THE IMPACT OF THE INTERNATIONAL COMMODITIES PRICE MOVEMENTS ON THE STOCK MARKETS OF THE GCC COUNTRIES

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DEDICATION

I would like to dedicate my degree to my family. Their love, care, and support allowed me to receive a higher education at Haigazian University.

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ABSTRACT

THE IMPACT OF THE INTERNATIONAL COMMODITIES PRICE MOVEMENTS OF THE STOCK MARKETS OF THE GCC COUNTRIES

This research performs an empirical investigation on the impact of Energy, Agricultural and Metal commodities on the GCC stock markets. The study employs data from January 2005 to February 2017 with a weekly frequency. Utilizing Granger Causality, VAR Model, GARCH Model, Lucey and Baur (2010) model to test for the existence of safe haven and hedging effects, and Least Square method to test whether the energy commodities have symmetric or asymmetric impact on the stock markets of the GCC countries. The study finds that Agricultural commodities have safe haven and hedging effect on all the GCC stock indices. Whereas, Metal commodities have safe haven effect only on Saudi Arabia, Qatar, Oman, Kuwait and Abu Dhabi's stock markets but have hedging effect on all the GCC stock market. Moreover, Energy commodities do not have hedging effect on all the GCC stock markets and have asymmetric impact on all the GCC stock markets other than Qatar with Decreasing Energy prices having more significant impact on the GCC stock markets than their increase.

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I. Introduction and Statement of the Problem:

The GCC countries nowadays have become one of the most developed economies in both the MENA and the Middle East regions for the past few decades. This has been supported by the IMF Discussion note SDN/14/12 published on www.imf.org in 2014.

Various studies have been done examining the relationship between the oil prices and GCC Stock Markets throughout the years. In one of the studies, a non-linear direct relationship was found between the oil prices and the GCC Stock Indices (Maghyereh and Al-Kandari, 2007). Whereas Mohalhal 2015 has found that the movement of GCC Stock indices are not directly associated with the movement in oil prices; he concludes that the three indirect factors affecting the GCC stock indices are: the changing of market sentiments, news and other factors e.g. political factors (Mohalhal ,2015)

On the other hand, Yu-Min Wang (2013) and his co-researchers have tested the existence of the Safe haven effect of the International commodities (Rogers International Commodity Indexes) on equity prices in several markets. The results of the research showed that the safe haven effect was existent for most regions/countries after the 2008 financial crises. Where safe haven means: an asset uncorrelated or negatively correlated with another asset or a portfolio during economic turmoil or market crises.

This research therefore will test whether the International Commodity price movements have any statistically significant effect on the GCC Stock market indices and whether the stock prices can be predicted by the International commodity price movements taking into consideration the interest rates, International and regional stock markets.

II. Justification of the Research:

Similar studies and research papers in the last few decades have been done examining the impact of the oil prices on both the Macro and Micro economic variables of The GCC countries, not taking into consideration that other commodities may also affect the GCC economies such as: agricultural, precious and Industrial metals. The GCC stock markets have witnessed two major financial downturns in the past decade, one in 2008 and the other in 2014 following a rapid decline of oil prices.

Additionally, the GCC countries possess developed financial systems and stock markets; this was necessary to attract foreign investment not only in the energy sector but also in other industries. The development that the GCC countries have had in the preceding decades have made them a hub connecting the Asian Countries with Africa and Europe. As per the information published on the European Commission's website, the GCC countries are considered the 5^{th} largest trading partner of the EU region in terms of export to GCC countries. On the other hand, EU is the first trading partner for the GCC countries then China comes as 2^{nd} and Japan as 3^{rd} in terms of import from those countries to GCC. As per the same source, these across continent trades are not only based on oil products. This means that oil may have been the primary factor affecting the economies of the GCC countries, it is not the only, especially in the last three years where oil has witnessed a significant plunge and lost around 70% of its value in just 7 months. Oil is not as reliable as it used to be for the GCC countries in generating cash flow.

Based on all the reasoning above, I have chosen to test whether the various commodities price movements have any effects on the GCC countries stock markets taken into consideration other regional and International stock markets, and interest rates. As a result, I will be able to find the extent that other commodities, besides oil, affect the GCC stock markets.

My goal, through examining the relationship between the international commodity prices and the stock markets, is to be able to advise Fund managers, Portfolio Managers, Financial Advisors and Individual Investors in the GCC area to better diversify their portfolios, plan their investment strategies and hedge against stock market shocks by using various commodities.

III. Brief Findings of the Literature Review:

The survey of the literature is divided into two parts; the first part is conducted to test the relationship between the international stock markets and the commodity prices, whereas the second part of is to test the relationship between the GCC stock indices and oil prices:

1. The relationship between international stock market indices and commodity prices:

Johnson and Soenen (2009) test whether the stock markets of South American countries are affected by the changes in commodity prices in the short run after controlling for changes in the currency exchange rates.

The authors estimated a VAR model for each of the six South American countries and used the Gewke Measure of Feedback (measures the linear dependence between multiple time series) to test the variation in the stock market returns that are not explained by the VAR model. The main hypothesis they test for each South American Country is shown below:

1- H_1: There is no contemporaneous relationship between r_{it} (equity return) and r_{jt} (Goldman Sachs commodity price index) on the same day.

The stock markets of Brazil, Argentina and Peru were found to have a statistically significant relationship with the various commodity price indexes at 1% confidence level except for the industrial metals for the case of Brazil and livestock for the case of Peru.

Commodities e.g. Agricultural and mineral represent around 25% of Venezuela's GDP. Nevertheless, their effect on the country's stock indices movement is insignificant and this is partly explained by political factors. The Stock market in Chili has a same day reaction to the changes in the prices of energy, industrial and precious metals.

To conclude, the research has found that the stock markets of the South American countries have same day reactions to the commodity price indexes neither lagged nor led by them.

Barbara Rossi (2012) investigates the relationship between commodity prices and equity markets in the opposite way intended for this research, testing whether the equity prices can predict the commodity future prices in the commodity exporting countries.

As per Rossi, the important factor in this paper is that the subject countries' equity values are a reflection of the net present value of their future cash flow. She conducts her research on commodity-exporting countries where any change in political or economic factors will have a reflection on the equity prices which in turn will have an effect on the commodity prices of those particular producers.

She also conducts a unit root test as a first step to test the stationarity of the time series and then cross correlates the stock indices and commodity price variables, taking into consideration the global demand index and interest rates. She finds after the tests that the commodity prices are positively correlated with the equity prices, global demand,

and interest rates lagged one and two quarters. Furthermore, she conducts Granger Causality analysis (to forecast whether one-time series is useful in predicting another, given the past history of that series) to test whether the equity market growth has in-sample predictive content for the future global commodity price index:

$$E_t \Delta cp_{t+h}^W = \beta_0 + \beta_1 \Delta m_t,$$

$$E_t \Delta cp_{t+h}^W = \beta_0 + \beta_1 \Delta m_t + \beta_2 \Delta cp_t^W, \quad t = 1,2, \dots, T.$$

Where Δcp_t^W refers to the world commodity price index and h represents the horizon.

And m_t is a country's specific equity value in log levels.

First equation is when the commodity price growth is close to a random walk and the second is when it is close to autoregressive model.

Rossi tests whether the stock market growth has either in-sample or out-of-sample predictive content for future commodity prices as two separate null hypotheses, in addition to the causality between the stock market index and commodity prices.

She tests whether the equity markets Granger Cause the future commodity prices in Australia, New Zealand, Canada, Chili and South Africa using h=2 quarters. The p-value of the results are as follow for each of the countries: Australia (0.00), New Zealand (0.00), Canada (0.00), Chili (0.33) and South Africa (0.28). Meaning that there is strong predictive ability two quarters ahead in commodity prices for Australia, New Zealand and Canada only. However, for h=1 there is no predictive ability for any of the five countries included in this research.

Zapata, Detre, and Hanabuchi (2012) found that the agricultural commodities play a big role in a risk-averse investor's portfolio because they are less volatile in market crises periods. They conducted their study by using monthly data of S&P 500 index, PPI (Producer Pricing Index) and Commodity future contracts from CME (Chicago Mercantile Exchange), through testing for correlation between the various commodities (food, farm, energy, metals, etc.) and the US stock market.

Kang, Hu, and Chen (2013) examine the causal relationship between the international food commodity prices and the stock market indices in China using daily data.

As a start, they run a unit root test to test the stationarity of the time series and do first differencing as the results showed that the time series are non-stationary.

Next, they run a Granger causality analysis and test the null hypotheses to check whether each commodity index movements do or do not Granger Cause either of the Shanghai Stock Exchange (SSE) & Shenzhen Stock Exchange (SZSE) movements.

After the granger causality is identified, the authors examine the dynamic analysis of Vector Autoregressive Model and found a bilateral Granger Causal relationship between most of the food future prices (wheat, corn, soybean, and soybean oil) and the stock market indices (SSE and SZSE) except for rough rice which only has a unilateral relationship with the stock indices; meaning that the Rough Rice future prices do not Granger Cause the SSE and SZSE stock indexes. Nevertheless, both the SSE and SZSE stock indexes Granger Cause the Rough Rice future prices at a significance level of 5%

for the SSE and 10% for the SZSE with a lag term of 12 trading days. While investigating the impulse-response analysis with VAR models, the stock indices showed negative responses to the increase in future food prices on one hand, whereas food prices showed positive responses to the increase in the stock market indices on another hand.

Heaton, Milunovich, and Passe-De Silva (2011) proposed a method for estimating the earliest time in the trading day when overnight information affects the domestic share price.

At first, they formed a system of seemingly unrelated regression (SUR) and tested the following null hypothesis:

H_0: one day lagged commodity prices do not affect the Australian stock market returns. The results show some stickiness in the Australian Stock exchange opening price, in the sense

that most of the reaction occurred after the market has opened, noting that the market's reaction and processing of the information happens within the first 15 minutes of the trading and that the overnight commodity returns have a significant effect on the equities listed on Australian Stock Exchange.

Patel (2013) also investigated the relationship between gold prices and three stock exchange indices in India using monthly time series data; he conducted the following tests: ADF unit root approach to test for the stationarity of the time series, coefficient of correlation for the short-run time series, Johansen Cointegration (1990), and Granger Causality tests

They apply the Johansen Cointegration through the trace test and eigenvalue test statistic.

The research has reached three conclusions: 1) all the variables are stationary at first difference. 2) there is a long run equilibrium relationship between gold prices and all the stock market indices as Johansen's cointegration test infers to. 3) The Granger causality test suggests that the gold price contains significant information to forecast the Indian stock market returns. Therefore, Patel suggests developing a model which can forecast gold price and stock market indices by using econometric modeling techniques.

Wang, Lin, and Li (2013) examined the relationship between Rogers International commodity index Agriculture, Energy and Metal, and various stock market indices for 12 countries/regions using the Morgan Stanley Capital International (MSCI) indices for Europe, the United States, Japan, Canada, Australia, China, India, Russia, Brazil, South Korea, Taiwan, and Africa.

Two hypotheses are being tested: 1) Whether the commodities have a hedging effect on equity based portfolios. 2) Whether commodities have safe haven effect on equity based portfolios.

Hedge: an asset uncorrelated or negatively correlated with another asset or a portfolio on average, it could exhibit positive correlation during market crises.

Safe Haven: an asset uncorrelated or negatively correlated with another asset or a portfolio during economic turmoil or market crises.

The authors conducted the Granger causality and cointegration tests then used the ARCH model as the first market testing model for the commodities' indexes, as shown below:

$$R_{j,t} = \beta_{j,0} + \beta_{j,1}R_{stock,t} + \beta_{j,2}D(Vol2\sigma)R_{stock,t} + \beta_{j,3}D(R_{stock}2\sigma)R_{stock,t} + u_{j,t}$$

$$h_{j,t} = \alpha_{j,0} + \alpha_{j,1}u_{j,t-1}^2$$

Where $R_{j,t}$ represents the returns on all the commodity prices.

$$j = RICI\ , RICI - Agriculture, RICI - Energy, RICI - Metals$$

$D(Vol2\sigma)$ is the dummy variable which indicates the market returns are in a period of high volatility i.e. higher than two standard deviations of the mean volatility, and $D(R_{stock}2\sigma)$ is the dummy variable that indicates that the market returns are low i.e. below two standard deviations of the mean. Wang, Lin, and Li used a model established by Baur and Lucey (2010) to test the correlation between the commodities and the stock markets to determine whether commodities exhibit safe haven or hedging effects for equity portfolio strategies as the second market testing model.

Wang, Lin, and Li divided the second market testing model into three different periods.

- Low returns period: this is when the stock markets experience low returns and investors look for other investments as safe havens, the model is shown below:

  $$R_{j,t} = \beta_{j,0} + \beta_{j,t}R_{stock,t} + u_{j,t}$$

  $$\beta_{j,t} = \lambda_{j,1} + \lambda_{j,2}D(R_{stock}q_{10}) + \lambda_{j,3}D\left(R_{stock,t}q_5\right) + \lambda_{j,4}D(R_{stock}q_1)$$

  $$h_{j,t} = \alpha_{j,0} + \alpha_{j,1}u_{j,t-1}^2$$

$j = RICI\ , RICI - Agriculture, RICI - Energy, RICI - Metals$

$D(R_{stock,t} q_n)$ is the dummy variable. When the market return is lower than the set threshold of 10%, 5% & 1%, the dummy variables are set to 1.

