^2(-1)	0.081699	0.017875	4.570617	0.0000
RESID^2(-2)	0.156958	0.017923	8.757268	0.0000
RESID^2(-3)	0.070910	0.018097	3.918277	0.0001
RESID^2(-4)	0.035553	0.017923	1.983647	0.0474
RESID^2(-5)	0.066326	0.017874	3.710675	0.0002

R-squared	0.059665	Mean dependent var	0.885305
Adjusted R-squared	0.058156	S.D. dependent var	3.070378
S.E. of regression	2.979761	Akaike info criterion	5.023483
Sum squared resid	27666.88	Schwarz criterion	5.035103
Log likelihood	-7835.657	Hannan-Quinn criter.	5.027654

F-statistic	39.54222	Durbin-Watson stat	2.007052
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTMLY2

F-statistic	29.72680	Prob. F(5,2601)	0.0000
Obs*R-squared	140.9238	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 17:46
Sample (adjusted): 1/03/2008 12/29/2017
Included observations: 2607 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.558730	0.074486	7.501158	0.0000
RESID^2(-1)	0.073643	0.019552	3.766528	0.0002
RESID^2(-2)	0.148435	0.019588	7.577768	0.0000
RESID^2(-3)	0.066207	0.019619	3.374687	0.0007
RESID^2(-4)	0.038316	0.019435	1.971518	0.0488
RESID^2(-5)	0.070005	0.019397	3.609088	0.0003

R-squared	0.054056	Mean dependent var	0.931465
Adjusted R-squared	0.052237	S.D. dependent var	3.520545
S.E. of regression	3.427359	Akaike info criterion	5.303756
Sum squared resid	30553.41	Schwarz criterion	5.317257
Log likelihood	-6907.446	Hannan-Quinn criter.	5.308647
F-statistic	29.72680	Durbin-Watson stat	2.004543
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTTKY1

F-statistic	58.77340	Prob. F(5,3111)	0.0000
Obs*R-squared	269.0218	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 17:49
Sample (adjusted): 1/12/2006 12/22/2017
Included observations: 3117 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.492024	0.266414	9.353943	0.0000
RESID^2(-1)	0.036754	0.017835	2.060735	0.0394
RESID^2(-2)	0.083220	0.017577	4.734540	0.0000
RESID^2(-3)	0.110669	0.017529	6.313639	0.0000
RESID^2(-4)	0.172988	0.017578	9.841422	0.0000
RESID^2(-5)	0.101871	0.017837	5.711262	0.0000

R-squared	0.086308	Mean dependent var	5.038048
Adjusted R-squared	0.084839	S.D. dependent var	12.65310
S.E. of regression	12.10447	Akaike info criterion	7.826949
Sum squared resid	455817.7	Schwarz criterion	7.838584
Log likelihood	-12192.30	Hannan-Quinn criter.	7.831126
F-statistic	58.77340	Durbin-Watson stat	2.012186
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTTKY2

F-statistic	46.60794	Prob. F(5,3116)	0.0000
Obs*R-squared	217.2413	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 17:52
Sample (adjusted): 1/12/2006 12/29/2017
Included observations: 3122 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.013473	0.106896	9.480906	0.0000
RESID^2(-1)	0.125452	0.017884	7.014971	0.0000
RESID^2(-2)	0.059173	0.017976	3.291684	0.0010
RESID^2(-3)	0.133174	0.017849	7.461224	0.0000
RESID^2(-4)	0.073168	0.017976	4.070220	0.0000
RESID^2(-5)	0.058627	0.017883	3.278304	0.0011

R-squared	0.069584	Mean dependent var	1.841162
Adjusted R-squared	0.068091	S.D. dependent var	5.275655
S.E. of regression	5.092876	Akaike info criterion	6.095483
Sum squared resid	80820.91	Schwarz criterion	6.107103
Log likelihood	-9509.048	Hannan-Quinn criter.	6.099654
F-statistic	46.60794	Durbin-Watson stat	2.009476
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTTWN1

F-statistic	45.94491	Prob. F(5,2951)	0.0000
Obs*R-squared	213.5663	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 17:56
Sample (adjusted): 1/12/2006 5/12/2017
Included observations: 2957 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.037988	0.105999	9.792474	0.0000
RESID^2(-1)	0.029833	0.018282	1.631806	0.1028
RESID^2(-2)	0.127061	0.018176	6.990772	0.0000
RESID^2(-3)	0.086352	0.018255	4.730421	0.0000
RESID^2(-4)	0.110974	0.018173	6.106433	0.0000
RESID^2(-5)	0.116941	0.018277	6.398219	0.0000

R-squared	0.072224	Mean dependent var	1.965056
Adjusted R-squared	0.070652	S.D. dependent var	4.793518
S.E. of regression	4.621081	Akaike info criterion	5.901161
Sum squared resid	63016.80	Schwarz criterion	5.913319
Log likelihood	-8718.867	Hannan-Quinn criter.	5.905538
F-statistic	45.94491	Durbin-Watson stat	2.018803
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTTWN2

F-statistic	33.45723	Prob. F(5,2237)	0.0000
Obs*R-squared	156.0641	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 18:02
Sample (adjusted): 10/21/2008 5/25/2017
Included observations: 2243 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.665573	0.069094	9.632868	0.0000

RESID^2(-1)	0.132415	0.020984	6.310242	0.0000
RESID^2(-2)	0.074432	0.021090	3.529177	0.0004
RESID^2(-3)	0.101780	0.021009	4.844636	0.0000
RESID^2(-4)	0.018502	0.021054	0.878805	0.3796
RESID^2(-5)	0.119107	0.020756	5.738424	0.0000

R-squared	0.069578	Mean dependent var	1.206441
Adjusted R-squared	0.067499	S.D. dependent var	2.628975
S.E. of regression	2.538699	Akaike info criterion	4.703852
Sum squared resid	14417.44	Schwarz criterion	4.719141
Log likelihood	-5269.370	Hannan-Quinn criter.	4.709433
F-statistic	33.45723	Durbin-Watson stat	1.995551
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH QTR1

F-statistic	51.81663	Prob. F(5,2167)	0.0000
Obs*R-squared	232.0562	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 18:07
Sample (adjusted): 6/16/2006 10/14/2014
Included observations: 2173 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.252756	0.237729	5.269688	0.0000
RESID^2(-1)	0.132863	0.021310	6.234666	0.0000
RESID^2(-2)	0.084448	0.021249	3.974257	0.0001
RESID^2(-3)	0.045426	0.021304	2.132319	0.0331
RESID^2(-4)	0.152651	0.021249	7.184043	0.0000
RESID^2(-5)	0.125809	0.021310	5.903892	0.0000

R-squared	0.106791	Mean dependent var	2.735961
Adjusted R-squared	0.104730	S.D. dependent var	10.74061
S.E. of regression	10.16263	Akaike info criterion	7.478068
Sum squared resid	223805.5	Schwarz criterion	7.493762
Log likelihood	-8118.921	Hannan-Quinn criter.	7.483806
F-statistic	51.81663	Durbin-Watson stat	2.031072
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTQTR2

F-statistic	58.31839	Prob. F(5,2275)	0.0000
Obs*R-squared	259.1457	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/14/18 Time: 18:10
Sample (adjusted): 8/24/2006 5/21/2015
Included observations: 2281 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.338670	0.249064	5.374802	0.0000
RESID^2(-1)	0.172075	0.020797	8.274107	0.0000
RESID^2(-2)	0.048093	0.020899	2.301248	0.0215
RESID^2(-3)	0.056510	0.020889	2.705196	0.0069
RESID^2(-4)	0.141214	0.020899	6.757035	0.0000
RESID^2(-5)	0.126663	0.020797	6.090504	0.0000

R-squared	0.113611	Mean dependent var	2.938621
Adjusted R-squared	0.111662	S.D. dependent var	11.60432
S.E. of regression	10.93726	Akaike info criterion	7.624855
Sum squared resid	272143.9	Schwarz criterion	7.639933
Log likelihood	-8690.147	Hannan-Quinn criter.	7.630355
F-statistic	58.31839	Durbin-Watson stat	2.017483
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH IND1

F-statistic	22.21855	Prob. F(5,1942)	0.0000
Obs*R-squared	105.4062	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/18/18 Time: 09:42
Sample (adjusted): 12/29/2009 6/15/2017
Included observations: 1948 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.919571	0.098480	9.337600	0.0000
RESID^2(-1)	0.063203	0.022505	2.808402	0.0050
RESID^2(-2)	0.077284	0.022498	3.435165	0.0006
RESID^2(-3)	0.086367	0.022481	3.841787	0.0001
RESID^2(-4)	0.067851	0.022498	3.015886	0.0026

RESID^2(-5)	0.128075	0.022506	5.690751	0.0000

R-squared	0.054110	Mean dependent var	1.593571
Adjusted R-squared	0.051675	S.D. dependent var	3.336304
S.E. of regression	3.248960	Akaike info criterion	5.197622
Sum squared resid	20499.25	Schwarz criterion	5.214792
Log likelihood	-5056.484	Hannan-Quinn criter.	5.203935
F-statistic	22.21855	Durbin-Watson stat	2.012773
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH RTIND2

F-statistic	32.82716	Prob. F(5,2632)	0.0000
Obs*R-squared	154.8531	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/18/18 Time: 09:47
Sample (adjusted): 10/18/2007 11/27/2017
Included observations: 2638 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.568038	0.229842	6.822250	0.0000
RESID^2(-1)	0.090251	0.019342	4.666018	0.0000
RESID^2(-2)	0.095141	0.019367	4.912640	0.0000
RESID^2(-3)	0.049054	0.019431	2.524479	0.0116
RESID^2(-4)	0.075160	0.019366	3.880943	0.0001
RESID^2(-5)	0.123730	0.019342	6.396941	0.0000

R-squared	0.058701	Mean dependent var	2.767807
Adjusted R-squared	0.056913	S.D. dependent var	11.05660
S.E. of regression	10.73736	Akaike info criterion	7.587607
Sum squared resid	303445.5	Schwarz criterion	7.600976
Log likelihood	-10002.05	Hannan-Quinn criter.	7.592447
F-statistic	32.82716	Durbin-Watson stat	2.019427
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH CHN1

F-statistic	193.4637	Prob. F(5,3117)	0.0000
Obs*R-squared	739.6425	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/18/18 Time: 09:50
Sample (adjusted): 1/11/2006 12/29/2017
Included observations: 3123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.997184	0.169095	5.897175	0.0000
RESID^2(-1)	0.099110	0.017882	5.542487	0.0000
RESID^2(-2)	0.241368	0.017970	13.43196	0.0000
RESID^2(-3)	0.267083	0.017852	14.96121	0.0000
RESID^2(-4)	0.002631	0.017969	0.146399	0.8836
RESID^2(-5)	0.057242	0.017881	3.201236	0.0014

R-squared	0.236837	Mean dependent var	2.999805
Adjusted R-squared	0.235613	S.D. dependent var	9.854105
S.E. of regression	8.615368	Akaike info criterion	7.146892
Sum squared resid	231358.0	Schwarz criterion	7.158508
Log likelihood	-11153.87	Hannan-Quinn criter.	7.151062
F-statistic	193.4637	Durbin-Watson stat	2.002457
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH CHN2

F-statistic	236.0507	Prob. F(5,3115)	0.0000
Obs*R-squared	857.5911	Prob. Chi-Square(5)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/18/18 Time: 09:54
Sample (adjusted): 1/13/2006 12/29/2017
Included observations: 3121 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.718937	0.124764	5.762374	0.0000
RESID^2(-1)	0.099409	0.017894	5.555441	0.0000
RESID^2(-2)	0.227032	0.017971	12.63318	0.0000
RESID^2(-3)	0.345620	0.017354	19.91590	0.0000
RESID^2(-4)	-0.036351	0.017971	-2.022762	0.0432
RESID^2(-5)	0.050880	0.017894	2.843337	0.0045

R-squared	0.274781	Mean dependent var	2.292550
Adjusted R-squared	0.273617	S.D. dependent var	7.456885

S.E. of regression	6.355363	Akaike info criterion	6.538396
Sum squared resid	125816.8	Schwarz criterion	6.550019
Log likelihood	-10197.17	Hannan-Quinn criter.	6.542568
F-statistic	236.0507	Durbin-Watson stat	1.999324
Prob(F-statistic)	0.000000		

APPENDIX IV

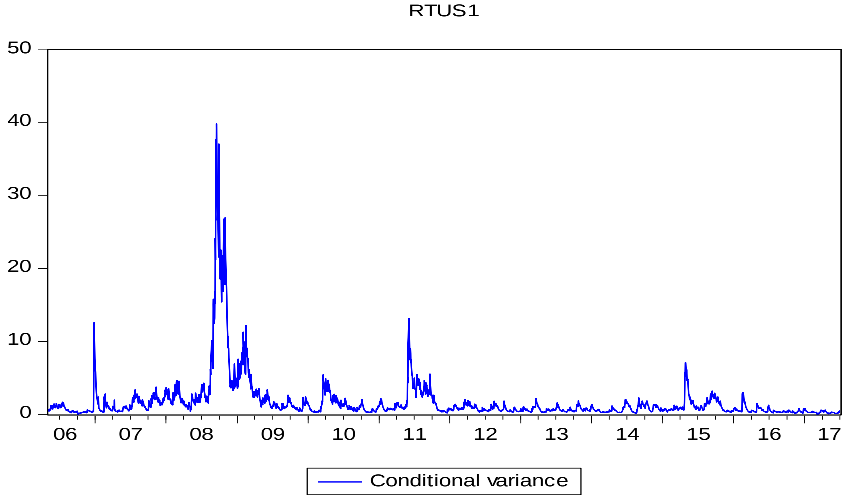
Results on Macroeconomic Variables

Dependent Variable: RTUS1
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/19/18 Time: 12:28
Sample (adjusted): 5/03/2006 7/05/2017
Included observations: 2916 after adjustments
Failure to improve likelihood (non-zero gradients) after 158 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.082139	0.011371	7.223481	0.0000
AR(1)	-0.101758	0.320632	-0.317368	0.7510
MA(1)	0.044774	0.323006	0.138617	0.8898
	Variance Equation			
C	0.022086	0.006871	3.214512	0.0013
RESID(-1)^2	0.184823	0.029365	6.293895	0.0000
GARCH(-1)	0.844659	0.016890	50.01035	0.0000
DLOG(EUI)	-0.002544	0.040512	-0.062796	0.9499
DLOG(FFR)	-0.048717	0.217347	-0.224146	0.8226
DLOG(M2)	5.755797	14.55802	0.395369	0.6926
DLOG(VFI)	0.258910	0.195161	1.326648	0.1846
DLOG(CPI)	33.94814	5.368430	6.323664	0.0000
D(TB)	-1.051788	0.371531	-2.830957	0.0046
DLOG(OIL)	0.901075	0.521410	1.728151	0.0840
T-DIST. DOF	3.588531	0.354969	10.10943	0.0000

R-squared	0.006108	Mean dependent var	0.025858
Adjusted R-squared	0.005426	S.D. dependent var	1.153740
S.E. of regression	1.150606	Akaike info criterion	2.519099
Sum squared resid	3856.503	Schwarz criterion	2.547800
Log likelihood	-3658.847	Hannan-Quinn criter.	2.529438
Durbin-Watson stat	2.104279		

Inverted AR Roots	-.10
Inverted MA Roots	-.04



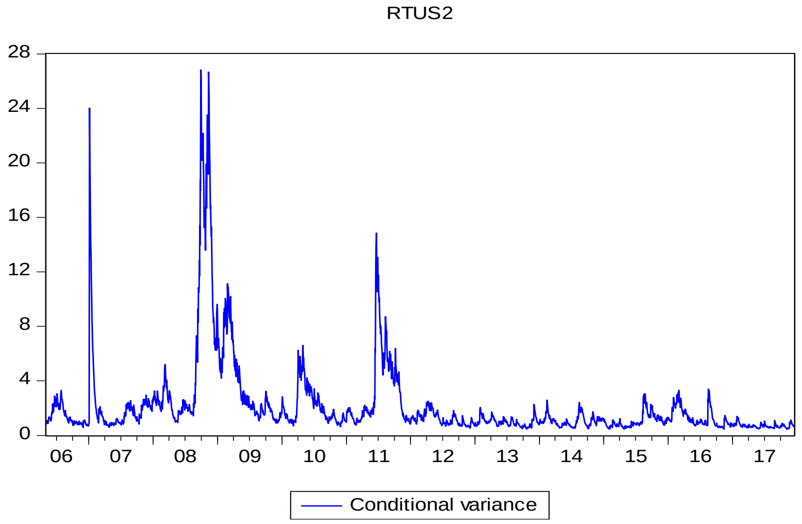
Dependent Variable: RTUS2
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/19/18 Time: 16:34
Sample (adjusted): 5/03/2006 12/18/2017
Included observations: 3034 after adjustments
Convergence achieved after 140 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.080394	0.013303	6.043478	0.0000
AR(1)	0.921767	0.025867	35.63554	0.0000
MA(1)	-0.945192	0.021114	-44.76609	0.0000
Variance Equation				
C	0.026629	0.008712	3.056526	0.0022
RESID(-1)^2	0.089439	0.011167	8.009242	0.0000
GARCH(-1)	0.896764	0.011800	75.99405	0.0000
DLOG(EUI)	-0.024539	0.062350	-0.393561	0.6939
DLOG(FFR)	-0.242810	0.295033	-0.822993	0.4105
DLOG(M2)	0.543249	21.04680	0.025811	0.9794

DLOG(VFI)	0.041816	0.261936	0.159641	0.8732
DLOG(CPI)	21.93973	18.44037	1.189766	0.2341
D(TB)	-0.057964	0.734023	-0.078968	0.9371
DLOG(OIL)	-0.851014	0.699181	-1.217159	0.2235
T-DIST. DOF	7.094477	0.782043	9.071717	0.0000

R-squared	-0.001153	Mean dependent var	0.028071
Adjusted R-squared	-0.001813	S.D. dependent var	1.475761
S.E. of regression	1.477098	Akaike info criterion	3.186580
Sum squared resid	6613.091	Schwarz criterion	3.214347
Log likelihood	-4820.041	Hannan-Quinn criter.	3.196562
Durbin-Watson stat	2.062964		

Inverted AR Roots	.92
Inverted MA Roots	.95



Dependent Variable: RTEU1
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/24/18 Time: 10:01
Sample (adjusted): 11/16/2006 11/03/2017
Included observations: 2862 after adjustments
Convergence achieved after 184 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI)