E.g. for Europe $\lambda_{RICIA,2}$'s coefficient=0.1037 (any change of the stock index by 1 will change the subject $\beta_{j,t}$ by 0.1037) and P. value=0.05 (marginal significance within a statistical hypothesis test)

- <u>Periods of high market volatility:</u> under circumstances of high volatility in stock markets, investors look for other safe havens to avoid uncertainty, model used is shown below:

$$R_{j,t} = \beta_{j,0} + \beta_{j,t} R_{stock,t} + u_{j,t}$$

$$\beta_{j,t} = \lambda_{j,1} + \lambda_{j,2} D(h_{stock} q_{90,t-1}) + \lambda_{j,3}(h_{stock,t} q_{95,t-1}) + \lambda_{j,4}(h_{stock} q_{99,t-1})$$

$$h_{j,t} = \alpha_{j,0} + \alpha_{j,1} u_{j,t-1}^2$$

$$j = RICI\ , RICI - Agriculture, RICI - Energy, RICI - Metals$$

E.g. for Europe $\lambda_{RICIA,2}$'s coefficient=0.0263 (any change of the stock index by 1 will change the subject $\beta_{j,t}$ by 0.0263) and P. value=0.53

- <u>Market crisis period:</u> during financial crises in stock markets investors look for other alternatives or investment instruments as safe havens to avoid the crises, model shown below:

$$R_{j,t} = \beta_{j,0} + \beta_{j,t} R_{stock,t} + u_{j,t}$$

$$\beta_{j,t} = \lambda_{j,1} + \lambda_{j,2} D(subprime, 2008)$$

$$h_{j,t} = \alpha_{j,0} + \alpha_{j,1} u_{j,t-1}^2$$

$$j = RICI\ , RICI - Agriculture, RICI - Energy, RICI - Metals$$

E.g. for Europe $\lambda_{RICIA,2}$'s coefficient=0.1179 (any change of the stock index by 1 will change the subject $\beta_{j,t}$ by 0.1179) and P. value=0.00

The commodity markets found to lead stock markets by testing the causal relationship between them.

As for the hedging and safe haven effects, agricultural, metal, and energy commodities have exhibited safe haven effects for only few regions/countries' stock markets before the 2008 financial crises. However, the commodity indices exhibited the safe haven effect for most regions/countries' stock markets following the 2008 financial crises.

Mensi, Beljid, Boubaker, and Managi (2013) used VAR-Garch model to investigate the relationship and the volatility spillover between the Commodity price indices and S&P 500 using daily data from 3-Jan-2000 to 31-Dec-2011. They conducted ADF and PP Unit Root tests to test the stationarity of the time series, then applied VAR-Garch model (displayed below), and tested for the correlation between the commodity indices and the stock market index.

$$\begin{cases} Y_t = c + \Phi Y_{t-1} + \varepsilon_t \\ \varepsilon_t = h_t^{1/2} \eta_t \end{cases}$$

Where Y_t=($R_t^{COM}, R_t^{S\&P500}$) where R_t^{COM} and $R_t^{S\&P500}$ are the commodity and S&P500 returns.

ε_t=($\varepsilon_t^{COM}, \varepsilon_t^{S\&P500}$) where ε_t^{COM} and $\varepsilon_t^{S\&P500}$ are the residual of the mean equations.

η_t=($\eta_t^{COM}, \eta_t^{S\&P500}$) is the i.i.d. distributed random vector and the

$h_t^{1/2}$=($\sqrt{h_t^{COM}}, \sqrt{h_t^{S\&P500}}$) are the conditional variances given by:

$$h_t^{COM} = C_{Com} + \alpha_{COM}(\varepsilon_{t-1}^{COM})^2 + \beta_{COM}h_{t-1}^{COM} + \alpha_{S\&P500}(\varepsilon_{t-1}^{S\&P500})^2 + \beta_{S\&P500}h_{t-1}^{S\&P500}$$

$$h_t^{S\&P500} = C_{S\&P500} + \alpha_{S\&P500}\left(\varepsilon_{t-1}^{S\&P500}\right)^2 + \beta_{S\&P500}h_{t-1}^{S\&P500} + \alpha_{COM}(\varepsilon_{t-1}^{COM})^2 + \beta_{COM}h_{t-1}^{COM}$$

They test the null hypotheses of whether there is a predictive content in S&P500's past returns for its current returns, and whether the past S&P500's index has predictive content for the current commodity prices.

The highest market reaction to S&P500's index change one day lagged was observed with Gold 0.16, WTI 0.123, and Wheat 0.0981. (Any change with S&P500 by 1 index point will change the respective commodity price by 0.16 for gold, 0.123 for WTI and 0.0981 for WHEAT)

The estimated coefficients of VAR-Garch model are: Brent with S&P500 -0.1172, S&P500 with Gold 0.0236 (any change in Brent's or Gold's price by 1 will change the S&P500 by -0.1172 and 0.0236 respectively).

The CCC (constant conditional correlation) between S&P500 and commodity indices are 0.0114 for Brent and 0.0812 for Gold.

As per the estimates, a significant correlation and volatility transmission was found across commodity and equity markets. The results also showed the importance of adding commodities to an equity based portfolio to improve its risk-adjusted return.

Ntantamis and Zhou (2015) tested the effects of the commodities such as oil and gold on the market value of corporations that produce them. Therefore, they used the Canadian stock index data to conduct the empirical analysis on the relationship between the commodity prices and stock market as it mostly consists of businesses primarily involved in mining and marketing such commodities. They used an algorithm developed by Lunde and Timmermann (2004) to determine whether the observation belongs to a bull or bear market. Then computed the conditional probability of stock market related series being in bear (bull) market when the commodity is in a bear (bull) market. In the end the authors used a simple Probit model to categorize the findings whether there is a significant relationship between the dependent variable (market index/Specific commodity producing stock) and the independent variables (lagged or current commodity series).

The results showed that the commodity markets face longer bear phases whereas stock markets face a longer bull phases. It also showed that any commodity price is an indicator for its respective sector's stock price unless when the stock is subject to idiosyncratic risk (a risk specific to a certain asset or group of assets which also has only a little or no correlation with market risk).

2. The relationship between GCC stock market indices and oil prices:

Maghyereh and Al-Kandari (2007) examines the non-linear relationship between the oil prices and GCC stock market indices.

The authors start by running the Rank Unit Root test developed by Breitung and Gourieroux (1997) as the initial step, then they conduct the Rank Test for Cointegration developed by Breitung (2001) and test the following hypothesis:

H_0: there is no Cointegration between the oil prices and GCC stock markets

The results after the rank cointegration analysis show that the relationship between the oil price and the GCC stock indices are non-linear which is consistent with the findings of Mork (1989) and Hamilton (1996).

Mork (1989) and Hamilton (1996) in their publications argue about the non-linearity of the relationship between the oil prices and economic activity. Mork, through his research found that the increase in oil price is much more influential on the macroeconomic factors than its decrease on one hand, on the other hand, Hamilton found that the increases in the oil prices since 1986 is a correction to its previous decreases, he reached to this result by using the net oil price increase approach which compares the oil price of each quarter with the maximum value observed within the preceding four quarters, Meaning that when the value of oil in the current quarter exceeds the previous year's maximum, it is plotted on the diagram. Otherwise it is plotted as 0 for time t.

Daly and Fayyad (2011) tested the relationship between oil prices and stock markets returns in several countries including (Kuwait, Oman, Qatar, Bahrain, UAE, UK and USA) using daily data. They ran a unit root test first then apply the Vector Auto Regression (VAR) analysis to examine how the changes in oil price will affect the stock markets in the GCC and vice versa.

The two below null Hypotheses and their alternatives are being tested:

H_0: The oil prices can predict the stock market returns on daily basis.

H_0: The oil prices can be predicted by the stock market returns on daily basis.

The VAR estimates during the period from Oct/2006 to Oct/2008 when oil prices rose sharply from $50/barrel to $143/barrel show that oil prices can predict the following stock markets (lags/daily): USA (-2), UAE (-1) and Kuwait (-3). Whereas during the period from Oct/2008 to Feb/2010 when oil prices started to decrease after the sharp rise; the tests showed that the oil prices can predict the stock returns with daily lags of USA (-1), UK (-1), UAE (-2), Oman (-2) and Qatar (-1).

In the first period, the explanatory power of the results is strong with the following countries' stock indices: UAE 44%, Bahrain 27%, Qatar 45%, UK 34% and USA 42%. Whereas in the latter period when oil prices start to decrease the explanatory power gets weaker for USA 22.6%, UK 11.4% and Oman 10%.

To summarize, the results show that oil prices have a significant inter relationship with the developing markets like the GCC stock markets and developed ones like the USA and UK stock markets but to varying degrees.

Mohanty, Nandha, Turkistani, and Alaitani (2011) investigated the effects of the crude oil prices on the GCC stock markets prices following the below models:

Return-generating process: $\tilde{R}_{it} = \alpha_{i_0} + \sum_{i=1}^{k} \beta_{ij}\tilde{X}_{jt} + \tilde{\varepsilon}_{it},$ (1)

Where $\tilde{X}_{jt}$ is the risk factor j in time t.

$$\tilde{R}_{i,mt} = \alpha_{i_0} + \beta_w + \beta_{oil}\tilde{R}_{oilt} + \tilde{\varepsilon}_{it} \quad (2)$$

Where $\tilde{R}_{i,mt}$= the weekly return on stock index for country i at time t, derived as the log difference in price level of the market portfolio for country I over week t.

β_{oil}: is the oil Beta that provides measure of oil price risk sensitivity

And $\tilde{R}_{oilt}$= the weekly return on oil price at time t, derived as the log difference in oil price index at the beginning and end of week t.

$$\tilde{R}_{mt} = \alpha_{i_0} + \beta_w + \gamma_{u_i} D \times \tilde{R}_{oilt} + \gamma_{d_i}(1 - D) \times \tilde{R}_{oilt} + \tilde{\varepsilon}_{it} \quad (3)$$

Where D is the dummy variable which takes the value of unity if the oil price change is positive and D=0 otherwise; $\gamma_{u_i}$and γ_{d_i} are indicative of market index returns of the i-th country.

$$\tilde{R}_{it} = \alpha_{i_0} + \beta_m \tilde{R}^0_{mt} + \beta_{oil}\tilde{R}OIL + \tilde{\varepsilon}_{it} \quad (4)$$

$$\tilde{R}_{mt} - E(\tilde{R}_{mt}); \quad where, \qquad E(R_{mt}) = \alpha_{i_0} + \beta_{oil}R_{oilt};$$

$$\tilde{R}_{it} = \alpha_{i_0} + \beta_m \tilde{R}^0_{mt} + \gamma_{u_i} D \times \tilde{R}_{oilt} + \gamma_{d_i}(1-D)\times \tilde{R}_{oilt} + \tilde{\varepsilon}_{it} \quad (5)$$

They test the following null hypotheses:

$H_0: \gamma_{u_i} = \gamma_{d_i}$

$H_0: \gamma_{u_i} = \gamma_{d_i} = 0$

Where γ_{u_i} and $\gamma_{d_i}$are the i-th industry's oil price exposure with up (u) and down (d) movements in the oil price factor.

The estimated coefficients of model (2) that indicate oil price shocks on the GCC stock market, β_{oil} for Oman, UAE and Saudi Arabia are 0.2943, 0.4385 and 0.2907 at 1% confidence level whereas for Qatar 0.2751 and Bahrain 0.1245 at 5% and 10% confidence level respectively.

The estimated coefficients of model (3) that indicate the asymmetric effect of oil price shocks on the GCC stock market, γ_{u_i} for UAE is 0.3123, Saudi Arabia 0.2695 and Oman 0.1294 at significance level of 1%, 5% and 10% respectively, whereas $\gamma_{d_i}$for Qatar is 0.3784 and UAE 0.5483 at 1% significance level on the other hand γ_{d_i} for Bahrain is 0.2575, Kuwait 0.3316, Oman 0.4378 and Saudi Arabia 0.3092 at 5% significance level.

The research concludes that the decrease in the oil prices has a negative impact on all the six GCC countries' stock market returns, whereas the increase in the oil prices has significant positive impact on only three GCC stock market returns out of six (UAE, Saudi Arabia and Oman), which indicates an asymmetric impact of oil price shocks on the equity markets of GCC countries.

Arouri, Bellalah, and Nguyen (2011) use weekly data to capture the interactions between oil and stock prices in the GCC countries, the tests intended for both the short and long term dependencies, regarding the short term analysis, strong positive linkage has been found between the oil price changes and the stock markets' for UAE, Qatar, and for some extent Saudi Arabia, as for the long term analysis, only the stock market in Bahrain has a positive relationship with the oil price changes, whereas there is no evidence of any long term relationship between the oil price and the remaining five GCC countries.

They based their results using a GARCH model.

The estimated coefficients of oil prices on the respective GCC stock markets are as follow: On Qatar 0.354 at 1% significance level, on Saudi Arabia 0.228 at 1%, and UAE 0.149 at 5%.

They also used Cointegration and Cyclical Correlation tests to further support their results.

Azar and Basmajian (2013) also studied the impact of oil prices, macroeconomic variables on the GCC stock market returns, they used daily data starting from the 2008 financial crises until October of 2012, the research also included the Jordanian stock exchange as an Arab non-oil exporting country and test its linkage to the Major Arab oil exporting countries which are the Kuwait and Saudi Arabia in this case. They run a unit root test first to test for the stationarity of the time series, then the least square method and granger causality analysis to test for the relation between the two GCC countries' stock market returns, oil prices, macroeconomic variables, S&P500 and the Jordanian stock exchange.

The results showed: Any increase in the Kuwaiti stock returns by 1% will lead to an increase in the Saudi's stock returns by 0.54%, on the other hand if the S&P500 stock returns increase or decrease by 1% will lead to an increase or decrease in the Saudi stock returns by 0.31% at the same direction, any increase in the Jordanian stock return 1 day lagged by 1% will lead to an increase in Oman's stock returns by 0.14%, any increase in US 1 month treasury bill by 1% is expected to lead to a decrease of Saudi Stock returns by 9%.

They also conduct the Wald test in this process to remove all the insignificant variables.

As a conclusion, they found that the S&P500 has a significant positive relationship with the stock markets of Kuwait and Saudi Arabia, those two markets were also the only ones within the GCC markets to be affected by the US 1 month T-bills and corporate Baa bonds rate, all the GCC stock markets except for Bahrain are highly linked to one another in addition to Jordanian stock exchange, the research also concludes that there is an asymmetric and nonlinear relationship between oil prices and GCC stock indexes.

Mohalhal (2015) found that the equity market returns in the GCC region do not exactly associate with oil price movement; these movements could be indirect due to economic fundamentals such as changes in market sentiments, news, and other factors e.g. political factor.

He used daily data to conduct this research and used EGARCH by Nelson (1991) to investigate the heterogeneity of a sector's response in the stock market to the oil price changes and its volatility.

The null hypotheses that are being tested: there isn't any relationship between the lagged oil prices and different sectors within the different GCC stock markets.

At 0.1% significance level, the coefficients of one-day lag of oil price volatility are significantly and positively related to the Banks and insurance sector in Bahrain. Whereas in Qatar the oil price returns are significantly related to Consumers goods & services and the overall index.