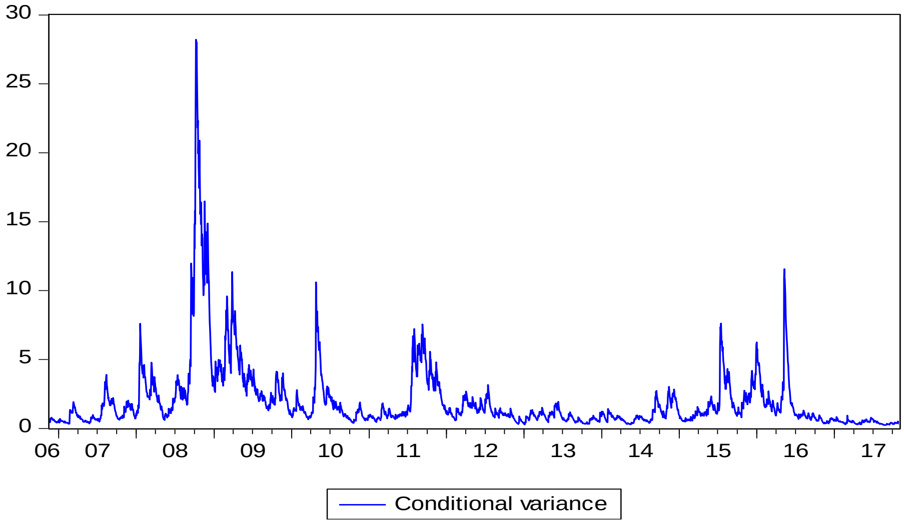
+ C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.052188	0.017585	2.967714	0.0030
AR(1)	-0.337707	0.699307	-0.482917	0.6292
MA(1)	0.360720	0.692421	0.520955	0.6024
		Variance Equation		
C	0.017249	0.006153	2.803282	0.0051
RESID(-1)^2	0.102607	0.012593	8.148181	0.0000
GARCH(-1)	0.891625	0.011940	74.67629	0.0000
DLOG(EUI)	-0.032857	0.054557	-0.602249	0.5470
DLOG(FFR)	0.167666	0.275582	0.608407	0.5429
DLOG(M2)	-6.309944	17.29377	-0.364868	0.7152
DLOG(VFI)	0.017820	0.153921	0.115777	0.9078
DLOG(CPI)	16.10389	16.60869	0.969606	0.3322
D(TB)	-0.901080	0.564304	-1.596798	0.1103
DLOG(OIL)	0.001515	0.656482	0.002308	0.9982
T-DIST. DOF	7.398952	1.011295	7.316312	0.0000

R-squared	-0.000515	Mean dependent var	0.000304
Adjusted R-squared	-0.001215	S.D. dependent var	1.384988
S.E. of regression	1.385830	Akaike info criterion	3.067645
Sum squared resid	5490.777	Schwarz criterion	3.096796
Log likelihood	-4375.800	Hannan-Quinn criter.	3.078155
Durbin-Watson stat	1.995301		

Inverted AR Roots	-.34
Inverted MA Roots	-.36

RTEU1



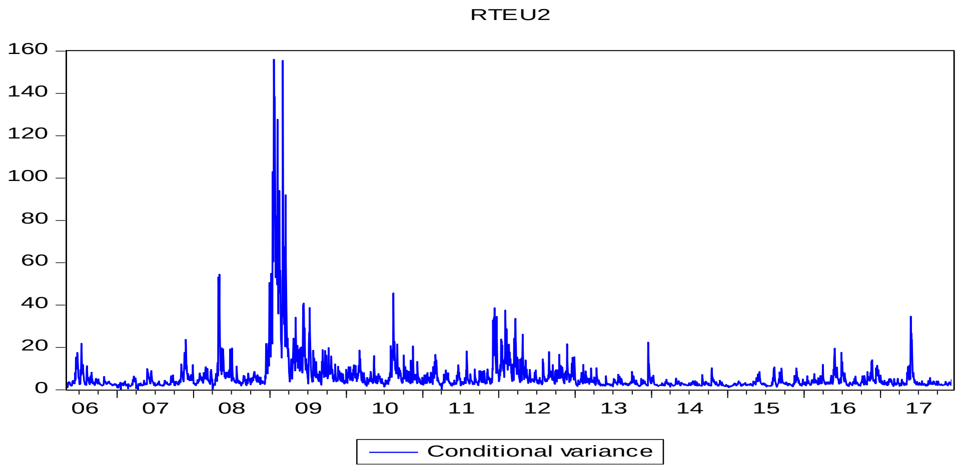
Dependent Variable: RTEU2
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/24/18 Time: 10:15
Sample (adjusted): 5/03/2006 12/18/2017
Included observations: 3034 after adjustments
Failure to improve likelihood (non-zero gradients) after 72 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.053675	0.014768	3.634662	0.0003
AR(1)	-0.026765	0.474651	-0.056388	0.9550
MA(1)	-0.009829	0.475178	-0.020684	0.9835
Variance Equation				
C	0.575793	0.367732	1.565795	0.1174
RESID(-1)^2	0.939650	0.586427	1.602331	0.1091
GARCH(-1)	0.633353	0.041303	15.33440	0.0000

DLOG(EUI)	0.034838	0.165316	0.210735	0.8331
DLOG(FFR)	-0.443928	1.211502	-0.366428	0.7140
DLOG(M2)	135.0499	160.5102	0.841379	0.4001
DLOG(VFI)	-0.365731	0.221136	-1.653874	0.0982
DLOG(CPI)	-168.5963	99.76761	-1.689890	0.0910
D(TB)	-0.624499	3.496690	-0.178597	0.8583
DLOG(OIL)	6.685324	5.336098	1.252849	0.2103
T-DIST. DOF	2.303148	0.216635	10.63145	0.0000

R-squared	0.000158	Mean dependent var	0.003607
Adjusted R-squared	-0.000502	S.D. dependent var	1.373735
S.E. of regression	1.374080	Akaike info criterion	3.086334
Sum squared resid	5722.816	Schwarz criterion	3.114102
Log likelihood	-4667.969	Hannan-Quinn criter.	3.096316
Durbin-Watson stat	2.004592		

Inverted AR Roots	-.03
Inverted MA Roots	.01



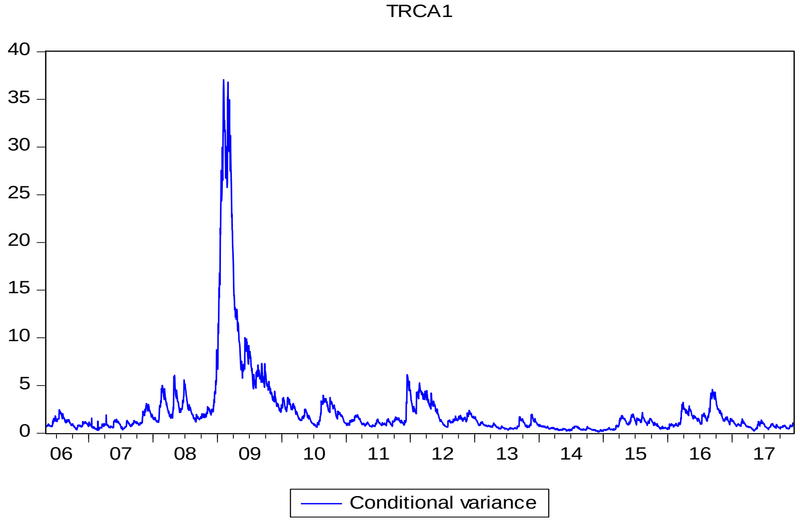
Dependent Variable: RTCA1
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/20/18 Time: 11:16
Sample (adjusted): 5/03/2006 12/18/2017
Included observations: 3034 after adjustments
Convergence achieved after 120 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) +

C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.054794	0.017538	3.124370	0.0018
AR(1)	0.167075	0.732066	0.228225	0.8195
MA(1)	-0.146639	0.734863	-0.199546	0.8418
Variance Equation				
C	0.009839	0.004641	2.120049	0.0340
RESID(-1)^2	0.068994	0.009146	7.543678	0.0000
GARCH(-1)	0.927615	0.008789	105.5456	0.0000
DLOG(EUI)	-0.074749	0.052695	-1.418516	0.1560
DLOG(FFR)	-0.137721	0.175017	-0.786902	0.4313
DLOG(M2)	1.931537	13.67148	0.141282	0.8876
DLOG(VFI)	0.199632	0.176154	1.133280	0.2571
DLOG(CPI)	-0.898624	14.88123	-0.060386	0.9518
D(TB)	-0.962937	0.504056	-1.910378	0.0561
DLOG(OIL)	0.499560	0.399382	1.250835	0.2110
T-DIST. DOF	6.257420	0.837249	7.473787	0.0000

R-squared	-0.001258	Mean dependent var	0.003182
Adjusted R-squared	-0.001919	S.D. dependent var	1.490948
S.E. of regression	1.492378	Akaike info criterion	3.093903
Sum squared resid	6750.619	Schwarz criterion	3.121670
Log likelihood	-4679.450	Hannan-Quinn criter.	3.103885
Durbin-Watson stat	2.011514		

Inverted AR Roots	.17
Inverted MA Roots	.15



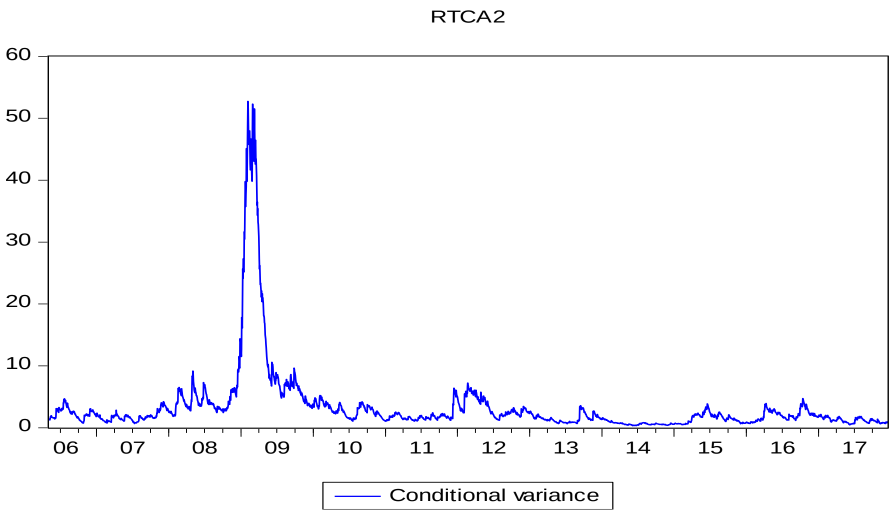
Dependent Variable: RTCA2
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/20/18 Time: 11:31
Sample (adjusted): 5/03/2006 12/18/2017
Included observations: 3034 after adjustments
Convergence achieved after 134 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.041891	0.021692	1.931121	0.0535
AR(1)	0.077258	0.844265	0.091510	0.9271
MA(1)	-0.056179	0.845425	-0.066450	0.9470
		Variance Equation		
C	0.010629	0.006457	1.646224	0.0997
RESID(-1)^2	0.061557	0.008467	7.270161	0.0000
GARCH(-1)	0.936290	0.007910	118.3642	0.0000
DLOG(EUI)	-0.059671	0.085022	-0.701828	0.4828
DLOG(FFR)	-0.009157	0.265388	-0.034506	0.9725
DLOG(M2)	2.512036	20.03094	0.125408	0.9002
DLOG(VFI)	0.107816	0.296069	0.364157	0.7157
DLOG(CPI)	12.85400	23.65281	0.543445	0.5868

D(TB)	-1.299691	0.733146	-1.772759	0.0763
DLOG(OIL)	0.213895	0.640961	0.333710	0.7386
T-DIST. DOF	6.021580	0.778708	7.732783	0.0000

R-squared	-0.000637	Mean dependent var	-0.005303
Adjusted R-squared	-0.001298	S.D. dependent var	1.796611
S.E. of regression	1.797776	Akaike info criterion	3.508625
Sum squared resid	9796.188	Schwarz criterion	3.536392
Log likelihood	-5308.583	Hannan-Quinn criter.	3.518607
Durbin-Watson stat	2.011366		

Inverted AR Roots	.08
Inverted MA Roots	.06



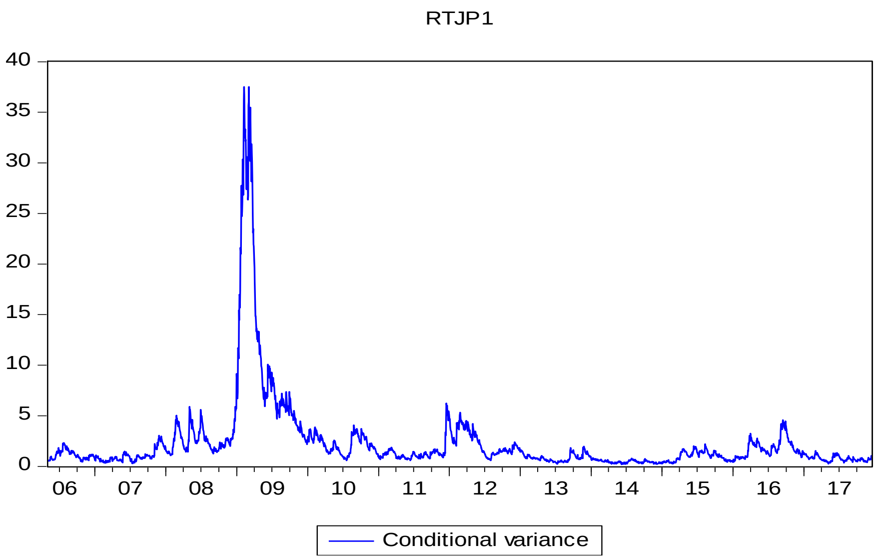
Dependent Variable: RTJP1
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/20/18 Time: 11:41
Sample (adjusted): 5/03/2006 12/18/2017
Included observations: 3034 after adjustments
Convergence achieved after 161 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.

C	0.053678	0.017506	3.066202	0.0022
AR(1)	0.225076	0.698698	0.322136	0.7473
MA(1)	-0.205596	0.702264	-0.292761	0.7697
		Variance Equation		
C	0.006983	0.004517	1.545800	0.1222
RESID(-1)^2	0.068854	0.009089	7.575502	0.0000
GARCH(-1)	0.929313	0.008585	108.2486	0.0000
DLOG(EUI)	-0.116254	0.052684	-2.206629	0.0273
DLOG(FFR)	-0.229766	0.192767	-1.191939	0.2333
DLOG(M2)	9.009855	13.80394	0.652702	0.5139
DLOG(VFI)	-0.007755	0.130804	-0.059287	0.9527
DLOG(CPI)	-13.37831	13.61194	-0.982837	0.3257
D(TB)	-0.753430	0.450732	-1.671570	0.0946
DLOG(OIL)	-0.257398	0.415367	-0.619687	0.5355
T-DIST. DOF	6.203320	0.801435	7.740266	0.0000

R-squared	-0.001225	Mean dependent var	0.003060
Adjusted R-squared	-0.001886	S.D. dependent var	1.490837
S.E. of regression	1.492242	Akaike info criterion	3.092950
Sum squared resid	6749.393	Schwarz criterion	3.120718
Log likelihood	-4678.006	Hannan-Quinn criter.	3.102933
Durbin-Watson stat	2.009745		

Inverted AR Roots	.23
Inverted MA Roots	.21

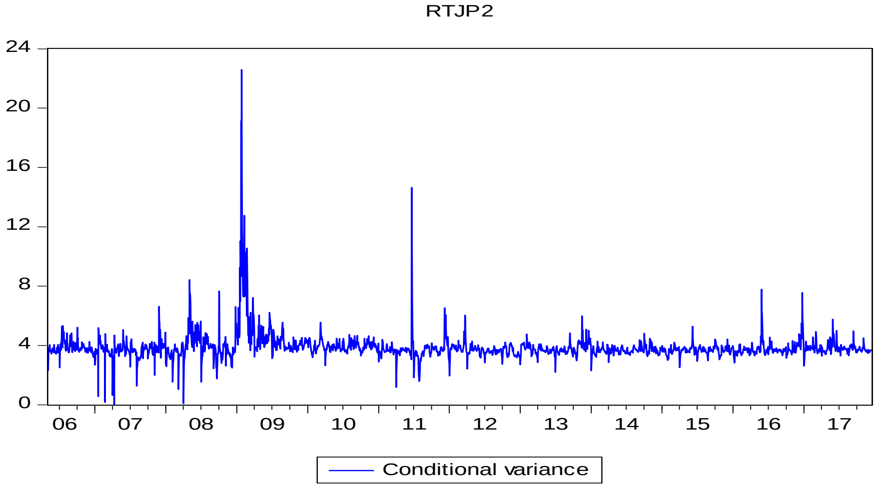


Dependent Variable: RTJP2
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/20/18 Time: 11:53
Sample (adjusted): 5/03/2006 12/18/2017
Included observations: 3034 after adjustments
Failure to improve likelihood (non-zero gradients) after 73 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.021431	0.015396	1.391935	0.1639
AR(1)	-0.070337	0.174245	-0.403668	0.6865
MA(1)	-0.010255	0.175836	-0.058321	0.9535
		Variance Equation		
C	1.537381	0.852990	1.802343	0.0715
RESID(-1)^2	0.086912	0.049672	1.749710	0.0802
GARCH(-1)	0.586857	0.137446	4.269735	0.0000
DLOG(EUI)	-0.062786	0.293321	-0.214053	0.8305
DLOG(FFR)	0.298762	1.143226	0.261333	0.7938
DLOG(M2)	-297.1630	158.1244	-1.879299	0.0602
DLOG(VFI)	-0.717765	0.211013	-3.401522	0.0007
DLOG(CPI)	-169.4948	53.79227	-3.150913	0.0016
D(TB)	3.299778	1.722323	1.915889	0.0554
DLOG(OIL)	0.770831	4.752487	0.162195	0.8712
T-DIST. DOF	2.330744	0.133535	17.45422	0.0000

R-squared	0.013911	Mean dependent var	0.002172
Adjusted R-squared	0.013260	S.D. dependent var	1.310640
S.E. of regression	1.301922	Akaike info criterion	3.059168
Sum squared resid	5137.547	Schwarz criterion	3.086936
Log likelihood	-4626.758	Hannan-Quinn criter.	3.069150
Durbin-Watson stat	2.110004		

Inverted AR Roots	-.07
Inverted MA Roots	.01



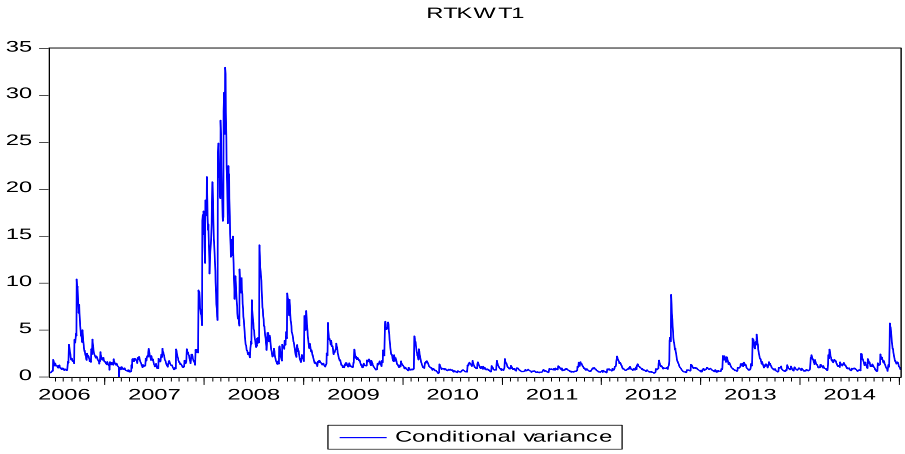
Dependent Variable: RTKWT1
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/20/18 Time: 12:04
Sample (adjusted): 6/12/2006 1/06/2015
Included observations: 2237 after adjustments
Convergence achieved after 196 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.005843	0.020373	0.286807	0.7743
AR(1)	0.692069	0.197928	3.496570	0.0005
MA(1)	-0.682572	0.201361	-3.389792	0.0007
Variance Equation				
C	0.040697	0.012486	3.259465	0.0011
RESID(-1)^2	0.111159	0.017798	6.245413	0.0000
GARCH(-1)	0.871289	0.017291	50.38854	0.0000
DLOG(EUI)	-0.067647	0.096862	-0.698387	0.4849
DLOG(FFR)	-0.168700	0.370690	-0.455096	0.6490
DLOG(M2)	2.812534	23.84330	0.117959	0.9061
DLOG(VFI)	-0.201890	0.241600	-0.835638	0.4034