In Saudi Arabia, the coefficients of oil prices are have a negative significant relationship with the real estate, agriculture and hotels sectors at 1% confidence level.

Then OLS regressions were performed to further test the relationship between the oil prices and stock markets.

The results from the literature review show the existence of significant relationship between the commodity prices and stock market indices, this relationship is more obvious in commodity exporting and producing countries e.g. GCC countries, Canada, Australia,…. Unless if an exogenous factor is involved as the case for Venezuela.

Some of the tests aimed to predict the future commodity prices using lagged values of Stock indices and others aimed to forecast the stock market returns using lagged values of commodity prices; both tests showed significant predicative ability to exist between them.

Additionally, the commodities were found to have hedging and safe haven effects in equity based portfolios in the first part of the literature review.

Moreover, the volatility transmission between the stock market indices and commodities increase during the financial crises periods.

IV. Research Methodology:

The data characteristics and sources:

The Data that will be used in this research will be of weekly frequency. The GCC stock market indices will be the dependent variables, whereas the International commodity prices, S&P500 index, LIBOR Rate, Jordanian and Moroccan Stock indexes will be the independent variables for the sake of this study. The starting point of the time series will be the January 1, 2005 and the end point will be February 28, 2017, the total observations for each variable is 524.

Initially, daily data was downloaded for all the variables and transferred into weekly where Tuesday's closing figure of each week was chosen. Later on, the data was adjusted to be continuous time series (adjusted for holiday breaks) and, since the GCC countries Stock markets are closed on Thursdays and Fridays. Jordanian Market is closed on Fridays and Saturdays; Moroccan, S&P 500 and International Commodity Markets are closed on Saturdays and Sundays, leaving the research with three common days that the Markets have in common which are Monday, Tuesday and Wednesday.

Although this thesis intends to research the impact of International Commodity prices on GCC stock indices, we cannot discard the other factors that also affect those indices.

Hence, we have chosen the independent variables S&P 500 and LIBOR to stand as a benchmark for the international stock markets and the international interest rates respectively, and test their effect on the regional GCC stock Indexes.

Moreover, we have chosen two regional countries' Indexes as independent variables: The Jordanian and the Moroccan Stock Indexes. The Jordanian Stock Index is chosen because of the country's economic and social structure remains the closest to the GCC countries' and it has the most developed stock market in the Middle East beside the GCC markets (Azar and Basmajian 2013). The rationale behind choosing the Moroccan Stock Market as another regional independent variable is mainly because Morocco is also an Arab Monarchy like the GCC countries and it was invited to join the council in 2011, making it as a valuable regional independent variable that can have effect on the GCC stock Indices.

The data used in this research are collected from online sources, details are shown below:

TASI: Tadawul All Share Index, Saudi Arabia's all stock index; it has 168 listed equities, **DFMGI:** Dubai Financial Market General Index, it has 33 listed equities, **ADX:** Abu Dhabi Securities Exchange General index, it has 41 listed equities, **KWSE:** Kuwait Main Market Index, it has 187 listed equities, **BAX:** Bahrain All Share Index, it has 39 listed equities, **MSM30**: Muscat Stock Index, most liquid 30 stocks in the market and **QE:** Qatar Stock Exchange General, it has 20 listed equities. GCC Stock Indexes, The Jordanian Stock Index, the Moroccan Stock Index and S&P500 are collected from www.investing.com. LIBOR is collected from ICE Benchmark Administration Limited (IBA)

The Rogers International commodity Index figures (**RICI:** Rogers International Commodity Index comprised of 37 commodities futures contracts, quoted in four different currencies, listed on nine exchanges in four countries, each future contract has a different weight based on its market liquidity, the initial value was 1000 as 31-July-1998, it is a good reflector of international commodity prices such as the Goldman Sachs Commodity Index, **RICIA:** Rogers International Commodity Index Agriculture comprised of 21 different agricultural commodity future contracts, initial value was 1000 as of 30-November-2004, **RICIE:** Rogers International Commodity Index Energy comprised of 6 different energy commodity future contracts, initial value was 1000 as of 30-November-2004. **RICIM:** Rogers International Commodity Index Metals comprised of 10 different metal commodity future contracts, initial value was 1000 as of 30-November-2004) are collected from their official website www.rogersmaterial.com.

Please see the below table for the symbols that will be used while performing the tests with their respective descriptions:

Sybmbol	Description
DLADX	The first difference of Log(Abu Dhabi Securities Exchange General Index)
DLBAX	The first difference of Log(Bahrain All Share Index)
DLDFMGI	The first difference of Log(Dubai Financial Market General Index)
DLKWSE	The first difference of Log(Kuwait Main Market Index)
DLMSM30	The first difference of Log(Muscat Stock Index)
DLQE	The first difference of Log(Qatar Stock Exchange General)
DLTASI	The first difference of Log(Tadawul All Share Index)
DLRICIE	The first difference of Log(Rogers International Commodity Index Energy)
DLRICIA	The first difference of Log(Rogers International Commodity Index Agriculture)
DLRICIM	The first difference of Log(Rogers International Commodity Index Metal)
DLAMGNRLX	The first difference of Log(Jordanian Stock Index)
DLMASI	The first difference of Log(Moroccan Stock Index)
DLSP500	The first difference of Log(The Standard & Poor's 500)
DLLIBOR	The first difference of Log(London Interbank Offered Rate)

This research will perform many levels of tests to determine the significance of the relationship between the independent variables (International commodity prices, regional and international stock indices) and the dependent variables (GCC Stock Indices). The tests are performed in the following order:

1) Unit Root test

It is crucial to test for the stationarity of the time series, by testing for the existence of Unit Root. It is common for macroeconomic variables to increase or decrease with mean, variance and correlation not remaining constant through time.

Therefore, by conducting Unit Root test, then differencing or detrending the time series, we will be getting better forecasting results and minimizing the probability of having spurious regression results.

There are three main tests that are usually performed to test the stationarity of the time series, mentioned here: Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS). The first two tests for the null hypothesis of the time series to be integrated of order one, whereas the KPSS tests the null hypothesis of the time series being integrated of order zero.

The KPSS test will be used in this research.

The results obtained are portrayed in Table 1 in the VIII. Tables section, the Table 2 shows that all the Log(variables) have unit root when PP test was conducted at level. Whereas, Log(KWSE) and Log(MSM 30) are the only variables that are stationary at 10% confidence level when KPSS test was conducted at level.

After first differencing the time series, the part of the table related to PP show that all the variables become stationary at 1% confidence level. Whereas, the KPSS test shows that most variables are stationary at 1% confidence level and some are only stationary at 5% and 10% confidence levels.

2) Granger-Causality test

To test for the causal relationship between the time series by using a multivariate Granger Causality regression analysis. Testing for the causal relationship will provide robust results for the significance of the relationship between the International Commodity Prices and the GCC stock markets taken into consideration the interest rates, and international & regional stock indices as well.

3) Vector Auto Regression and GARCH model

We estimate a VAR model to test for the existence of predictive ability in the international commodity prices (RICIE, RICIA and RICIM), Interest rates (LIBOR), International Stock market (S&P500) and Regional Stock markets

(MASI and AMGNRLX). Then we estimate a GARCH model to test for the existence of Autocorrelation and Conditional Heteroskedasticity to help us get good estimates for the coefficients.

4) Test for the existence of Safe Haven and Hedging effects

We will test whether the international commodity prices have Safe Haven or a Hedging effect on the GCC stock markets by applying the model introduced by Bauer and Lucey (2010), the result of this test will show us the correlation between the variables and whether it is positive, negative or none during either normal circumstances and financial distress. Additionally, the outcome of this test will help portfolio managers in GCC countries to better diversify their portfolios and protect against the volatility or sudden value decrease of their portfolio due to financial distress.

5) Least Square Method and Wald Test

At the end, we run the Least Square Method regression analysis to test whether the increase or decrease of RICIE has symmetric or asymmetric impact on each of the GCC stock markets taken into consideration all the remaining independent variables.

V. Research Questions and Hypotheses:

My research questions are as follow:

- How do commodity price movements affect each of the GCC countries stock Markets?
- Do commodities have hedging and safe haven effects on the GCC countries stock markets?
- Is the effect of Energy commodities price movements on the GCC stock markets symmetric or asymmetric?

Summary of hypotheses:

First set of hypotheses:

H_0: Commodity prices do not have causal effect on the GCC countries' stock markets

H_1: Commodity prices have causal effect on the GCC countries' stock markets

Second set of hypotheses:

H_0: Commodity prices do not predict the stock indices of the GCC counties

H_1: Commodity prices do predict the stock indices of the GCC counties

Third set of hypotheses:

H_0: Rogers International Commodity Index and any of the GCC countries stock indexes do not exhibit safe haven effect.

H_1: Rogers International Commodity Index and any of the GCC countries stock indexes exhibit safe haven effect.

Fourth set of hypotheses:

H_0: Rogers International Commodity Index and any of the GCC countries stock indexes do not exhibit hedging effect.

H_1: Rogers International Commodity Index and any of the GCC countries stock indexes exhibit hedging effect.

Fifth set of hypotheses:

H_0: Rogers International Commodity Index for Energy has symmetric impact on the GCC Index that is being tested

H_1: Rogers International Commodity Index for Energy has asymmetric impact on the GCC Index that is being tested

All the above hypotheses will be repeated for each of the three Rogers commodity indexes and seven stock markets of the GCC countries.

VI. Empirical Results:

This section portrays the results of the analysis for all the GCC countries stock indices as dependent variables, and Rogers Material Commodity Indexes, regional and international countries' stock indices, and interest rates as independent variables. the results below are in the same sequence as stated in the section IV. Research Methodology:

1) Granger Causality results with Lag=1 (One week): The results are portrayed in Table 2. In the results, we find that the DLRICIM granger Causes DLQE at 1% confidence level meaning that Rogers Material Metal Commodity Index leads Qatar stock exchange. Similarly, we can see that DLLIBOR significantly leads DLQE, DLMSM30, DLKWSE at 1% significance level and DLDFMGI, DLBAX and DLTASI at 5% confidence level, and DLADX at 10% confidence level. Moreover, we find that the DLRICIE leads all the GCC stock markets at either 1% or 5% confidence levels. We also found that DLRICIA only leads DLBAX at 1% confidence level and it doesn't have any significant effect on the other GCC stock markets. As for DLRICIM, we found that it leads DLMSM30 at 5% confidence level, and it leads DLKWSE and DLBAX at 1% confidence level.

   The international and regional stock markets also lead some of the GCC stock markets at varying confidence levels, the complete results are displayed in Table 2.

2) Vector Auto Regression results with Lag=1 (1 week): I have performed many VAR tests trying to minimize the Schwarz criterion. As a result, I have chosen to perform seven regression analysis with each of the GCC stock markets as dependent variable

and Moroccan Stock Market, Jordanian Stock Market, DLLIBOR, DLSP500, DLRICI agriculture, DLRICI Energy and DLRICI Metals as independent variables.

While reviewing the results in Table 3, we find that Rogers Material Agriculture Commodity index lagged one week does not have significant forecasting ability on any of the GCC stock markets. Rogers Material Energy Commodities Index lagged one week has only significant forecasting ability to predict stock market in Kuwait at 1% confidence level with estimated coefficient of 0.07023 (Any increase/decrease in DLRICIE by 1% will lead to an increase/decrease in DLKWSE by 0.07% one week later). Whereas, Rogers Material Metal Commodity index only has significant forecasting ability to predict the stock market in Bahrain at 5% confidence level with an estimated coefficient of 0.06142 (Any increase/decrease in DLRICIM by 1% will lead to an increase/decrease in DLBAX by 0.06% one week later).

Moreover, we find that DLLIBOR has significant forecasting ability to predict all the GCC stock markets at varying confidence levels, Interest rates have always had significant relationships with stock markets around the world based on many studies. In this study, we find that the DLLIBOR predicts Abu Dhabi and Saudi Arabia's stock indices at 5% confidence level with estimated coefficients of 0.060657 and 0.093568 respectively (Any increase/decrease in DLLIBOR by 1% will lead to an increase/decrease in DLADX and DLTASI by 0.06% and 0.09% one week later respectively), and it predicts the remaining stock markets i.e. Bahrain, Dubai, Kuwait, Oman and Qatar at 1% confidence level with estimated coefficients of 0.045305, 0.104045, 0.072298, 0.071166 and 0.147379 respectively (Any

increase/decrease in DLLIBOR by 1% will lead to an increase/decrease in DLBAX, DLDFMGI, DLKWSE and DLMSM30 by 0.06% and 0.09% one week later respectively). However, the estimated coefficients in the results had positive signs which was surprising. As we continue to review the results further, we notice that the DLSP500 doesn't predict any of the GCC stock markets one week ahead. Whereas, the other regional stock markets such as the Jordanian and Moroccan stock indices predict the stock markets in the GCC countries to varying degrees with the Jordanian stock market having more forecasting ability than the Moroccan. We also witnessed the anomaly of predictability that DLKWSE(-1) has significant effect at 1% on DLKWSE. The estimated coefficients and their relative
t-statistics are all displayed in Table 3.

3) GARCH model results: We estimated GARCH model, and tested for the existence of Auto-correlation and conditional heteroskedasticity. At first, I aimed to eliminate the insignificant variables from the model. I did this by estimating the model with all the independent variables included then by running a Wald test to check whether the eliminated variables are jointly insignificant. If not, we use the trial and error method trying to find all the significant variables and estimate the GARCH model for the second time with all the significant variables only included in the model. In rare cases, we had to include an insignificant variable, because the inclusion of that insignificant variable was a reason for one and more insignificant variables to have significant impact on the dependent variable. Afterwards, I tested for the existence of Auto-correlation and

conditional heteroskedasticity with 12 lags for each GARCH model I previously estimated. If any of them had Auto-correlation and conditional heteroskedasticity, I re-estimated the GARCH model with the inclusion of one extra independent variable which is one week lagged value of the same dependent variable that is being tested. Meaning that if DLKWSE is the dependent variable in a model, DLKWSE(-1) is added to the model as an independent variable and re-estimated.