DLOG(CPI)	0.864417	18.12081	0.047703	0.9620
D(TB)	-0.083335	1.192477	-0.069884	0.9443
DLOG(OIL)	0.156290	1.122188	0.139272	0.8892
T-DIST. DOF	4.612234	0.454676	10.14400	0.0000

R-squared	0.002135	Mean dependent var	-0.015458
Adjusted R-squared	0.001241	S.D. dependent var	1.513458
S.E. of regression	1.512519	Akaike info criterion	3.095178
Sum squared resid	5110.751	Schwarz criterion	3.130931
Log likelihood	-3447.957	Hannan-Quinn criter.	3.108232
Durbin-Watson stat	1.809348		

Inverted AR Roots	.69
Inverted MA Roots	.68

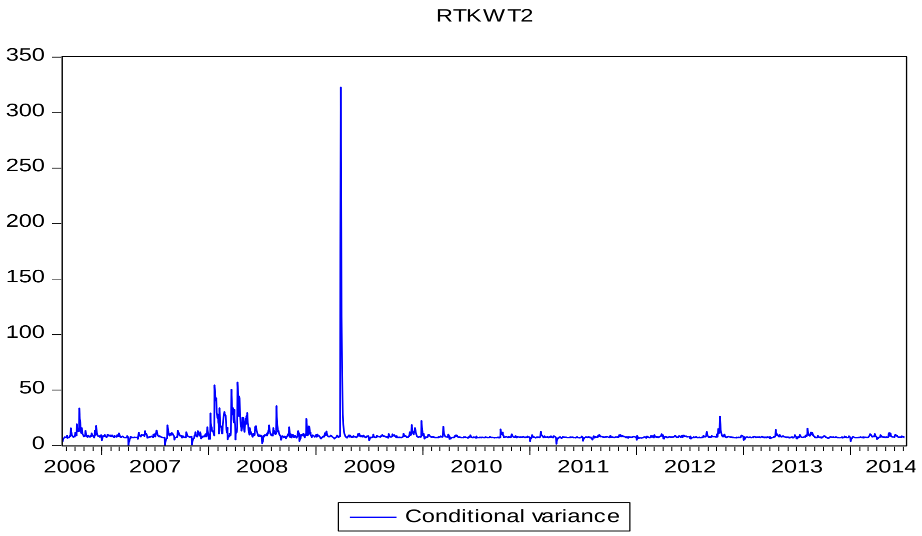


Dependent Variable: RTKWT2
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/20/18 Time: 12:18
Sample (adjusted): 8/18/2006 7/09/2014
Included observations: 2059 after adjustments
Failure to improve likelihood (non-zero gradients) after 64 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.038282	0.023164	1.652664	0.0984
AR(1)	-0.006502	1.044746	-0.006224	0.9950
MA(1)	-0.010618	1.043578	-0.010174	0.9919
		Variance Equation		
C	2.912951	2.481630	1.173805	0.2405
RESID(-1)^2	0.327795	0.272639	1.202304	0.2292
GARCH(-1)	0.586925	0.089394	6.565600	0.0000
DLOG(EUI)	-0.030635	0.639829	-0.047880	0.9618
DLOG(FFR)	-2.827760	4.614492	-0.612800	0.5400
DLOG(M2)	-97.66801	438.6017	-0.222680	0.8238
DLOG(VFI)	-0.181710	1.727391	-0.105193	0.9162
DLOG(CPI)	-416.4303	349.2738	-1.192275	0.2332
D(TB)	11.48788	10.02730	1.145660	0.2519
DLOG(OIL)	-0.184252	14.65079	-0.012576	0.9900
T-DIST. DOF	2.197610	0.182359	12.05104	0.0000

R-squared	-0.001108	Mean dependent var	-0.030181
Adjusted R-squared	-0.002082	S.D. dependent var	1.764994
S.E. of regression	1.766830	Akaike info criterion	3.420581
Sum squared resid	6418.192	Schwarz criterion	3.458861
Log likelihood	-3507.488	Hannan-Quinn criter.	3.434616
Durbin-Watson stat	2.006055		

Inverted AR Roots	-.01
Inverted MA Roots	.01

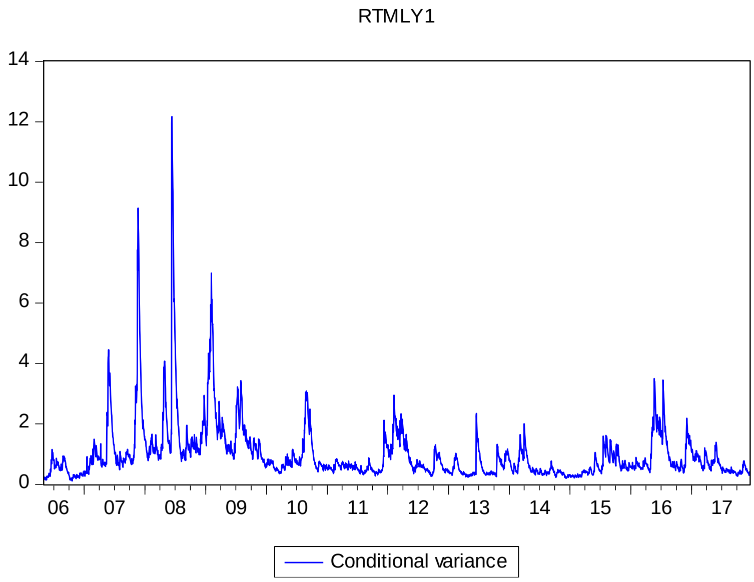


Dependent Variable: RTMLY1
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 16:39
Sample (adjusted): 5/03/2006 12/18/2017
Included observations: 3034 after adjustments
Convergence achieved after 203 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.038063	0.014032	2.712703	0.0067
AR(1)	0.411459	0.148097	2.778305	0.0055
MA(1)	-0.320825	0.154090	-2.082057	0.0373
Variance Equation				
C	0.016695	0.004676	3.570246	0.0004
RESID(-1)^2	0.086542	0.012324	7.022372	0.0000
GARCH(-1)	0.903378	0.011636	77.63736	0.0000
DLOG(EUI)	-0.051662	0.036402	-1.419207	0.1558
DLOG(FFR)	-0.004174	0.146728	-0.028449	0.9773
DLOG(M2)	-4.455712	10.08476	-0.441826	0.6586
DLOG(VFI)	0.115352	0.138403	0.833453	0.4046
DLOG(CPI)	8.488521	10.34305	0.820698	0.4118
D(TB)	-0.681449	0.427535	-1.593902	0.1110
DLOG(OIL)	0.442004	0.400359	1.104020	0.2696
T-DIST. DOF	4.080209	0.361149	11.29785	0.0000

R-squared	0.012248	Mean dependent var	0.012280
Adjusted R-squared	0.011596	S.D. dependent var	0.959034
S.E. of regression	0.953458	Akaike info criterion	2.406550
Sum squared resid	2755.425	Schwarz criterion	2.434317
Log likelihood	-3636.736	Hannan-Quinn criter.	2.416532
Durbin-Watson stat	1.971798		

Inverted AR Roots	.41
Inverted MA Roots	.32



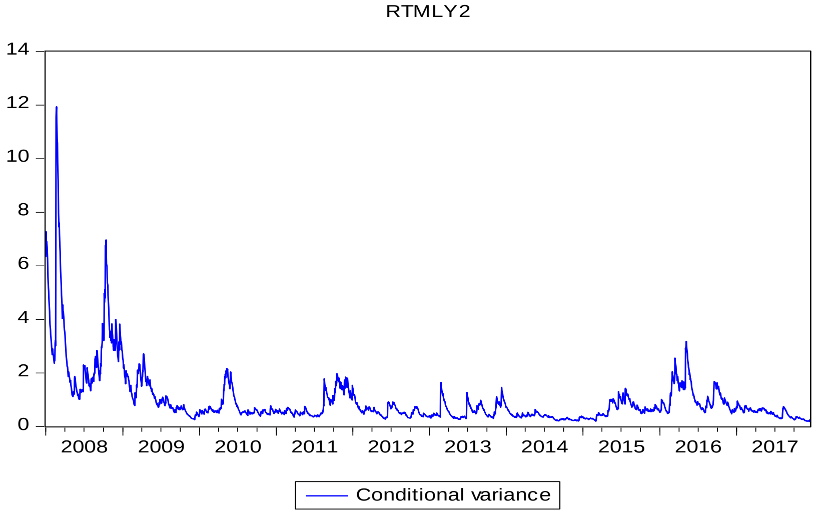
Dependent Variable: RTMLY2
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 16:48
Sample (adjusted): 12/28/2007 12/18/2017
Included observations: 2602 after adjustments
Convergence achieved after 116 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.008909	0.015226	0.585160	0.5584
AR(1)	0.383881	0.178218	2.153999	0.0312
MA(1)	-0.302697	0.184471	-1.640892	0.1008
Variance Equation				
C	0.007517	0.003298	2.279057	0.0227
RESID(-1)^2	0.061120	0.010280	5.945351	0.0000
GARCH(-1)	0.929018	0.010402	89.31068	0.0000

DLOG(EUI)	-0.006769	0.046721	-0.144887	0.8848
DLOG(FFR)	0.029762	0.128950	0.230804	0.8175
DLOG(M2)	5.626703	8.393251	0.670384	0.5026
DLOG(VFI)	0.080063	0.163826	0.488709	0.6250
DLOG(CPI)	5.193324	11.63778	0.446247	0.6554
D(TB)	-0.066069	0.628128	-0.105185	0.9162
DLOG(OIL)	0.095787	0.376847	0.254179	0.7994
T-DIST. DOF	5.076582	0.514226	9.872280	0.0000

R-squared	0.009990	Mean dependent var	-0.012676
Adjusted R-squared	0.009228	S.D. dependent var	0.977480
S.E. of regression	0.972960	Akaike info criterion	2.427319
Sum squared resid	2460.345	Schwarz criterion	2.458871
Log likelihood	-3143.942	Hannan-Quinn criter.	2.438751
Durbin-Watson stat	2.000488		

Inverted AR Roots	.38
Inverted MA Roots	.30



Dependent Variable: RTTKY1
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 16:57
Sample (adjusted): 5/03/2006 12/18/2017
Included observations: 3034 after adjustments
Convergence achieved after 102 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)

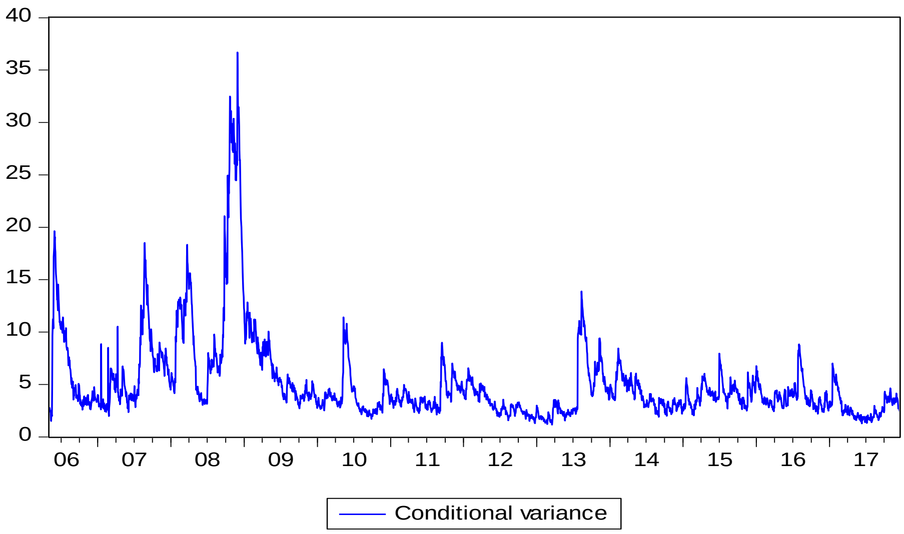
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.075266	0.033140	2.271129	0.0231
AR(1)	0.263380	0.760237	0.346444	0.7290
MA(1)	-0.243807	0.765272	-0.318589	0.7500
Variance Equation				
C	0.064907	0.022365	2.902137	0.0037
RESID(-1)^2	0.050713	0.007984	6.352127	0.0000
GARCH(-1)	0.935820	0.009288	100.7585	0.0000
DLOG(EUI)	0.400979	0.235517	1.702546	0.0887
DLOG(FFR)	0.442563	0.912721	0.484883	0.6278
DLOG(M2)	-12.94811	50.79952	-0.254887	0.7988
DLOG(VFI)	1.230259	0.840577	1.463588	0.1433
DLOG(CPI)	75.68557	58.27378	1.298793	0.1940
D(TB)	-3.969568	2.205269	-1.800038	0.0719
DLOG(OIL)	-0.113098	1.976692	-0.057216	0.9544
T-DIST. DOF	5.548004	0.588994	9.419450	0.0000

R-squared	0.000094	Mean dependent var	-0.002015
Adjusted R-squared	-0.000566	S.D. dependent var	2.252755
S.E. of regression	2.253393	Akaike info criterion	4.224231
Sum squared resid	15390.74	Schwarz criterion	4.251998
Log likelihood	-6394.158	Hannan-Quinn criter.	4.234213
Durbin-Watson stat	1.965109		

Inverted AR Roots	.26
Inverted MA Roots	.24

RTTKY1



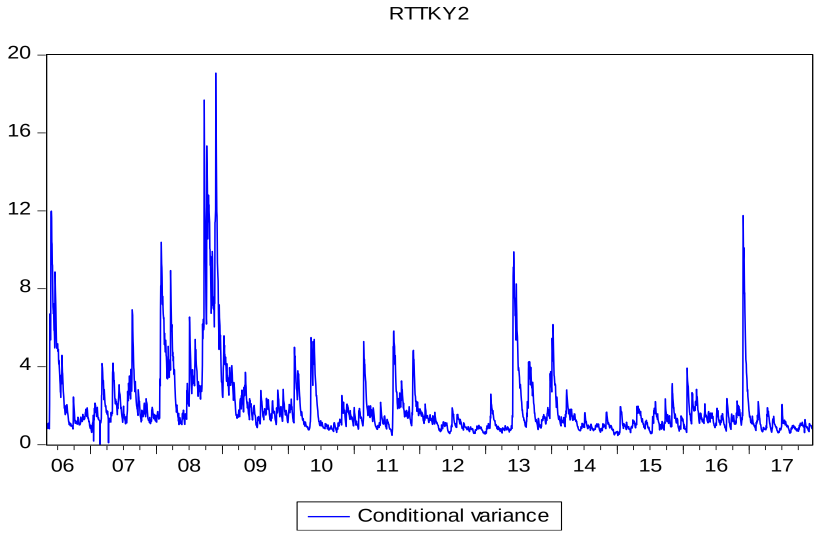
Dependent Variable: RTTKY2
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 17:05
Sample (adjusted): 5/03/2006 12/18/2017
Included observations: 3034 after adjustments
Failure to improve likelihood (singular hessian) after 116 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.068617	0.017730	3.870064	0.0001
AR(1)	0.619354	2.970572	0.208496	0.8348
MA(1)	-0.619891	2.968983	-0.208789	0.8346
Variance Equation				
C	0.064648	0.015012	4.306497	0.0000
RESID(-1)^2	0.106142	0.014862	7.141781	0.0000
GARCH(-1)	0.868830	0.016845	51.57891	0.0000
DLOG(EUI)	0.016055	0.090329	0.177738	0.8589
DLOG(FFR)	0.236784	0.362587	0.653040	0.5137
DLOG(M2)	-21.79403	18.62685	-1.170033	0.2420

DLOG(VFI)	-0.238720	0.045344	-5.264669	0.0000
DLOG(CPI)	13.75351	26.77479	0.513674	0.6075
D(TB)	-1.408404	0.974938	-1.444609	0.1486
DLOG(OIL)	0.687444	0.853118	0.805802	0.4204
T-DIST. DOF	4.068213	0.369747	11.00268	0.0000

R-squared	-0.001189	Mean dependent var	0.022227
Adjusted R-squared	-0.001850	S.D. dependent var	1.353791
S.E. of regression	1.355043	Akaike info criterion	3.114647
Sum squared resid	5565.343	Schwarz criterion	3.142415
Log likelihood	-4710.920	Hannan-Quinn criter.	3.124630
Durbin-Watson stat	1.937409		

Inverted AR Roots	.62
Inverted MA Roots	.62



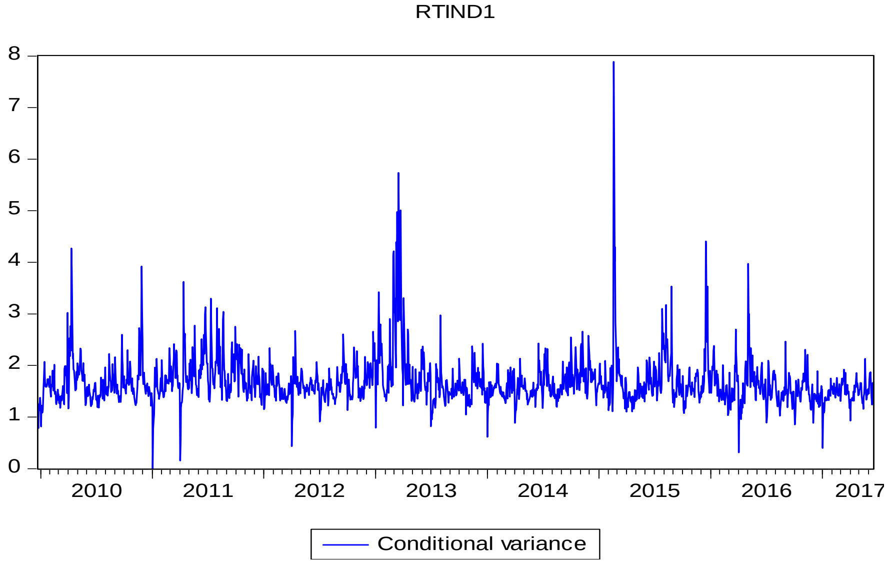
Dependent Variable: RTIND1
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 17:13
Sample (adjusted): 12/23/2009 6/15/2017
Included observations: 1952 after adjustments
Failure to improve likelihood (non-zero gradients) after 43 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)

GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.041067	0.026496	1.549941	0.1212
AR(1)	0.040996	0.331067	0.123829	0.9015
MA(1)	0.023807	0.331144	0.071894	0.9427
		Variance Equation		
C	0.549972	0.146419	3.756151	0.0002
RESID(-1)^2	0.094945	0.024672	3.848246	0.0001
GARCH(-1)	0.577662	0.089003	6.490373	0.0000
DLOG(EUI)	0.136387	0.144470	0.944052	0.3451
DLOG(FFR)	-0.104294	0.258170	-0.403973	0.6862
DLOG(M2)	76.39294	87.29774	0.875085	0.3815
DLOG(VFI)	0.776264	0.742820	1.045023	0.2960
DLOG(CPI)	-139.7641	18.15405	-7.698781	0.0000
D(TB)	1.011243	6.622769	0.152692	0.8786
DLOG(OIL)	-3.827355	2.819468	-1.357474	0.1746
T-DIST. DOF	5.047421	0.716739	7.042205	0.0000

R-squared	0.002856	Mean dependent var	0.030239
Adjusted R-squared	0.001833	S.D. dependent var	1.263766
S.E. of regression	1.262608	Akaike info criterion	3.213328
Sum squared resid	3107.054	Schwarz criterion	3.253325
Log likelihood	-3122.209	Hannan-Quinn criter.	3.228032
Durbin-Watson stat	2.019191		