In Table 4, we find that DLRICIE, DLSP500, Jordanian Stock Market and DLLIBOR have significant effects on the Abu Dhabi Stock index at 1% and 5% confidence levels with estimated coefficients of 0.8819, 0.1357, 0.2972 and -0.0527 respectively (Any increase/decrease in DLRICIE, DLSP500 and DLAMGNRLX by 1% will have significant positive effect on DLADX by 0.88%, 0.13% and 0.29% respectively and any increase/decrease in DLLIBOR will have significant inverse effect on DLADX by 0.05%). Then, we ran Wald test on the omitted variables from the GARCH model and found that they are jointly insignificant. Then we tested for the existence of Auto-correlation and conditional heteroskedasticity with up to 12 lags, and found that they do not exist in the estimated model. I also estimated the GARCH model for BAX. In the initial estimation, I found that Auto-correlation exists. Then I re-estimated the model by including DLBAX(-1) as independent variable into the model to resolve the Auto-correlation. However, I encountered the Auto correlation problem again. I fixed this issue by including DLBAX(-2) in the model as independent variable in addition to DLBAX(-1), and the Auto-correlation was resolved. The results are portrayed in Table 5, the Jordanian and Moroccan stock indexes have significant effects on DLBAX at 1% significance level with estimated coefficients of 0.154511 and 0.104091 respectively.

When it comes to Dubai Stock index, we find that only DLRICIE, DLSP500 and Jordanian stock market have significant effects on the DLDFMGI with estimated coefficients of 0.1328, 0.3773 and 0.5131 respectively. Then we conducted Wald test and realized that all the eliminated variables are jointly insignificant.

We also found no auto correlation and conditional heteroskedasticity in this model.

I performed the same sequence of tests on Kuwait, Oman, Qatar and Saudi Arabia stock indices exhibited in Tables 7, 8, 9 and 10 respectively. The results show that DLRICIE has significant effect on all of the four GCC stock markets mentioned above. Whereas, other commodities don't. We also found that LIBOR and other regional and international stock indices also have significant effects on these stock markets to varying degrees, please review the subject tables for further details.

4) Lucey and Bauer Model: We use this model to find whether the Energy, Agriculture or Metal commodity indexes are positively, negatively or non-correlated with the GCC stock indexes, taking into consideration the other variables included in this thesis.

To estimate the coefficients, I started by creating an interactive dummy, which will later be multiplied with the commodity index that is being tested. I used three values of Z statistics to choose the sample which will be the base to create the interactive dummy. The three Z values are 1.96, 1.645 and 1.28155 which represent the strength of the financial crisis as severe, less severe and non-severe respectively. The coefficient that is estimated as a result of multiplying the commodity index with the dummy, represents the effect of that commodity during financial crisis on the dependent variable. The results for the DUMMY multiplied with DLRICIE are displayed in the Tables from 11 to 17, with DLRICIA are displayed in the Tables from 18 to 24, and multiplied with DLRICIM are displayed in the Tables from 25 to 31.

- The results for the Safe Haven effect:

While analyzing the results for DLRICIE as independent variable during financial crisis, we find that DLRICIE*DUMMY is positively correlated with DLADX, DLBAX, DLDFMGI, DLKWSE, DLMSM30 and DLTASI with estimated coefficients of 0.23712, 0.1439, 0.3297, 0.2027, 0.2101 and 0.2246 during non-severe financial crisis at 1% confidence level (Any 1% decrease in DLRICIE if the rate is lower than 1.28 standard deviations away from the mean will lead to a decrease in DLADX, DLBAX, DLDFMGI, DLKWSE, DLMSM30 and DLTASI by 0.23%, 0.14%, 0.33%, 0.2%, 0.21% and 0.22% respectively). Whereas, DLRICIE does not have significant relationship with DLQE, meaning that DLRICIE and DLQE are uncorrelated during non-severe financial crisis. The same goes for the results when the model is estimated using Z statistic of 1.96 and 1.645 to create the interactive dummy, we find that all the GCC stock indices are positively and significantly correlated with DLRCIE*DUMMY except for DLQE that remains uncorrelated. This means that DLRICIE is considered safe haven for DLQE. Please check the tables from 11 to 18 to review all the results related to DLRICIE*DUMMY as independent variable.

While analyzing the results for the DLRICIA*DUMMY as independent variable, we found that none of the GCC stock indices are correlated with the DLRICIA while using the Z=1.96 to create the dummy. This means that DLRICIA is considered safe haven for all the GCC stock markets during severe financial crisis. Whereas, when we check the results for the dummy variable that is created using a Z=1.28155, which is the non-severe financial crisis period. We find that DLKWSE is positively correlated with DLRICIA at 5% confidence level with an estimated coefficient of 0.184617 (Any 1% decrease in DLRICIA if the rate is lower than 1.28 standard deviations away from the mean will lead to a decrease in DLKWSE by 0.18%) and DLBAX at 1% confidence level with an estimated coefficient of 0.197374 only (Any 1% decrease in DLRICIA if the rate is lower than 1.28 standard deviations away from the mean will lead to a decrease in DLBAX by 0.18%). The remaining five GCC stock indices remain uncorrelated. The remaining results for the DLRICIA*DUMMY are displayed in the tables from 18 to 24.

Then, we analyze the results for the DLRICIM*DUMMY as the independent variable and find that DLADX, DLBAX, DLDFMGI, DLKWSE and DLMSM30 are positively correlated with DLRICIM*DUMMY when Z=1.96 at 5% confidence level with estimated coefficients of 0.316574, 0.154119, 0.454599, 0.168689 and 0.184697 (Any 1% decrease in DLRICIM if the rate is lower than 1.96 standard deviations away from the mean will lead to a decrease in DLADX, DLBAX, DLDFMGI, DLKWSE and DLMSM30 by 0.31%, 0.15%, 0.45%, 0.17% AND 0.18% respectively). we also find that DLRICIM*DUMMY is negatively correlated with DLQE at 1% confidence level, and DLRICIM*DUMMY is uncorrelated with DLTASI at any significance level. Whereas, when we look at the results where Z=1.28155, we find that DLDFMGI is the only variable that is positively correlated with DLRICIM*DUMMY. Whereas, DLADX, DLBAX, DLKWSE, DLMSM30 and DLTASI are not correlated with the DLRICIM*DUMMY. DLQE on the other hand is negatively correlated with DLRICIM at 1% confidence level with an estimated coefficient of -0.389955 (Any 1% decrease in DLRICIM if the rate is lower than 1.28 standard deviations away from the mean will lead to an increase in DLQE by 0.39%). The remaining results for DLRICIM*DUMMY are displayed in the tables from 25 to 31.

- The results for the Hedging effect:

We analyze the results whether Energy commodities can have a hedging effect on the GCC stock markets, we find that energy commodity prices don't have hedging effect on any of the GCC stock indices. Whereas, when we review the results whether Agricultural and Metal commodities have any hedging effect on the GCC stock market indices, we find that both Agricultural and Metal commodities can be used to hedge against all the GCC stock markets during normal circumstances. The results for DLRICIE, DLRICIA and DLRICIM as hedge are also displayed in the tables from 11 to 31.

5) Least Square Method and Wald Test: To start, we create an Interactive Dummy where DLRICIE values that are lower than zero are set to 1; otherwise they are set to 0. Then we estimate our model by running the regression analysis. However, to run the regression analysis, we have to create two independent variables to include them in the model estimation. To create the first one, we multiply DLRICIE with the DUMMY which represents the decreasing values of Rogers International Commodity Index for Energy. To create the second one, we multiply DLRICIE with (1-DUMMY) which represents the increasing values of Rogers International Commodity Index for Energy. After estimating the model, we run a Wald Test on the two newly created variables. The null hypothesis that is being tested here is C(2)=C(3) i.e. the increase or the decrease of DLRICIE has equal impact on the GCC stock markets. In another word, DLRICIE has symmetric effect on the GCC stock markets. The results are displayed in the tables from 32 to 38.

   We start by reviewing the Wald Test results of the Tables from 32 to 38 and realize that we fail to reject the null hypothesis in Table 37 only, where DLQE is the dependent variable. Otherwise, we reject the null hypothesis for the remaining six GCC stock Indexes at 1% significance level. We interpret these results by: The rising or falling of Energy Commodities prices have asymmetric impact on all the GCC stock Markets except on Qatar's stock market which have a symmetric impact. When we review the estimated coefficients in Table 37, we see that both DLRICIE*DUMMY and DLRICIE*(1-DUMMY) have significant positive relationship with DLQE at 1% confidence level with estimated coefficients of 0.167754 and 0.189031 respectively (Any 1% decrease or increase in DLRICIE will lead to a decrease or increase in DLQE by 0.17% and 0.18% respectively).

We also find that rising DLRICIE has only significant impact on DLQE (Mentioned above), DLBAX at 5% significance level with an estimated coefficient of -0.06723 (Any increase in DLRICIE by 1% will lead to a decrease in DLBAX by 0.07% at 5% confidence level).and on DLKWSE at 10% significance level with an estimated coefficient of -0.07578 (Any increase in DLRICIE by 1% will lead to a decrease in DLKWSE by 0.08% at 10% confidence level). Whereas, falling oil prices have significant impact on all the GCC stock markets at 1% significance level with estimated coefficients of 0.28054 for DLADX, 0.132549 for DLBAX, 0.357343 for DLDFMGI, 0.158124 for DLKWSE, 0.275926 for DLMSM30, 0.167754 for DLQE (Mentioned above) and 0.301578 for DLTASI (Any 1% decrease in DLRICIE will lead to a decrease in DLADX, DLBAX, DLDFMGI, DLKWSE, DLMSM30, DLQE, and DLTASI by 0.28%, 0.13%, 0.35%, 0.15%, 0.27%, 0.17% and 0.3% respectively).

VII. Conclusion and Recommendations:

I have run Four different series of tests to analyze the relationship between the commodity prices represented by the Rogers Material Index of Energy, Agriculture and Metals and the GCC stock indices, taken into consideration interest rates, regional and international stock markets. As stated in the literature review, the Energy commodity prices have always had significant relationship with the GCC stock markets. The main reason for that is the production and exportation of oil. Therefore, the economies of those countries are largely affected by the cash flow that the oil industry generates. When we analyze the results reached in the empirical part of this thesis, we find that oil price movements have significant relationship with the GCC stock indexes and they usually move in the same direction and lead the GCC stock indices. As a result, when oil prices fall internationally, the GCC stock indices fall as well. This is explained by the decrease in the earnings of the companies that depend on oil in generating revenue, banks will suffer due to the insolvency of companies and individuals that work in the energy sector, insurance companies will suffer due to the increase in risk and the consequences that come along, the macroeconomic factors will be highly affected too such as the GDP, trade deficit, unemployment rate and most importantly the foreign investor’s confidence will decrease causing cash outflow from the region. Therefore, these will directly affect the share prices of the companies in the sector and indirectly the overall economy and the share prices of the companies in GCC area that are not in the energy sector but do business in the Gulf region and listed on the GCC countries' stock exchanges.

While analyzing the results for VAR and Granger Causality, we find that the interest rates represented by LIBOR has significant predictive ability in forecasting the stock markets of the GCC countries one week in advance. We also find that international stock markets represented by S&P500 has also predictive ability in forecasting the stock markets of Dubai and Bahrain one week in advance.

We also find that the regional markets represented by the Moroccan Stock exchange and Amman Stock Exchange also predict some of the GCC stock markets to varying degrees. This is explained by the economic integration between those two countries and GCC countries in the MENA region.

Moreover, we found that the Metal commodities have significant predictive ability in forecasting the stock market in Bahrain only. Whereas, the Agricultural commodities do not predict any of the GCC stock markets. These can be explained by the lack of mining and the farming areas in those countries which are mostly covered by sandy deserts.

After testing the existence of causation and predictive ability, we started analyzing the results of the most important test of this thesis which is whether commodity prices play safe haven or hedging roles on the GCC stock indices during financial crisis and normal circumstances respectively. I have created two tables to summarize my findings; the first table that I have created here below summarizes the findings of the existence of safe haven between commodity prices and the GCC stock markets. The existence of such effect is represented by the symbol (X). Otherwise (-) represents the non-existence of safe haven effect, meaning that the variables exhibit significant positive correlation at 5% and 1% significance levels, see the table below:

	Crisis strenght level	Abu Dhabi	Bahrain	Dubai	Kuwait	Oman	Qatar	Saudi Arabia
Energy commodities	Severe	-	-	-	-	-	x	-
	Less severe	-	-	-	-	-	x	-
	Non-severe	-	-		-	-	x	-
Agricultural commodities	Severe	x	x	x	x	x	x	x
	Less severe	x	-	x	-	x	x	x
	Non-severe	x	-	x	-	x	x	x
Metal commodities	Severe	-	-	-	-	-	x	x
	Less severe	x	-	-	x	x	x	x
	Non-severe	x	x	-	x	x	x	x

The second table which summarizes the findings for the existence of Hedging effect is displayed below. The existence of such effect between the variables is represented by the symbol (x). whereas, the non-existence of such effect is represented by (-). However, you may notice that the results are not differentiated by financial crisis strength levels here because the hedge measures correlation during the total period of the test. See the table below:

	Abu Dhabi	Bahrain	Dubai	Kuwait	Oman	Qatar	Saudi Arabia
Energy commodities	-	-	-	-	-	-	-
Agricultural commodities	x	x	x	x	x	x	x
Metal commodities	x	x	x	x	x	x	x

Moreover, we find that any increase or decrease in the International energy commodities prices affect the GCC stock market indices asymmetrically except for Qatar which is affected symmetrically by any increase or decrease in the

Energy commodities prices. Furthermore, decreasing Energy commodities prices has significant positive impact on all the GCC stock indices. Whereas, increasing energy commodities prices has significant negative impact on the stock markets in Bahrain and Kuwait with 5% and 10% confidence levels respectively, and significant positive impact on the stock market in Qatar with 1% confidence level.

Based on the conclusion above, I will be providing my recommendations here below:

- If you are an investor in the GCC countries stock markets, you may use Metal and agricultural commodity based financial instruments (Future contracts, ETFs, Index funds, etc.) to hedge against market volatility during normal circumstances.
- If you are an investor in the GCC countries Stock markets and you want to protect your portfolio's value during financial crisis; using agricultural commodity based financial instruments as safe-haven may protect its value during severe financial crisis.
- If you are an investor in Qatar and Saudi Arabia's stock markets and you want to protect your portfolio's value during financial crisis; using metal commodity based financial instruments as safe-haven in your portfolio may protect its value during those periods.
- If you are an investor in Abu Dhabi, Bahrain, Kuwait and Oman stock markets and you want to protect your portfolio's value during financial

crisis, you may use metal commodity based financial instruments as safe-haven in your portfolio to protect its value during non-severe financial crisis.