Inverted AR Roots	.04
Inverted MA Roots	-.02



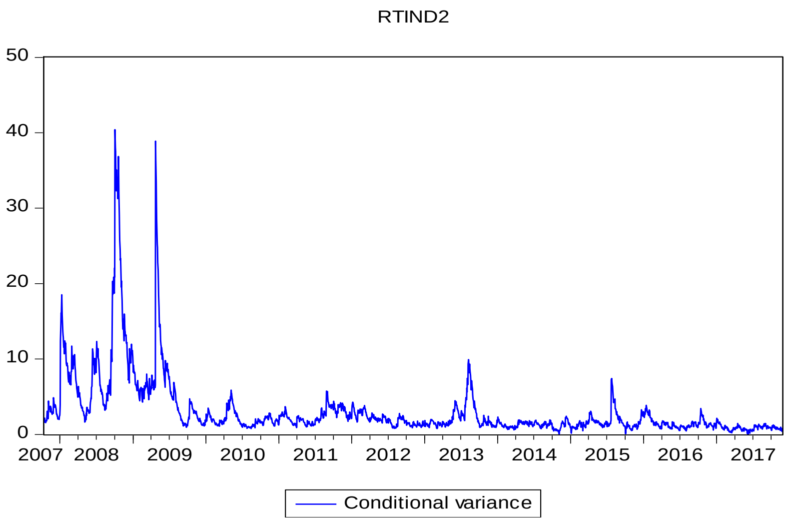
Dependent Variable: RTIND2
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 17:25
Sample (adjusted): 10/12/2007 11/27/2017
Included observations: 2642 after adjustments
Failure to improve likelihood (non-zero gradients) after 91 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.054481	0.022456	2.426082	0.0153
AR(1)	0.027666	0.301713	0.091695	0.9269
MA(1)	0.034518	0.301521	0.114481	0.9089
Variance Equation				
C	0.021210	0.008897	2.384044	0.0171
RESID(-1)^2	0.085756	0.013593	6.308871	0.0000
GARCH(-1)	0.913848	0.011274	81.05536	0.0000
DLOG(EUI)	-0.290231	0.105169	-2.759665	0.0058
DLOG(FFR)	0.737699	0.267960	2.753019	0.0059
DLOG(M2)	4.451067	26.38124	0.168721	0.8660

DLOG(VFI)	0.276201	0.378554	0.729622	0.4656
DLOG(CPI)	95.55322	35.42010	2.697712	0.0070
D(TB)	-1.268958	0.363635	-3.489644	0.0005
DLOG(OIL)	1.166675	0.870669	1.339976	0.1803
T-DIST. DOF	4.507591	0.499844	9.017989	0.0000

R-squared	-0.000161	Mean dependent var	-0.005156
Adjusted R-squared	-0.000919	S.D. dependent var	1.664786
S.E. of regression	1.665550	Akaike info criterion	3.405518
Sum squared resid	7320.738	Schwarz criterion	3.436672
Log likelihood	-4484.689	Hannan-Quinn criter.	3.416796
Durbin-Watson stat	2.044373		

Inverted AR Roots	.03
Inverted MA Roots	-.03



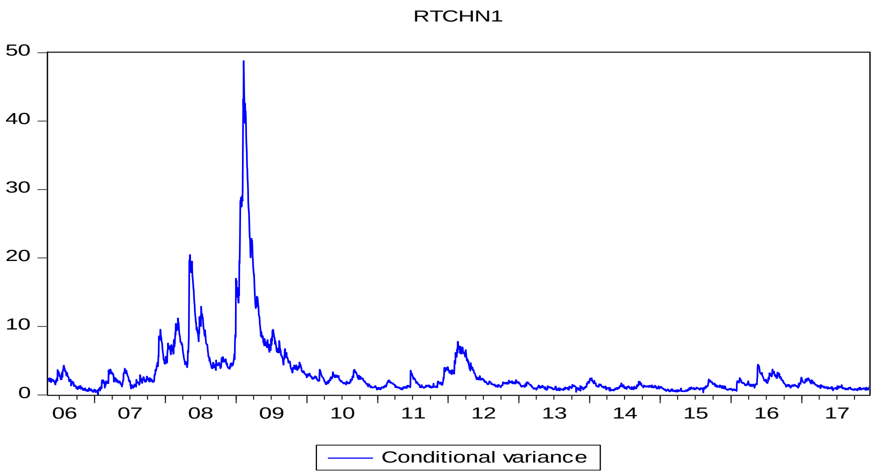
Dependent Variable: RTCHN1
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 17:36
Sample (adjusted): 5/03/2006 12/18/2017
Included observations: 3034 after adjustments
Convergence achieved after 139 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI)

+ C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.045582	0.021630	2.107325	0.0351
AR(1)	0.193162	0.348267	0.554638	0.5791
MA(1)	-0.143020	0.351844	-0.406488	0.6844
		Variance Equation		
C	0.016365	0.006577	2.488160	0.0128
RESID(-1)^2	0.053072	0.007572	7.009071	0.0000
GARCH(-1)	0.942932	0.007750	121.6712	0.0000
DLOG(EUI)	0.220118	0.083926	2.622780	0.0087
DLOG(FFR)	-0.033478	0.279357	-0.119840	0.9046
DLOG(M2)	-8.766183	19.15602	-0.457620	0.6472
DLOG(VFI)	-0.161160	0.252589	-0.638033	0.5235
DLOG(CPI)	-13.82363	20.83778	-0.663393	0.5071
D(TB)	-1.159239	0.790359	-1.466724	0.1425
DLOG(OIL)	0.035279	0.631626	0.055854	0.9555
T-DIST. DOF	5.536032	0.638320	8.672814	0.0000

R-squared	0.000345	Mean dependent var	0.017278
Adjusted R-squared	-0.000315	S.D. dependent var	1.749818
S.E. of regression	1.750094	Akaike info criterion	3.460575
Sum squared resid	9283.430	Schwarz criterion	3.488343
Log likelihood	-5235.692	Hannan-Quinn criter.	3.470557
Durbin-Watson stat	2.035045		

Inverted AR Roots	.19
Inverted MA Roots	.14



Dependent Variable: RTCHN2
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 17:47
Sample (adjusted): 5/03/2006 12/18/2017
Included observations: 3034 after adjustments
Convergence achieved after 158 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.058119	0.017277	3.363899	0.0008
AR(1)	-0.304530	0.709704	-0.429095	0.6679
MA(1)	0.283301	0.714845	0.396311	0.6919
		Variance Equation		
C	0.012245	0.005754	2.128055	0.0333
RESID(-1)^2	0.064736	0.009180	7.051506	0.0000
GARCH(-1)	0.931094	0.008810	105.6843	0.0000
DLOG(EUI)	-0.092408	0.061582	-1.500574	0.1335
DLOG(FFR)	0.045597	0.207838	0.219389	0.8263
DLOG(M2)	9.953794	17.18540	0.579201	0.5625
DLOG(VFI)	0.522385	0.229895	2.272272	0.0231
DLOG(CPI)	6.817049	17.97372	0.379279	0.7045
D(TB)	-0.783011	0.816132	-0.959417	0.3373
DLOG(OIL)	1.640124	0.462761	3.544216	0.0004
T-DIST. DOF	5.223548	0.656042	7.962218	0.0000

R-squared	-0.000030	Mean dependent var	0.012921
Adjusted R-squared	-0.000689	S.D. dependent var	1.529945
S.E. of regression	1.530472	Akaike info criterion	3.182583
Sum squared resid	7099.650	Schwarz criterion	3.210350
Log likelihood	-4813.978	Hannan-Quinn criter.	3.192565
Durbin-Watson stat	2.000979		

Inverted AR Roots	-.30
Inverted MA Roots	-.28

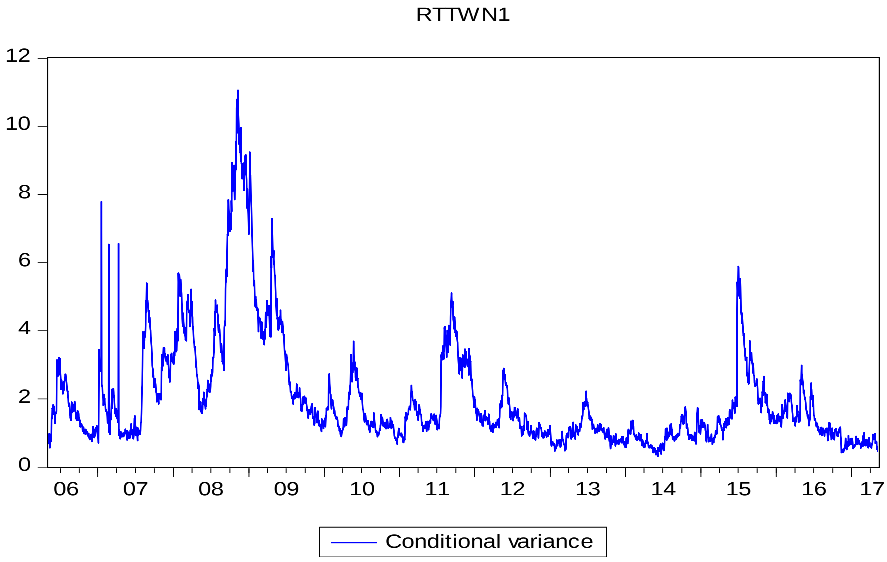
Dependent Variable: RTTWN1
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 18:01
Sample (adjusted): 5/03/2006 5/12/2017
Included observations: 2878 after adjustments
Convergence achieved after 118 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.064348	0.018726	3.436377	0.0006
AR(1)	0.713072	0.226328	3.150611	0.0016
MA(1)	-0.730533	0.220393	-3.314678	0.0009
		Variance Equation		
C	0.014998	0.005791	2.590032	0.0096
RESID(-1)^2	0.038795	0.006764	5.735527	0.0000
GARCH(-1)	0.953883	0.007184	132.7818	0.0000
DLOG(EUI)	-0.109004	0.074198	-1.469081	0.1418
DLOG(FFR)	-0.163384	0.285755	-0.571765	0.5675
DLOG(M2)	0.116153	17.23681	0.006739	0.9946
DLOG(VFI)	1.131640	0.342116	3.307763	0.0009
DLOG(CPI)	-4.081071	16.39977	-0.248849	0.8035
D(TB)	-1.036281	0.652263	-1.588747	0.1121
DLOG(OIL)	0.461287	0.685898	0.672530	0.5012
T-DIST. DOF	5.354912	0.565211	9.474185	0.0000