- If you are an investor in the Dubai stock market, it is advisable not to use metal commodity based financial instruments if your purpose is to protect your portfolio's value during financial crisis regardless of its severity. However, using Agricultural commodities may play safe haven role in protecting the portfolio's value during financial crises regardless of its level of severity.
- Energy commodity related financial instruments are neither a hedge nor safe haven for the GCC stock indices except for Qatar. If you are an investor in any of the stock markets in the GCC other than Qatar, it is advisable not to include Energy commodities related financial instruments in your portfolio if your purpose is to hedge or protect your portfolio's value during financial crisis.
- If you are an investor and want to forecast the stock market movement in Kuwait one week ahead; tracking the RICI Energy index movement may carry significant information to predict the stock market's movement.

As for future research, I recommend that portfolio theory researchers in the GCC region to use my findings as foundation to reach the optimum portfolio that generates the highest returns which is also hedged against market volatility and protected during financial crisis.

VIII. Limitations:

The main limitation of this research is the measurement of the political factor (regional and domestic) and its effect on the stock markets of the GCC countries. The political factor here could be the result of military or political tension, or could be the result of internal policy changes that could affect the stock market of certain GCC countries given that all the GCC countries are monarchies where “uncontested authority allows them to impose economic and political reforms from above to assuage opposition groups and the wider public” (Yom and Gregory III, 2012).

The uprising in Bahrain that started in February 2011 is a major political factor.

Another major political factor is the war between Yemen and some of the GCC countries.

Iraq which has borders with Kuwait and Saudi Arabia is in a war state since 2003.

There is continuous tension in the Gulf region between Iran and most of the GCC countries.

It is very difficult to measure the impact of the above factors on the GCC stock markets, and perform quantitative analysis on them, similar to the ones performed in the empirical part of this thesis.

Another limitation is whether oil prices and the Rogers International Commodity Index for Energy have significant relationship. Testing this relationship is not within the scope of this thesis.

There is also the anomaly that the LIBOR leads stock markets of the GCC countries one week ahead. However, this is not possible in real life situation due to transaction costs, limits to arbitrage, additional risk, sampling errors and small-sample bias.

IX. Tables:

Table 1

Unit Root Test

	PP - P value at level	Confidence level	PP - P value 1st Diff.	Confidence level	KPSS - LM level	Confidence level	KPSS - LM 1st Diff.	Confidence level
log(ADX)	0.692		0.000	*	0.504	*	0.066	
log(AMGNRLX)	0.476		0.000	*	0.378	*	0.101	
log(BAX)	0.727		0.000	*	0.304	*	0.132	***
log(DFMGI)	0.818		0.000	*	0.548	*	0.119	***
log(FED)	0.979		0.000	*	0.542	*	0.144	***
log(KWSE)	0.143		0.000	*	0.180	**	0.108	
log(LIBOR)	0.992		0.000	*	0.499	*	0.201	**
log(MASI)	0.336		0.000	*	0.462	*	0.241	*
log(MSM 30)	0.138		0.000	*	0.201	**	0.064	
log(PRIME)	0.955		0.000	*	0.487	*	0.249	*
log(QE)	0.309		0.000	*	0.290	*	0.045	
log(RICI)	0.431		0.000	*	0.317	*	0.047	
log(RICIA)	0.502		0.000	*	0.274	*	0.045	
log(RICIE)	0.394		0.000	*	0.240	*	0.038	
log(RICIM)	0.421		0.000	*	0.472	*	0.078	
log(SP500)	0.845		0.000	*	0.517	*	0.069	
log(TASI)	0.499		0.000	*	0.411	*	0.069	
Regarding KPSS test, we reject the null hypothesis at the following confidence levels:								
			LM stat above 0.216		1% confidence level		*	
			LM stat above 0.146		5% confidence level		**	
			LM stat above 0.119		10% confidence level		***	
Regarding PP test, we fail to reject the null hypothesis at the following confidence levels:								
					1% confidence level		*	
					5% confidence level		**	
					10% confidence level		***	

Table 2				
Granger-Causality Test 1/2				
Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**	**Confidence Level**
DLRICIE does not Granger Cause DLQE	522	6.20914	0.013	**
DLQE does not Granger Cause DLRICIE		3.87629	0.0495	**
DLRICIM does not Granger Cause DLQE	522	7.00494	0.0084	***
DLQE does not Granger Cause DLRICIM		0.92053	0.3378	
DLRICIA does not Granger Cause DLQE	522	1.07024	0.3014	
DLQE does not Granger Cause DLRICIA		0.25947	0.6107	
DLSP500 does not Granger Cause DLQE	522	1.62812	0.2025	
DLQE does not Granger Cause DLSP500		0.11794	0.7314	
DLAMGNRLX does not Granger Cause DLQE	522	1.89278	0.1695	
DLQE does not Granger Cause DLAMGNRLX		2.37886	0.1236	
DLMASI does not Granger Cause DLQE	522	0.19142	0.6619	
DLQE does not Granger Cause DLMASI		4.99809	0.0258	**
DLLIBOR does not Granger Cause DLQE	522	16.4726	6.00E-05	***
DLQE does not Granger Cause DLLIBOR		2.52645	0.1126	
DLRICIE does not Granger Cause DLMSM30	522	5.78921	0.0165	**
DLMSM30 does not Granger Cause DLRICIE		0.32046	0.5716	
DLRICIM does not Granger Cause DLMSM30	522	6.24425	0.0128	**
DLMSM30 does not Granger Cause DLRICIM		0.03763	0.8463	
DLRICIA does not Granger Cause DLMSM30	522	0.63093	0.4274	
DLMSM30 does not Granger Cause DLRICIA		0.49067	0.4839	
DLSP500 does not Granger Cause DLMSM30	522	0.14564	0.7029	
DLMSM30 does not Granger Cause DLSP500		0.17623	0.6748	
DLAMGNRLX does not Granger Cause DLMSM30	522	14.6104	0.0001	***
DLMSM30 does not Granger Cause DLAMGNRLX		2.51361	0.1135	
DLMASI does not Granger Cause DLMSM30	522	8.8432	0.0031	***
DLMSM30 does not Granger Cause DLMASI		18.8211	2.00E-05	***
DLLIBOR does not Granger Cause DLMSM30	522	7.49445	0.0064	***
DLMSM30 does not Granger Cause DLLIBOR		0.14381	0.7047	
DLRICIE does not Granger Cause DLKWSE	522	13.2759	0.0003	***
DLKWSE does not Granger Cause DLRICIE		3.88435	0.0493	**
DLRICIM does not Granger Cause DLKWSE	522	7.05518	0.0081	***
DLKWSE does not Granger Cause DLRICIM		1.97291	0.1607	
DLRICIA does not Granger Cause DLKWSE	522	2.36798	0.1245	
DLKWSE does not Granger Cause DLRICIA		0.89396	0.3448	
DLSP500 does not Granger Cause DLKWSE	522	0.00396	0.9498	
DLKWSE does not Granger Cause DLSP500		4.49859	0.0344	**
DLAMGNRLX does not Granger Cause DLKWSE	522	0.18638	0.6661	
DLKWSE does not Granger Cause DLAMGNRLX		3.0581	0.0809	*
DLMASI does not Granger Cause DLKWSE	522	1.37564	0.2414	
DLKWSE does not Granger Cause DLMASI		1.9175	0.1667	
DLLIBOR does not Granger Cause DLKWSE	522	12.4018	0.0005	***
DLKWSE does not Granger Cause DLLIBOR		4.41432	0.0361	**
DLRICIE does not Granger Cause DLDFMGI	522	5.59937	0.0183	**
DLDFMGI does not Granger Cause DLRICIE		9.10401	0.0027	***
DLRICIM does not Granger Cause DLDFMGI	522	0.88381	0.3476	
DLDFMGI does not Granger Cause DLRICIM		0.10919	0.7412	
DLRICIA does not Granger Cause DLDFMGI	522	0.1553	0.6937	
DLDFMGI does not Granger Cause DLRICIA		0.28013	0.5968	
DLSP500 does not Granger Cause DLDFMGI	522	0.06345	0.8012	
DLDFMGI does not Granger Cause DLSP500		0.1138	0.736	

Table 2

Granger-Causality Test 2/2

Null Hypothesis:	Obs	F-Statistic	Prob.	Confidence Level
DLAMGNRLX does not Granger Cause DLDFMGI	522	15.1608	0.0001	***
DLDFMGI does not Granger Cause DLAMGNRLX		5.08722	0.0245	**
DLMASI does not Granger Cause DLDFMGI	522	0.14342	0.7051	
DLDFMGI does not Granger Cause DLMASI		3.48052	0.0627	*
DLLIBOR does not Granger Cause DLDFMGI	522	3.99854	0.0461	**
DLDFMGI does not Granger Cause DLLIBOR		1.7211	0.1901	
DLRICIE does not Granger Cause DLBAX	522	10.5239	0.0013	***
DLBAX does not Granger Cause DLRICIE		0.28465	0.5939	
DLRICIM does not Granger Cause DLBAX	522	15.6648	9.00E-05	***
DLBAX does not Granger Cause DLRICIM		1.12941	0.2884	
DLRICIA does not Granger Cause DLBAX	522	7.50026	0.0064	***
DLBAX does not Granger Cause DLRICIA		0.49289	0.483	
DLSP500 does not Granger Cause DLBAX	522	9.28439	0.0024	***
DLBAX does not Granger Cause DLSP500		0.04896	0.825	
DLAMGNRLX does not Granger Cause DLBAX	522	4.32009	0.0382	**
DLBAX does not Granger Cause DLAMGNRLX		2.39278	0.1225	
DLMASI does not Granger Cause DLBAX	522	0.07969	0.7778	
DLBAX does not Granger Cause DLMASI		1.66998	0.1968	
DLLIBOR does not Granger Cause DLBAX	522	4.9073	0.0272	**
DLBAX does not Granger Cause DLLIBOR		1.0176	0.3136	
DLRICIE does not Granger Cause DLADX	522	4.80002	0.0289	**
DLADX does not Granger Cause DLRICIE		1.86193	0.173	
				***
DLRICIM does not Granger Cause DLADX	522	0.06231	0.803	
DLADX does not Granger Cause DLRICIM		0.24759	0.619	
DLRICIA does not Granger Cause DLADX	522	0.24013	0.6243	
DLADX does not Granger Cause DLRICIA		0.21696	0.6416	
DLSP500 does not Granger Cause DLADX	522	0.0043	0.9478	
DLADX does not Granger Cause DLSP500		0.00568	0.94	
DLAMGNRLX does not Granger Cause DLADX	522	17.1994	4.00E-05	***
DLADX does not Granger Cause DLAMGNRLX		1.28133	0.2582	
DLMASI does not Granger Cause DLADX	522	0.16771	0.6823	
DLADX does not Granger Cause DLMASI		1.22041	0.2698	
DLLIBOR does not Granger Cause DLADX	522	2.73534	0.0988	*
DLADX does not Granger Cause DLLIBOR		0.38654	0.5344	
DLRICIE does not Granger Cause DLTASI	522	5.62646	0.0181	**
DLTASI does not Granger Cause DLRICIE		2.0858	0.1493	
DLRICIM does not Granger Cause DLTASI	522	1.51123	0.2195	
DLTASI does not Granger Cause DLRICIM		0.01306	0.909	
DLRICIA does not Granger Cause DLTASI	522	0.92625	0.3363	
DLTASI does not Granger Cause DLRICIA		0.08742	0.7676	
DLSP500 does not Granger Cause DLTASI	522	0.08026	0.7771	
DLTASI does not Granger Cause DLSP500		0.33413	0.5635	
DLAMGNRLX does not Granger Cause DLTASI	522	7.18853	0.0076	***
DLTASI does not Granger Cause DLAMGNRLX		0.11281	0.7371	
DLMASI does not Granger Cause DLTASI	522	0.02517	0.874	
DLTASI does not Granger Cause DLMASI		0.31521	0.5747	
DLLIBOR does not Granger Cause DLTASI	522	4.65034	0.0315	**
DLTASI does not Granger Cause DLLIBOR		1.40402	0.2366	

We reject the null hypothesis at the following confidence levels:

If P value is less than 0.01:	1% confidence level
If P value is less than 0.05:	5% confidence level
If P value is less than 0.10:	10% confidence level

Table 3
Vector Auto Regression Test

	Y=DLADX	Y=DLBAX	Y=DLDFMGI	Y=DLKWSE	Y=DLMSM30	Y=DLQE	Y=DLTASI
	Y	Y	Y	Y	Y	Y	Y
Y(-1)	0.068744	0.091437	0.063063	0.228912	-0.059238	0.034096	-0.024111
Standard error	(0.04697)	(0.04655)	(0.04858)	(0.04674)	(0.04981)	(0.05185)	(0.04869)
t-statistics	[1.46365]	[1.96449]	[1.29811]	[4.89801]	[-1.18926]	[0.65754]	[-0.49520]
DLMASI(-1)	-0.074532	-0.009323	-0.103787	0.041884	0.113183	0.00915	-0.036822
Standard error	(0.05831)	(0.03051)	(0.08486)	(0.04118)	(0.05069)	(0.07079)	(0.07793)
t-statistics	[-1.27829]	[-0.30558]	[-1.22307]	[1.01714]	[2.23293]	[0.12926]	[-0.47251]
DLAMGNRLX(-1)	0.268597	0.045898	0.373847	0.006636	0.189976	-0.125939	0.213986
Standard error	(0.06199)	(0.03152)	(0.09133)	(0.04361)	(0.05436)	(0.07908)	(0.08308)
t-statistics	[4.33275]	[1.45601]	[4.09319]	[0.15216]	[3.49468]	[-1.59245]	[2.57552]
DLLIBOR(-1)	0.060657	0.045305	0.104045	0.072298	0.071166	0.147379	0.093568
Standard error	(0.03045)	(0.01561)	(0.04431)	(0.02122)	(0.02628)	(0.03683)	(0.04071)
t-statistics	[1.99229]	[2.90154]	[2.34826]	[3.40681]	[2.70773]	[4.00105]	[2.29851]
DLSP500(-1)	-0.038574	0.054708	-0.030102	-0.060373	-0.041976	0.055927	-0.042895
Standard error	(0.06955)	(0.03532)	(0.10219)	(0.04828)	(0.05985)	(0.08423)	(0.09415)
t-statistics	[-0.55466]	[1.54891]	[-0.29457]	[-1.25059]	[-0.70138]	[0.66400]	[-0.45562]
DLRICIA(-1)	-0.00379	0.030786	-0.043267	0.030803	-0.014084	0.01965	0.026569
Standard error	(0.06654)	(0.03422)	(0.09686)	(0.04609)	(0.05757)	(0.08045)	(0.08891)
t-statistics	[-0.05695]	[0.89952]	[-0.44672]	[0.66834]	[-0.24465]	[0.24426]	[0.29881]
DLRICIE(-1)	0.069145	0.013286	0.096437	0.07023	0.047758	0.045941	0.079696
Standard error	(0.03788)	(0.01928)	(0.05519)	(0.02602)	(0.03310)	(0.04604)	(0.05040)
t-statistics	[1.82514]	[0.68906]	[1.74747]	[2.69944]	[1.44296]	[0.99790]	[1.58116]
DLRICIM(-1)	-0.044469	0.06142	0.003912	0.046607	0.074346	0.122216	0.006233
Standard error	(0.05889)	(0.03020)	(0.08568)	(0.04087)	(0.05087)	(0.07152)	(0.07894)
t-statistics	[-0.75518]	[2.03411]	[0.04566]	[1.14033]	[1.46152]	[1.70883]	[0.07896]
C	0.001271	-0.000564	0.001423	0.000294	0.001067	0.000708	0.00026
Standard error	(0.00144)	(0.00074)	(0.00209)	(0.00099)	(0.00124)	(0.00174)	(0.00192)
t-statistics	[0.88474]	[-0.76507]	[0.68103]	[0.29522]	[0.85969]	[0.40775]	[0.13576]
R-squared	0.069238	0.08044	0.070352	0.129339	0.069289	0.054104	0.032792
Adj. R-squared	0.054723	0.066099	0.055855	0.115762	0.054775	0.039353	0.017709
Sum sq. resids	0.541275	0.142323	1.145868	0.259677	0.403299	0.78953	0.965686
S.E. equation	0.032483	0.016656	0.047262	0.022499	0.028038	0.039231	0.043387
F-statistic	4.770133	5.609408	4.852718	9.525955	4.77392	3.667857	2.174087
Log likelihood	1052.774	1401.426	857.027	1244.476	1129.574	954.244	901.6786
Akaike AIC	-3.999135	-5.334966	-3.249146	-4.733625	-4.293386	-3.621625	-3.420225
Schwarz SC	-3.925727	-5.261558	-3.175738	-4.660217	-4.219978	-3.548217	-3.346817
Mean dependent	0.000644	-0.000628	0.000621	9.25E-05	0.000937	0.000714	-0.000323
S.D. dependent	0.03341	0.017236	0.048639	0.023926	0.028839	0.040026	0.043776
Determinant resid covariance (dof adj.)	1.31E-25	3.58E-26	2.55E-25	6.12E-26	8.41E-26	1.58E-25	2.27E-25
Determinant resid covariance	1.14E-25	3.12E-26	2.22E-25	5.33E-26	7.32E-26	1.38E-25	1.98E-25
Log likelihood	9064.566	9403.144	8891.213	9263.19	9180.481	9015.493	8921.036
Akaike information criterion	-34.45428	-35.75151	-33.79009	-35.21529	-34.8984	-34.26626	-33.90435
Schwarz criterion	-33.86701	-35.16425	-33.20282	-34.62802	-34.31113	-33.67899	-33.31709

Each coefficient is considered significant at: 1% significant level if the t-statistic beneath it is higher than 2.33
5% significant level if the t-statistic beneath it is higher than 1.96
10% significant level if the t-statistic beneath it is higher than 1.645

Table 4

GARCH Model estimation for DLADX as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001072	0.001015	1.056827	0.2906
DLRICIE	0.08819	0.022177	3.976575	0.0001
DLSP500	0.135713	0.04678	2.901107	0.0037
DLAMGNRLX	0.297281	0.0462	6.434664	0
DLLIBOR	-0.052791	0.022514	-2.344789	0.019

Omitted Variables: DLRICIA, DLRICIM and DLMASI

Variance Equation:

C	5.99E-06	3.56E-06	1.6818	0.0926
RESID(-1)^2	0.059867	0.012096	4.949263	0
GARCH(-1)	0.93142	0.010309	90.35406	0

Diagnostics:

R-squared	0.162249	Mean dependent var		0.000647
Adjusted R-squared	0.15578	S.D. dependent var		0.033378
S.E. of regression	0.030668	Akaike info criterion		-4.3517
Sum squared resid	0.487188	Schwarz criterion		-4.286544
Log likelihood	1145.97	Hannan-Quinn criter.		-4.326182
Durbin-Watson stat	1.844828			

Wald Test:

Test Statistic	Value	df	Probability
F-statistic	0.851332	(3, 512)	0.4663
Chi-square	2.553995	3	0.4656

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 5
GARCH Model estimation for DLBAX as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000373	0.000635	-0.587146	0.5571
DLRICIE	0.037917	0.015014	2.525445	0.0116
DLRICIM	0.037606	0.019241	1.954447	0.0506
DLAMGNRLX	0.151422	0.021915	6.909583	0
DLMASI	0.107624	0.020442	5.264835	0
DLBAX(-1)	0.154907	0.042083	3.681001	0.0002

Omitted Variables: DLRICIA, DLSP500 and DLLIBOR

Variance Equation:

C	7.12E-06	2.92E-06	2.434965	0.0149
RESID(-1)^2	0.061412	0.015852	3.87412	0.0001
GARCH(-1)	0.906607	0.024575	36.89141	0

Diagnostics:

R-squared	0.172275	Mean dependent var		-0.000628
Adjusted R-squared	0.164255	S.D. dependent var		0.017236
S.E. of regression	0.015757	Akaike info criterion		-5.5574
Sum squared resid	0.128109	Schwarz criterion		-5.483992
Log likelihood	1459.481	Hannan-Quinn criter.		-5.528648
Durbin-Watson stat	2.162662			

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000302	0.00063	-0.478869	0.632
DLRICIE	0.037634	0.014977	2.512818	0.012
DLRICIM	0.043181	0.019452	2.219894	0.0264
DLAMGNRLX	0.154511	0.021739	7.107606	0
DLMASI	0.104091	0.021068	4.940669	0
DLBAX(-1)	0.140519	0.043291	3.24592	0.0012
DLBAX(-2)	0.104241	0.046501	2.241725	0.025

Omitted Variables: DLRICIA, DLSP500 and DLLIBOR

Variance Equation:

C	6.23E-06	2.36E-06	2.643066	0.0082
RESID(-1)^2	0.056456	0.014319	3.942641	0.0001
GARCH(-1)	0.91426	0.020479	44.64428	0

Diagnostics:

R-squared	0.181234	Mean dependent var		-0.000638
Adjusted R-squared	0.171677	S.D. dependent var		0.017251
S.E. of regression	0.0157	Akaike info criterion		-5.564739
Sum squared resid	0.1267	Schwarz criterion		-5.483055
Log likelihood	1459.615	Hannan-Quinn criter.		-5.532743
Durbin-Watson stat	2.135069			

Wald Test:

Test Statistic	Value	df	Probability
F-statistic	0.725755	(3, 512)	0.5369
Chi-square	2.177264	3	0.5364

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 6

GARCH Model estimation for DLDFMGI as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000309	0.001559	0.198206	0.8429
DLRICIE	0.132877	0.035464	3.7468	0.0002
DLSP500	0.3773	0.056642	6.661088	0
DLAMGNRLX	0.513146	0.066176	7.754291	0

Omitted Variables: DLRICIA, DLRICIM, DLMASI and DLLIBOR

Variance Equation:

C	0.000119	4.40E-05	2.710474	0.0067
RESID(-1)^2	0.16733	0.03788	4.417374	0
GARCH(-1)	0.778337	0.049094	15.85398	0

Diagnostics:

R-squared	0.225508	Mean dependent var		0.000611
Adjusted R-squared	0.221031	S.D. dependent var		0.048593
S.E. of regression	0.042888	Akaike info criterion		-3.602128
Sum squared resid	0.954645	Schwarz criterion		-3.545117
Log likelihood	948.9565	Hannan-Quinn criter.		-3.5798
Durbin-Watson stat	1.912169			

Wald Test:

Test Statistic	Value	df	Probability
F-statistic	0.400262	(4, 512)	0.8085
Chi-square	1.60105	4	0.8086

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 7

GARCH Model estimation for DLKWSE as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000682	0.000732	0.930451	0.3521
DLRICIE	0.031054	0.015846	1.959774	0.05
DLSP500	0.095384	0.036503	2.613056	0.009
DLAMGNRLX	0.258273	0.018681	13.82574	0
DLMASI	0.150935	0.026592	5.675887	0
DLLIBOR	-0.018621	0.016413	-1.134545	0.2566
DLKWSE(-1)	0.249885	0.045685	5.46976	0

Omitted Variables: DLRICIA and DLRICIM

Variance Equation:

C	7.57E-05	1.27E-05	5.96004	0
RESID(-1)^2	0.421857	0.072411	5.825886	0
GARCH(-1)	0.466202	0.055111	8.459275	0

Diagnostics:

R-squared	0.247787	Mean dependent var		9.25E-05
Adjusted R-squared	0.239023	S.D. dependent var		0.023926
S.E. of regression	0.020872	Akaike info criterion		-5.085202
Sum squared resid	0.22435	Schwarz criterion		-5.003637
Log likelihood	1337.238	Hannan-Quinn criter.		-5.053255
Durbin-Watson stat	2.150707			

Wald Test:

Test Statistic	Value	df	Probability
F-statistic	0.051983	(2, 512)	0.9494
Chi-square	0.103965	2	0.9493

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 8
GARCH Model estimation for DLMSM30 as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001009	0.000785	1.286441	0.1983
DLRICIE	0.097185	0.017408	5.582592	0
DLSP500	0.154587	0.036908	4.188475	0
DLAMGNRLX	0.259413	0.039467	6.572972	0
DLMASI	0.045786	0.027841	1.644561	0.1001
DLLIBOR	-0.053446	0.018113	-2.950679	0.0032
DLMSM30(-1)	0.133794	0.041063	3.258243	0.0011

Omitted Variables: DLRICIA and DLRICIM

Variance Equation:

C	3.39E-05	1.01E-05	3.349067	0.0008
RESID(-1)^2	0.225261	0.048576	4.637302	0
GARCH(-1)	0.72474	0.048431	14.96424	0

Diagnostics:

R-squared	0.228379	Mean dependent var		0.000937
Adjusted R-squared	0.219389	S.D. dependent var		0.028839
S.E. of regression	0.02548	Akaike info criterion		-4.926938
Sum squared resid	0.334361	Schwarz criterion		-4.845374
Log likelihood	1295.931	Hannan-Quinn criter.		-4.894991
Durbin-Watson stat	2.328042			

Wald Test:

Test Statistic	Value	df	Probability
F-statistic	0.13267	(2, 512)	0.8758
Chi-square	0.265341	2	0.8758

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 9

GARCH Model estimation for DLQE as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001248	0.00074	1.687292	0.0915
DLRICIE	0.142093	0.017111	8.303985	0
DLSP500	0.203711	0.033808	6.025482	0
DLAMGNRLX	0.492519	0.034284	14.36577	0

Omitted Variables: DLRICIA, DLRICIM, DLMASI and DLLIBOR

Variance Equation:

RESID(-1)^2	0.117367	0.012879	9.112719	0
GARCH(-1)	0.882633	0.012879	68.53012	0

Diagnostics:

R-squared	0.285407	Mean dependent var		0.000738
Adjusted R-squared	0.281277	S.D. dependent var		0.039991
S.E. of regression	0.033904	Akaike info criterion		-4.311096
Sum squared resid	0.596569	Schwarz criterion		-4.270374
Log likelihood	1132.352	Hannan-Quinn criter.		-4.295148
Durbin-Watson stat	2.036148			

Wald Test:

Test Statistic	Value	df	Probability
F-statistic	1.134309	(4, 512)	0.3395
Chi-square	4.537236	4	0.3382

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 10
GARCH Model estimation for DLTASI as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00037	0.000763	-0.485411	0.6274
DLRICIE	0.14233	0.024044	5.919489	0
DLRICIA	-0.118068	0.025449	-4.639406	0
DLSP500	0.420147	0.037043	11.34201	0
DLAMGNRLX	0.259112	0.032295	8.023246	0
DLLIBOR	-0.052888	0.018989	-2.785175	0.0053

Omitted Variables: DLRICIM and DLMASI

Variance Equation:

RESID(-1)^2	0.15656	1.33E-02	11.78494	0
GARCH(-1)	0.843443	0.013285	63.49073	0

Diagnostics:

R-squared	0.18154	Mean dependent var		-0.00024
Adjusted R-squared	0.173624	S.D. dependent var		0.043776
S.E. of regression	0.039795	Akaike info criterion		-3.932006
Sum squared resid	0.818733	Schwarz criterion		-3.874994
Log likelihood	1035.22	Hannan-Quinn criter.		-3.909678
Durbin-Watson stat	2.010018			

Wald Test:

Test Statistic	Value	df	Probability
F-statistic	0.325535	(2, 514)	0.7223
Chi-square	0.651071	2	0.7221

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 11

Baur and Lucey model's results for DLADX as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.001969	0.1465	0.002023	0.1417	0.002519	0.0721
DLRICIE*DUMMY	0.262452	0.0001	0.215628	0.0007	0.23712	0.0001
DLRICIE	0.056313	0.155	0.061903	0.1284	0.037442	0.3832
DLRICIM	-0.002731	0.96	-0.006616	0.9038	-0.000155	0.9977
DLRICIA	0.012588	0.8384	0.003502	0.9549	0.009446	0.8785
DLLIBOR	-0.022043	0.4395	-0.021092	0.4628	-0.02227	0.4364
DLSP500	0.194528	0.0025	0.200252	0.0019	0.197983	0.0021
DLMASI	-0.03732	0.4916	-0.028812	0.5961	-0.024785	0.6468
DLAMGNRLX	0.318983	0	0.315613	0	0.322856	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 12