R-squared	-0.001991	Mean dependent var	0.014013
Adjusted R-squared	-0.002688	S.D. dependent var	1.411897
S.E. of regression	1.413793	Akaike info criterion	3.249424
Sum squared resid	5746.581	Schwarz criterion	3.278440
Log likelihood	-4661.921	Hannan-Quinn criter.	3.259883
Durbin-Watson stat	1.934017		

Inverted AR Roots .71

Inverted MA Roots	.73



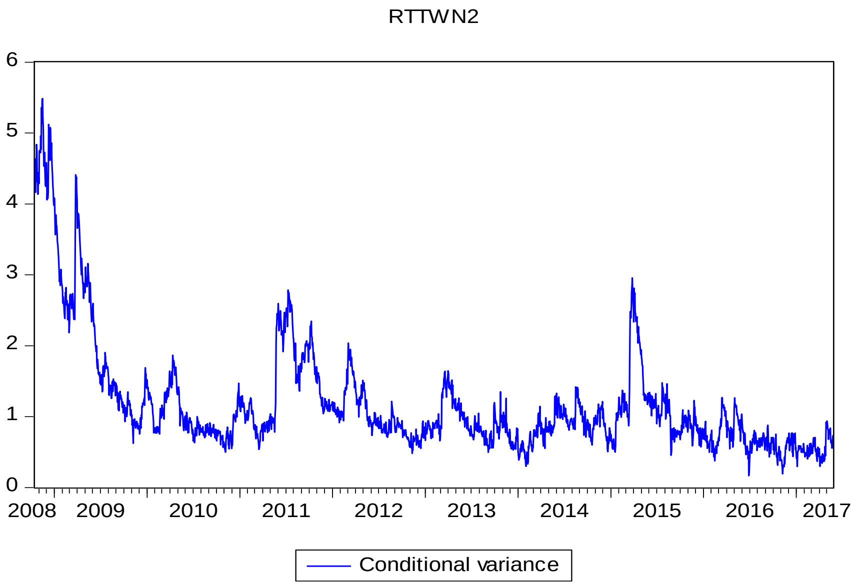
Dependent Variable: RTTWN2
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 18:16
Sample (adjusted): 10/15/2008 5/25/2017
Included observations: 2247 after adjustments
Convergence achieved after 101 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.055450	0.019337	2.867539	0.0041
AR(1)	-0.870081	0.070831	-12.28385	0.0000
MA(1)	0.885933	0.065719	13.48061	0.0000
		Variance Equation		
C	0.011134	0.005557	2.003435	0.0451
RESID(-1)^2	0.032880	0.007002	4.695958	0.0000
GARCH(-1)	0.955549	0.009037	105.7332	0.0000

DLOG(EUI)	-0.160063	0.069195	-2.313227	0.0207
DLOG(FFR)	-0.182406	0.210018	-0.868524	0.3851
DLOG(M2)	5.145941	13.36434	0.385050	0.7002
DLOG(VFI)	-0.461002	0.212476	-2.169662	0.0300
DLOG(CPI)	-13.58964	14.31453	-0.949360	0.3424
D(TB)	-0.364574	0.756824	-0.481715	0.6300
DLOG(OIL)	0.146364	0.459197	0.318738	0.7499
T-DIST. DOF	7.459457	1.205629	6.187189	0.0000

R-squared	0.006140	Mean dependent var	0.037564
Adjusted R-squared	0.005254	S.D. dependent var	1.102220
S.E. of regression	1.099320	Akaike info criterion	2.843736
Sum squared resid	2711.885	Schwarz criterion	2.879358
Log likelihood	-3180.937	Hannan-Quinn criter.	2.856739
Durbin-Watson stat	1.933138		

Inverted AR Roots	-.87
Inverted MA Roots	-.89



Dependent Variable: RTQTR1
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 18:23
Sample (adjusted): 6/12/2006 10/14/2014
Included observations: 2177 after adjustments
Failure to improve likelihood (non-zero gradients) after 88 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)

Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.020491	0.023216	0.882627	0.3774
AR(1)	0.091366	0.173590	0.526329	0.5987
MA(1)	-0.000497	0.174851	-0.002842	0.9977
		Variance Equation		
C	2.191147	0.837241	2.617106	0.0089
RESID(-1)^2	0.215600	0.072824	2.960580	0.0031
GARCH(-1)	0.433768	0.097063	4.468927	0.0000
DLOG(EUI)	0.523351	0.340903	1.535188	0.1247
DLOG(FFR)	-1.968698	1.564962	-1.257985	0.2084
DLOG(M2)	-513.7964	187.0987	-2.746125	0.0060
DLOG(VFI)	0.690649	0.893778	0.772729	0.4397
DLOG(CPI)	-242.7207	88.62818	-2.738640	0.0062
D(TB)	-1.860499	4.738438	-0.392640	0.6946
DLOG(OIL)	2.692761	7.121015	0.378143	0.7053
T-DIST. DOF	2.331377	0.127584	18.27320	0.0000

R-squared	0.011863	Mean dependent var	0.018550
Adjusted R-squared	0.010954	S.D. dependent var	1.665943
S.E. of regression	1.656793	Akaike info criterion	3.261968
Sum squared resid	5967.549	Schwarz criterion	3.298532
Log likelihood	-3536.652	Hannan-Quinn criter.	3.275336
Durbin-Watson stat	1.968531		

Inverted AR Roots	.09
Inverted MA Roots	.00

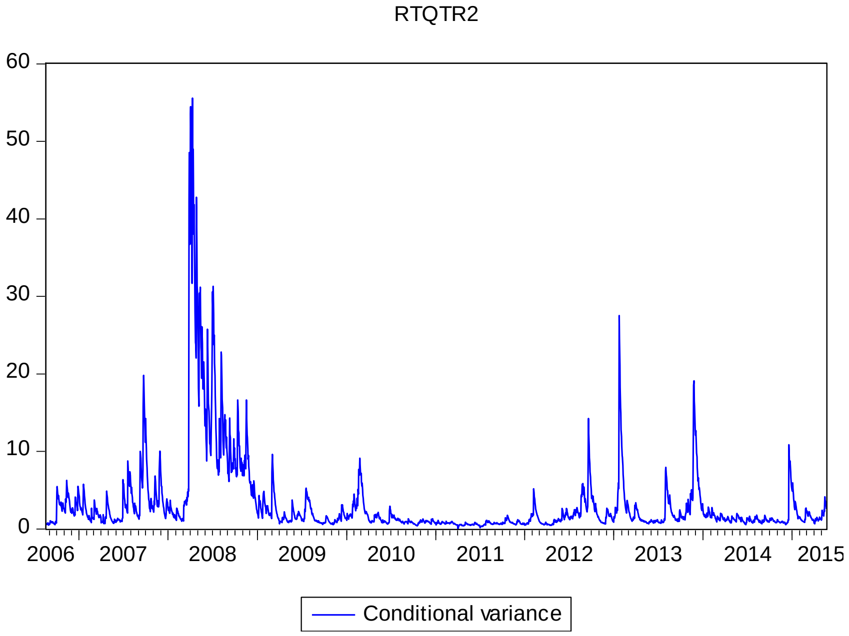
Dependent Variable: RTQTR2
Method: ML ARCH - Student's t distribution (BFGS / Marquardt steps)
Date: 05/23/18 Time: 18:30
Sample (adjusted): 8/18/2006 5/21/2015
Included observations: 2285 after adjustments

Convergence achieved after 175 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: OFF (Roots of MA process too large)
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*DLOG(EUI) +
C(8)*DLOG(FFR) + C(9)*DLOG(M2) + C(10)*DLOG(VFI) + C(11)
*DLOG(CPI) + C(12)*D(TB) + C(13)*DLOG(OIL)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.044696	0.021809	2.049439	0.0404
AR(1)	0.318485	0.166285	1.915295	0.0555
MA(1)	-0.210735	0.172886	-1.218924	0.2229
Variance Equation				
C	0.059901	0.015294	3.916747	0.0001
RESID(-1)^2	0.149567	0.024045	6.220334	0.0000
GARCH(-1)	0.848966	0.017244	49.23356	0.0000
DLOG(EUI)	-0.075347	0.110388	-0.682562	0.4949
DLOG(FFR)	-0.093217	0.389198	-0.239511	0.8107
DLOG(M2)	-16.69484	22.22860	-0.751052	0.4526
DLOG(VFI)	0.214599	0.296212	0.724478	0.4688
DLOG(CPI)	-31.33174	15.36532	-2.039120	0.0414
D(TB)	-2.405189	1.612382	-1.491699	0.1358
DLOG(OIL)	1.031634	1.321779	0.780489	0.4351
T-DIST. DOF	3.491195	0.294188	11.86721	0.0000

R-squared	0.013212	Mean dependent var	0.015968
Adjusted R-squared	0.012347	S.D. dependent var	1.725142
S.E. of regression	1.714459	Akaike info criterion	3.203273
Sum squared resid	6707.644	Schwarz criterion	3.238405
Log likelihood	-3645.739	Hannan-Quinn criter.	3.216086
Durbin-Watson stat	2.017106		

Inverted AR Roots	.32
Inverted MA Roots	.21


RTQTR2
60
50
40
30
20
10
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2006
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2008
2009
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2012
2013
2014
2015
Conditional variance