Baur and Lucey model's results for DLBAX as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	-0.0000709	0.9194	0.000113	0.8724	0.000295	0.6826
DLRICIE*DUMMY	0.15171	0	0.153066	0	0.143941	0
DLRICIE	0.00204	0.9205	-0.004291	0.8372	-0.01168	0.5979
DLRICIM	-0.000442	0.9875	-0.002379	0.9325	0.001302	0.9631
DLRICIA	0.067067	0.0358	0.063075	0.0476	0.0657	0.0397
DLLIBOR	-0.004114	0.78	-0.005806	0.6938	-0.004772	0.7465
DLSP500	0.029545	0.3716	0.029899	0.3648	0.030827	0.351
DLMASI	0.11352	0.0001	0.116142	0	0.120377	0
DLAMGNRLX	0.141171	0	0.13784	0	0.143316	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 13

Baur and Lucey model's results for DLDFMGI as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.002304	0.2269	0.002532	0.1901	0.003043	0.1224
DLRICIE*DUMMY	0.370979	0.0001	0.332869	0.0002	0.329732	0.0002
DLRICIE	0.086343	0.1211	0.084798	0.1377	0.061893	0.3057
DLRICIM	0.007758	0.9194	0.002572	0.9733	0.011197	0.8841
DLRICIA	-0.030717	0.7234	-0.042315	0.6261	-0.035513	0.6829
DLLIBOR	-0.005868	0.8836	-0.006739	0.8672	-0.005772	0.886
DLSP500	0.389538	0	0.39471	0	0.394988	0
DLMASI	0.006225	0.935	0.015983	0.834	0.02425	0.75
DLAMGNRLX	0.536969	0	0.530839	0	0.542519	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 14

Baur and Lucey model's results for DLKWSE as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.000752	0.426	0.001048	0.2706	0.00143	0.1392
DLRICIE*DUMMY	0.175104	0.0001	0.192088	0	0.202778	0
DLRICIE	0.006072	0.8257	-0.006423	0.8192	-0.024755	0.404
DLRICIM	-0.052559	0.1667	-0.054627	0.1488	-0.049186	0.1927
DLRICIA	0.015659	0.7158	0.011735	0.7837	0.016477	0.6995
DLLIBOR	0.039018	0.0499	0.035848	0.0713	0.035447	0.0734
DLSP500	0.150569	0.0008	0.149375	0.0008	0.148234	0.0009
DLMASI	0.154543	0.0001	0.156324	0	0.160389	0
DLAMGNRLX	0.275337	0	0.270742	0	0.27731	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 15

Baur and Lucey model's results for DLMSM30 as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.001771	0.111	0.002299	0.0389	0.002548	0.03
DLRICIE*DUMMY	0.164143	0.002	0.226534	0	0.210172	0
DLRICIE	0.101077	0.0019	0.07373	0.0251	0.063963	0.0668
DLRICIM	-0.037659	0.399	-0.039092	0.3765	-0.033751	0.4465
DLRICIA	0.089798	0.0762	0.08818	0.0781	0.091879	0.0674
DLLIBOR	-0.018775	0.4216	-0.025413	0.2736	-0.023663	0.3085
DLSP500	0.137346	0.009	0.131397	0.0116	0.133067	0.0107
DLMASI	0.106064	0.0173	0.103981	0.0182	0.11041	0.0122
DLAMGNRLX	0.323256	0	0.316687	0	0.324831	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 16

Baur and Lucey model's results for DLQE as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.000897	0.5516	0.001213	0.4256	0.001454	0.35
DLRICIE*DUMMY	-0.028249	0.6944	0.036575	0.5995	0.062678	0.3622
DLRICIE	0.185254	0	0.164538	0.0003	0.151202	0.0016
DLRICIM	-0.147632	0.015	-0.146564	0.0157	-0.144634	0.0172
DLRICIA	0.06941	0.3117	0.073038	0.2863	0.075514	0.2705
DLLIBOR	-0.040455	0.2019	-0.045274	0.1545	-0.047197	0.1371
DLSP500	0.275037	0.0001	0.268207	0.0002	0.265484	0.0002
DLMASI	0.144768	0.0166	0.139024	0.0211	0.13844	0.0213
DLAMGNRLX	0.607439	0	0.604892	0	0.605813	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 17

Baur and Lucey model's results for DLTASI as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.000547	0.7567	0.000791	0.6576	0.001388	0.44
DLRICIE*DUMMY	0.172938	0.0407	0.180676	0.0273	0.224645	0.0054
DLRICIE	0.095124	0.0655	0.085824	0.1041	0.054707	0.3259
DLRICIM	-0.134703	0.0583	-0.136843	0.0542	-0.130466	0.0658
DLRICIA	0.063558	0.4296	0.059282	0.4602	0.06596	0.4105
DLLIBOR	-0.050191	0.1772	-0.052609	0.1582	-0.055588	0.1344
DLSP500	0.407255	0	0.407015	0	0.402412	0
DLMASI	0.042954	0.5436	0.045443	0.5192	0.047352	0.4996
DLAMGNRLX	0.438558	0	0.434459	0	0.440173	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 18

Baur and Lucey model's results for DLADX as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.000982	0.4744	0.001014	0.4658	0.000857	0.5477
DLRICIA*DUMMY	0.060866	0.6428	0.055053	0.6534	-0.001142	0.9923
DLRICIE	0.134857	0.0001	0.134876	0.0001	0.13444	0.0001
DLRICIM	-0.00751	0.8922	-0.008167	0.8827	-0.008968	0.8713
DLRICIA	-0.018259	0.7878	-0.020142	0.7734	-0.005693	0.9378
DLLIBOR	-0.003416	0.9051	-0.003682	0.8976	-0.004095	0.8864
DLSP500	0.215033	0.0013	0.216299	0.0011	0.222787	0.0008
DLMASI	-0.011521	0.8332	-0.011965	0.827	-0.011391	0.8351
DLAMGNRLX	0.32523	0	0.325423	0	0.326123	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 19

Baur and Lucey model's results for DLBAX as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	-0.00051	0.4734	-0.000201	0.7786	0.0000615	0.9331
DLRICIA*DUMMY	0.101856	0.1342	0.184705	0.0035	0.197374	0.0013
DLRICIE	0.047889	0.0086	0.04864	0.0073	0.0489	0.0069
DLRICIM	-0.001616	0.9551	-0.001383	0.9613	-0.002621	0.9265
DLRICIA	0.035869	0.3072	0.00903	0.8019	-0.006481	0.8628
DLLIBOR	0.007381	0.6186	0.007605	0.6055	0.00887	0.5466
DLSP500	0.033038	0.3386	0.024451	0.4725	0.024634	0.4664
DLMASI	0.128298	0	0.126602	0	0.127257	0
DLAMGNRLX	0.143822	0	0.142993	0	0.142569	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 20

Baur and Lucey model's results for DLDFMGI as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.000735	0.7035	0.6076	0.6076	0.000626	0.7551
DLRICIA*DUMMY	-0.001708	0.9926	0.5775	0.5775	-0.028864	0.8626
DLRICIE	0.196778	0.0001	0.0001	0.0001	0.196542	0.0001
DLRICIM	-0.001088	0.9889	0.9966	0.9966	-0.001255	0.9871
DLRICIA	-0.056728	0.5522	0.4067	0.4067	-0.047891	0.641
DLLIBOR	0.019505	0.6284	0.6155	0.6155	0.019143	0.6348
DLSP500	0.429524	0	0	0	0.432406	0
DLMASI	0.042869	0.5777	0.5865	0.5865	0.043048	0.5761
DLAMGNRLX	0.547064	0	0	0	0.547437	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 21

Baur and Lucey model's results for DLKWSE as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.000232	0.808	0.000477	0.6206	0.000736	0.4565
DLRICIA*DUMMY	0.11069	0.2253	0.168145	0.0484	0.184617	0.0249
DLRICIE	0.058945	0.016	0.059508	0.0148	0.059787	0.0143
DLRICIM	-0.054079	0.1607	-0.054294	0.1576	-0.055386	0.1488
DLRICIA	-0.018971	0.6874	-0.039802	0.412	-0.055493	0.2727
DLLIBOR	0.05221	0.009	0.052218	0.0087	0.053434	0.0073
DLSP500	0.155462	0.0008	0.149898	0.0011	0.149535	0.0011
DLMASI	0.171614	0	0.170106	0	0.170671	0
DLAMGNRLX	0.278496	0	0.278	0	0.277546	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 22

Baur and Lucey model's results for DLMSM30 as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.001189	0.2875	0.001347	0.2337	0.001445	0.2131
DLRICIA*DUMMY	0.055739	0.6018	0.097136	0.3302	0.093525	0.3322
DLRICIE	0.150319	0	0.150699	0	0.150748	0
DLRICIM	-0.040227	0.3725	-0.040156	0.3725	-0.040882	0.3638
DLRICIA	0.066963	0.2254	0.053284	0.3491	0.048395	0.4151
DLLIBOR	-0.006932	0.7661	-0.006838	0.7689	-0.006308	0.7866
DLSP500	0.147955	0.0066	0.143711	0.0078	0.14491	0.007
DLMASI	0.122163	0.0063	0.121275	0.0066	0.121685	0.0064
DLAMGNRLX	0.326909	0	0.326504	0	0.326423	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 23

Baur and Lucey model's results for DLQE as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.000686	0.6474	0.000768	0.6135	0.000636	0.6832
DLRICIA*DUMMY	-0.166647	0.2455	-0.089717	0.5036	-0.09694	0.4547
DLRICIE	0.175727	0	0.176148	0	0.176012	0
DLRICIM	-0.150932	0.0129	-0.148254	0.0146	-0.14766	0.015
DLRICIA	0.104826	0.1577	0.094372	0.2177	0.102246	0.2007
DLLIBOR	-0.044206	0.1582	-0.043037	0.1695	-0.043665	0.1638
DLSP500	0.292904	0.0001	0.282383	0.0001	0.282409	0.0001
DLMASI	0.142315	0.0176	0.142902	0.0173	0.142591	0.0175
DLAMGNRLX	0.609072	0	0.607788	0	0.608008	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 24

Baur and Lucey model's results for DLTASI as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.0000658	0.9703	0.000204	0.9091	0.0000371	0.9839
DLRICIA*DUMMY	0.125541	0.4577	0.14014	0.3748	0.056115	0.7133
DLRICIE	0.147452	0.0012	0.147698	0.0012	0.147092	0.0012
DLRICIM	-0.135817	0.0574	-0.136789	0.0553	-0.138403	0.0526
DLRICIA	0.026105	0.765	0.015416	0.8641	0.033427	0.7223
DLLIBOR	-0.036985	0.3162	-0.037341	0.3111	-0.037615	0.3083
DLSP500	0.410054	0	0.40959	0	0.419775	0
DLMASI	0.059781	0.3964	0.058591	0.4059	0.05968	0.3974
DLAMGNRLX	0.441444	0	0.44151	0	0.442479	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 25

Baur and Lucey model's results for DLADX as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.001645	0.229	0.001528	0.2735	0.001499	0.3033
DLRICIM*DUMMY	0.316574	0.005	0.189218	0.0727	0.118234	0.2488
DLRICIE	0.12963	0.0002	0.131016	0.0002	0.133314	0.0002
DLRICIM	-0.070134	0.2353	-0.058933	0.3402	-0.050984	0.4412
DLRICIA	-0.000474	0.9939	0.000396	0.9949	-0.001534	0.9804
DLLIBOR	-0.019533	0.4995	-0.013066	0.6518	-0.009385	0.7457
DLSP500	0.192274	0.0032	0.20925	0.0013	0.213985	0.0011
DLMASI	-0.008798	0.8713	-0.007099	0.8966	-0.006555	0.9048
DLAMGNRLX	0.31947	0	0.318552	0	0.320643	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 26

Baur and Lucey model's results for DLBAX as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	-0.00033	0.642	-0.000204	0.777	-0.000345	0.6471
DLRICIM*DUMMY	0.154119	0.0085	0.14409	0.0083	0.067859	0.2018
DLRICIE	0.044861	0.0135	0.044593	0.0141	0.046555	0.0107
DLRICIM	-0.033825	0.2702	-0.042097	0.1876	-0.028162	0.412
DLRICIA	0.059007	0.0675	0.061203	0.0583	0.058885	0.0699
DLLIBOR	-0.001253	0.9335	-0.000573	0.9695	0.003225	0.8298
DLSP500	0.031014	0.3584	0.035594	0.2884	0.040828	0.2259
DLMASI	0.129769	0	0.131778	0	0.131283	0
DLAMGNRLX	0.142058	0	0.139536	0	0.142153	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 27

Baur and Lucey model's results for DLDFMGI as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.001863	0.3325	0.002036	0.298	0.002372	0.2455
DLRICIM*DUMMY	0.454599	0.0042	0.368739	0.0128	0.303137	0.0353
DLRICIE	0.189869	0.0001	0.190099	0.0001	0.193878	0.0001
DLRICIM	-0.088893	0.2846	-0.098431	0.2562	-0.108792	0.2414
DLRICIA	-0.049054	0.5742	-0.044497	0.6114	-0.045477	0.6043
DLLIBOR	-0.002667	0.9477	0.002011	0.9605	0.005921	0.884
DLSP500	0.385669	0	0.403167	0	0.407055	0
DLMASI	0.0466	0.5419	0.051244	0.5035	0.055282	0.4722
DLAMGNRLX	0.537509	0	0.532315	0	0.533029	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 28

Baur and Lucey model's results for DLKWSE as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.00043	0.6521	0.000243	0.8026	0.000315	0.7557
DLRICIM*DUMMY	0.168689	0.0321	0.065429	0.3732	0.056139	0.4316
DLRICIE	0.055636	0.0227	0.057016	0.02	0.057664	0.0186
DLRICIM	-0.089313	0.0307	-0.073996	0.0864	-0.076669	0.0967
DLRICIA	0.006195	0.8863	0.005451	0.9004	0.005367	0.902
DLLIBOR	0.042769	0.0345	0.047895	0.018	0.048484	0.0164
DLSP500	0.153148	0.0008	0.164703	0.0003	0.16522	0.0003
DLMASI	0.173223	0	0.173324	0	0.174137	0
DLAMGNRLX	0.276554	0	0.277478	0	0.277496	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 29

Baur and Lucey model's results for DLMSM30 as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.001536	0.1694	0.00132	0.246	0.000662	0.5765
DLRICIM*DUMMY	0.184697	0.0448	0.068715	0.4239	-0.077372	0.3539
DLRICIE	0.147134	0	0.148699	0	0.150689	0
DLRICIM	-0.077246	0.1098	-0.059703	0.2365	-0.014055	0.7942
DLRICIA	0.081395	0.1089	0.080481	0.1146	0.075179	0.1404
DLLIBOR	-0.016556	0.4835	-0.010804	0.6475	-0.004068	0.8629
DLSP500	0.137213	0.01	0.150072	0.0047	0.160624	0.0025
DLMASI	0.123793	0.0054	0.123837	0.0056	0.119106	0.0078
DLAMGNRLX	0.32384	0	0.324968	0	0.331288	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 30

Baur and Lucey model's results for DLQE as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	-0.000142	0.924	-0.00028	0.8535	-0.001085	0.491
DLRICIM*DUMMY	-0.467939	0.0001	-0.368194	0.0014	-0.389955	0.0005
DLRICIE	0.183967	0	0.183524	0	0.180589	0
DLRICIM	-0.056537	0.3786	-0.049721	0.4589	-0.008358	0.9071
DLRICIA	0.063165	0.3495	0.058861	0.3857	0.056503	0.4043
DLLIBOR	-0.019547	0.5341	-0.024903	0.4288	-0.024891	0.427
DLSP500	0.31693	0	0.298113	0	0.300636	0
DLMASI	0.138135	0.0196	0.133612	0.0247	0.126006	0.0341
DLAMGNRLX	0.616482	0	0.621374	0	0.624694	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 31

Baur and Lucey model's results for DLTASI as the dependent variable

Variable	Coefficient with Dummy Z=1.96	Prob.	Coefficient with Dummy Z=1.645	Prob.	Coefficient with Dummy Z=1.28155	Prob.
C	0.0000897	0.9596	-0.00014	0.938	-0.000673	0.7199
DLRICIM*DUMMY	0.110078	0.4507	0.012036	0.9295	-0.090992	0.491
DLRICIE	0.144935	0.0014	0.146392	0.0013	0.147485	0.0012
DLRICIM	-0.160079	0.0371	-0.141986	0.0757	-0.106466	0.2125
DLRICIA	0.053214	0.5089	0.051684	0.5219	0.047793	0.5536
DLLIBOR	-0.043727	0.2441	-0.038926	0.2985	-0.034271	0.3586
DLSP500	0.415228	0	0.424942	0	0.432475	0
DLMASI	0.060939	0.3874	0.060308	0.393	0.056307	0.4258
DLAMGNRLX	0.440945	0	0.442772	0	0.447458	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. Value at the cell on its right is less than 0.01, 0.05 and 0.1 respectively

Table 32
Least Square Method for DLADX as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.006672	0.001989	3.35381	0.0009
DLRICIE*DUMMY	0.28054	0.05082	5.520271	0
DLRICIE*(1-DUMMY)	-0.061437	0.060742	-1.011446	0.3123
DLRICIM	-0.00711	0.054495	-0.130466	0.8962
DLRICIA	0.006753	0.061664	0.109518	0.9128
DLLIBOR	-0.019092	0.028435	-0.671422	0.5023
DLSP500	0.199197	0.063918	3.116433	0.0019
DLMASI	-0.023372	0.053987	-0.432926	0.6653
DLAMGNRLX	0.330101	0.055591	5.938043	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. value at the cell on its rightmost column is less than 0.01, 0.05 and 0.1 respectively

Diagnostics:

R-squared	0.201073	Mean dependent var	0.000647
Adjusted R-squared	0.188638	S.D. dependent var	0.033378
S.E. of regression	0.030065	Akaike info criterion	-4.153844
Sum squared resid	0.46461	Schwarz criterion	-4.080543
Log likelihood	1095.23	Hannan-Quinn criter.	-4.125137
F-statistic	16.17033	Durbin-Watson stat	1.886726
Prob(F-statistic)	0		

Wald Test:

Test Statistic	Value	df	Probability
t-statistic	3.922335	514	0.0001
F-statistic	15.38471	(1, 514)	0.0001
Chi-square	15.38471	1	0.0001

We reject the null hypothesis at 1%, 5% and 10% significance level when the Probability value for the t-statisitic in the above table is less than 0.01, 0.05 and 0.1 respectively

Null Hypothesis: C(2)=C(3)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2) - C(3)	0.341977	0.087187

Table 33
Least Square Method for DLBAX as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.002683	0.001028	2.61078	0.0093
DLRICIE*DUMMY	0.132549	0.026253	5.049011	0
DLRICIE*(1-DUMMY)	-0.067225	0.031378	-2.142426	0.0326
DLRICIM	-0.002962	0.028151	-0.105217	0.9162
DLRICIA	0.063773	0.031854	2.002009	0.0458
DLLIBOR	-0.0025	0.014689	-0.170177	0.8649
DLSP500	0.0321	0.033019	0.972177	0.3314
DLMASI	0.121509	0.027888	4.356953	0
DLAMGNRLX	0.147622	0.028717	5.140574	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. value at the cell on its rightmost column is less than 0.01, 0.05 and 0.1 respectively

Diagnostics:

R-squared	0.198954	Mean dependent var	-0.000632
Adjusted R-squared	0.186487	S.D. dependent var	0.017219
S.E. of regression	0.015531	Akaike info criterion	-5.474896
Sum squared resid	0.123983	Schwarz criterion	-5.401596
Log likelihood	1440.685	Hannan-Quinn criter.	-5.446189
F-statistic	15.95765	Durbin-Watson stat	1.923534
Prob(F-statistic)	0		

Wald Test:

Test Statistic	Value	df	Probability
t-statistic	4.435577	514	0
F-statistic	19.67435	(1, 514)	0
Chi-square	19.67435	1	0

We reject the null hypothesis at 1%, 5% and 10% significance level when the Probability value for the t-statisitic in the above table is less than 0.01, 0.05 and 0.1 respectively

Null Hypothesis: C(2)=C(3)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2) - C(3)	0.199774	0.045039

Table 34
Least Square Method for DLDFMGI as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.007124	0.002814	2.531136	0.0117
DLRICIE*DUMMY	0.357343	0.071898	4.970122	0
DLRICIE*(1-DUMMY)	-0.01849	0.085935	-0.215157	0.8297
DLRICIM	0.000987	0.077097	0.012796	0.9898
DLRICIA	-0.042993	0.08724	-0.492809	0.6224
DLLIBOR	0.003025	0.040229	0.075186	0.9401
DLSP500	0.403518	0.090429	4.462265	0
DLMASI	0.029706	0.076378	0.388936	0.6975
DLAMGNRLX	0.551428	0.078648	7.011364	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. value at the cell on its rightmost column is less than 0.01, 0.05 and 0.1 respectively

Diagnostics:

R-squared	0.24555	Mean dependent var	0.000611
Adjusted R-squared	0.233807	S.D. dependent var	0.048593
S.E. of regression	0.042535	Akaike info criterion	-3.459921
Sum squared resid	0.929941	Schwarz criterion	-3.386621
Log likelihood	913.7694	Hannan-Quinn criter.	-3.431214
F-statistic	20.91134	Durbin-Watson stat	1.984181
Prob(F-statistic)	0		

Wald Test:

Test Statistic	Value	df	Probability
t-statistic	3.046902	514	0.0024
F-statistic	9.283613	(1, 514)	0.0024
Chi-square	9.283613	1	0.0023

We reject the null hypothesis at 1%, 5% and 10% significance level when the Probability value for the t-statisitic in the above table is less than 0.01, 0.05 and 0.1 respectively

Null Hypothesis: C(2)=C(3)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2) - C(3)	0.375832	0.123349

Table 35
Least Square Method for DLKWSE as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.003987	0.001385	2.878047	0.0042
DLRICIE*DUMMY	0.158124	0.035387	4.468417	0
DLRICIE*(1-DUMMY)	-0.075775	0.042296	-1.79156	0.0738
DLRICIM	-0.05545	0.037946	-1.461301	0.1445
DLRICIA	0.011981	0.042938	0.279035	0.7803
DLLIBOR	0.040735	0.0198	2.057314	0.0402
DLSP500	0.153291	0.044508	3.44415	0.0006
DLMASI	0.163647	0.037592	4.353245	0
DLAMGNRLX	0.282822	0.038709	7.306364	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. value at the cell on its rightmost column is less than 0.01, 0.05 and 0.1 respectively

Diagnostics:

R-squared	0.244716	Mean dependent var	0.0000872
Adjusted R-squared	0.232961	S.D. dependent var	0.023904
S.E. of regression	0.020935	Akaike info criterion	-4.877737
Sum squared resid	0.225271	Schwarz criterion	-4.804436
Log likelihood	1284.528	Hannan-Quinn criter.	-4.84903
F-statistic	20.81736	Durbin-Watson stat	1.68313
Prob(F-statistic)	0		

Wald Test:

Test Statistic	Value	df	Probability
t-statistic	3.852716	514	0.0001
F-statistic	14.84342	(1, 514)	0.0001
Chi-square	14.84342	1	0.0001

We reject the null hypothesis at 1%, 5% and 10% significance level when the Probability value for the t-statisitic in the above table is less than 0.01, 0.05 and 0.1 respectively

Null Hypothesis: C(2)=C(3)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2) - C(3)	0.233899	0.06071

Table 36
Least Square Method for DLMSM30 as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.006089	0.001616	3.767672	0.0002
DLRICIE*DUMMY	0.275926	0.041285	6.683419	0
DLRICIE*(1-DUMMY)	-0.018975	0.049345	-0.38454	0.7007
DLRICIM	-0.03996	0.04427	-0.90263	0.3671
DLRICIA	0.089184	0.050094	1.78032	0.0756
DLLIBOR	-0.020486	0.0231	-0.88683	0.3756
DLSP500	0.134706	0.051926	2.594205	0.0098
DLMASI	0.11195	0.043858	2.552568	0.011
DLAMGNRLX	0.331156	0.045161	7.332806	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. value at the cell on its rightmost column is less than 0.01, 0.05 and 0.1 respectively

Diagnostics:

R-squared	0.292436	Mean dependent var	0.000927
Adjusted R-squared	0.281424	S.D. dependent var	0.028813
S.E. of regression	0.024424	Akaike info criterion	-4.569419
Sum squared resid	0.306624	Schwarz criterion	-4.496119
Log likelihood	1203.903	Hannan-Quinn criter.	-4.540712
F-statistic	26.55454	Durbin-Watson stat	2.172826
Prob(F-statistic)	0		

Wald Test:

Test Statistic	Value	df	Probability
t-statistic	4.163562	514	0
F-statistic	17.33525	(1, 514)	0
Chi-square	17.33525	1	0

We reject the null hypothesis at 1%, 5% and 10% significance level when the Probability value for the t-statisitic in the above table is less than 0.01, 0.05 and 0.1 respectively

Null Hypothesis: C(2)=C(3)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2) - C(3)	0.294901	0.070829

Table 37
Least Square Method for DLQE as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000654	0.002209	0.296241	0.7672
DLRICIE*DUMMY	0.167754	0.056422	2.973189	0.0031
DLRICIE*(1-DUMMY)	0.189031	0.067438	2.803048	0.0053
DLRICIM	-0.147077	0.060502	-2.430933	0.0154
DLRICIA	0.07062	0.068462	1.031521	0.3028
DLLIBOR	-0.041455	0.03157	-1.313104	0.1897
DLSP500	0.273469	0.070965	3.853594	0.0001
DLMASI	0.142723	0.059938	2.381166	0.0176
DLAMGNRLX	0.606424	0.061719	9.825537	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. value at the cell on its rightmost column is less than 0.01, 0.05 and 0.1 respectively

Diagnostics:

R-squared	0.314007	Mean dependent var	0.000738
Adjusted R-squared	0.30333	S.D. dependent var	0.039991
S.E. of regression	0.033379	Akaike info criterion	-3.944692
Sum squared resid	0.572694	Schwarz criterion	-3.871391
Log likelihood	1040.537	Hannan-Quinn criter.	-3.915984
F-statistic	29.40978	Durbin-Watson stat	2.006699
Prob(F-statistic)	0		

Wald Test:

Test Statistic	Value	df	Probability
t-statistic	-0.219806	514	0.8261
F-statistic	0.048315	(1, 514)	0.8261
Chi-square	0.048315	1	0.826

We reject the null hypothesis at 1%, 5% and 10% significance level when the Probability value for the t-statisitic in the above table is less than 0.01, 0.05 and 0.1 respectively

Null Hypothesis: C(2)=C(3)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2) - C(3)	-0.021277	0.096799

Table 38
Least Square Method for DLTASI as dependent variable

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00598	0.002575	2.322397	0.0206
DLRICIE*DUMMY	0.301578	0.065785	4.584307	0
DLRICIE*(1-DUMMY)	-0.061178	0.078628	-0.778069	0.4369
DLRICIM	-0.136845	0.070542	-1.939912	0.0529
DLRICIA	0.064861	0.079822	0.812572	0.4168
DLLIBOR	-0.054279	0.036809	-1.47462	0.1409
DLSP500	0.400901	0.08274	4.845299	0
DLMASI	0.047333	0.069884	0.677303	0.4985
DLAMGNRLX	0.447489	0.071961	6.218519	0

The coeficient is considered significant at either 1%, 5% and 10% level when the prob. value at the cell on its rightmost column is less than 0.01, 0.05 and 0.1 respectively

Diagnostics:

R-squared	0.221733	Mean dependent var	-0.00024
Adjusted R-squared	0.20962	S.D. dependent var	0.043776
S.E. of regression	0.038918	Akaike info criterion	-3.63764
Sum squared resid	0.778526	Schwarz criterion	-3.564339
Log likelihood	960.2429	Hannan-Quinn criter.	-3.608933
F-statistic	18.30525	Durbin-Watson stat	2.015183
Prob(F-statistic)	0		

Wald Test:

Test Statistic	Value	df	Probability
t-statistic	3.214186	514	0.0014
F-statistic	10.33099	(1, 514)	0.0014
Chi-square	10.33099	1	0.0013

We reject the null hypothesis at 1%, 5% and 10% significance level when the Probabilit value for the t-statisitic in the above table is less than 0.01, 0.05 and 0.1 respectively

Null Hypothesis: C(2)=C(3)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2) - C(3)	0.362757	0.112861

X. List of References:

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