THE CO-MOVEMENT OF STOCK MARKET INDICES AND COMMODITY PRICES BEFORE AND DURING THE RECENT CRISIS

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ABSTRACT

This study investigates the short-run and long-run co-movement of commodity prices and different stock market indices before and during the recent crisis. To analyze these relationships, the existence Granger causality and cointegration is tested between oil and gold price and the stock market index of Hungary, Japan, Norway, Russia and the United Kingdom from January 1, 2000 to December 31, 2015. Both short-run and long-run co-movement was observed with gold prices more often than with oil prices. Gold price changes Granger caused Russian stock returns while for the other riskier country, Hungary, causal relationship was not observed. For Japanese stocks bidirectional causality was observed when the effect was significant. For Norway also gold price changes Granger caused stock returns. For the United Kingdom the direction of causality was different, stock returns Grange caused gold price changes more often. The causal relationship between oil price changes and stock returns was insignificant through the whole sample for the oil importing countries such as Hungary or Japan. Among the other countries oil price changes Granger caused stock returns for Norway the most often. In the pre-crisis period this effect was significant for the other oil exporting country, Russia too. For the United Kingdom the direction of causality was different again when the effect was significant. The results do not show that the short-run co-movement become stronger in the recent crisis. Long-run co-movement was significant for Hungary with oil in half of the periods, while for other countries it was insignificant in most cases.

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INTRODUCTION

In the past decades the integration of financial markets and the co-movement of asset prices became stronger due to globalization. Understanding the latter phenomenon is crucial for portfolio management. The variance of a portfolio can be largely determined by these co-movements. If past information forecasts current prices then extra return can be earn through these co-movements so not only simultaneous co-movement is important. These co-movements can be different for countries with different characteristics and can change through time too. Such as in the recent crisis when asset prices become more volatile and structural breaks could take place in the time series of some asset prices. Stocks and commodities are major asset classes so their relationship can be important from this aspect too. In this study I will analyze whether there is co-movement and causal relationship between the price of the most important commodities oil and gold and stock prices of five different countries from January 1, 2000 to December 31, 2015. Both oil exporting and oil importing countries and countries with riskier and safer assets can be found in the sample.

In the literature of asset prices there is an ongoing debate about the question whether the past values of an asset's prices can affect another asset's price. According to the semi-strong form of efficient market hypothesis (Fama, 1991) prices reflect all past and public information. If this is true then past asset prices should not affect the present price of any assets.

On the other hand, some factors affect gold and stock prices too and if information does not build into one of the prices immediately then causality can arise. One such factor is the interest rate. An interest rate increase usually causes gold price decrease (Choudhry et al., 2015). Future interest rate expectations also affect stock prices through portfolio allocation (Choudhry et al., 2015). If investors increase the share of bonds in their portfolio after an interest rate increase then stock prices can decrease. Another factor is inflation. Gold is used as a hedge against inflation but high inflation expectations can affect stock prices too through dividends and interest rate. These relationships can cause correlation between stock and gold prices. Gold is often assumed as a safe haven, which is an asset whose price increases or stays stable during recessions and extreme stock price decreases. This property can be useful to improve the risk adjusted return of a portfolio. If markets are not efficient then past values of one series can correlate with the present value of the other. If this is the case then extra return can be earned by taking advantage of these correlations.

Causal relationships can also arise between crude oil and stock prices because crude oil price changes can affect firms' profitability and firms' oil demand can affect crude oil price. The former effect arises because crude oil is an important cost of production in modern economies and other energy resources' price is often linked to the oil price. Due to these relationships oil prices and oil price expectations can affect the costs and profitability of firms and through this dividends and stock prices too. These effects would suggest negative co-movement of the two time series. Oil price can affect stock prices through discount rates too. Discount rates are influenced by real interest rates and expected inflation and the latter can be affected by oil prices. Higher oil prices can increase it directly or can have an indirect effect through monetary policy. For oil exporting countries crude oil can be an important source of revenue. In this case an oil price increase can have a positive effect in a large part of the country's stocks. Oil prices can also influence stock prices through the uncertainty which can arise after a huge price change (Filis et al., 2011). If firms' oil demand is rising due to the growth of the global economy and increasing international trade then this could cause significant positive feedbacks in the other direction too.

This paper analyzes the short-run and the long-run co-movement of commodity and stock prices for different types of countries. Through the case of a small oil importing country which assets are considered risky such as Hungary, a large oil importing country with safer assets such as Japan, a small oil exporting country with safer assets such as Norway, a large oil exporting country with riskier assets such as Russia and a country which has the same magnitude of oil consumption and production and has safer assets such as the United Kingdom. The existence of short-run causal relationships between stock and commodity returns are analyzed with Granger causality (Granger, 1969), while long-run relationships are investigated through Engle and Granger (1987) test of cointegration.

The remaining part of the paper is organized as follows. Section 1 gives a brief review of the literature. Section 2 describes the data. Section 3 introduces the methodology. Section 4 analyzes the results for Granger causality tests. Section 5 presents the results for cointegration tests. Finally, the last section concludes.

1. LITERATURE REVIEW

Understanding the short-run and long-run co-movement of commodity prices and stock prices can be useful for investors, producers, consumers and governments too. Several papers have addressed these relationships but the time period, the applied methodology and the countries for which the analysis was made could affect the result. So it can be useful to overview these studies to find general patterns.

The co-movement of the United States' stock market (S&P 500 index) and different commodity markets such as crude oil, gold, wheat and beverage between 2000 and 2011 was investigated by Mensi et al. (2013). They found that gold price had the strongest reaction for an S&P 500 index change, while for oil the effect was significant but weak using VAR-GARCH framework. They also found that past S&P 500 index shocks affect the volatility of oil and gold prices.

Other papers analyzed the change of the co-movement in the recent crisis. Choudhry et al. (2015) investigated the relationship between gold and stock market index returns and volatility before and after the crisis in Japan (Nikkei 225), UK (FTSE 100) and USA (S&P 500) with nonlinear Granger causality methods. They did not find causal relationship between stocks and gold prices in the pre-crisis period but the relationship became significant in the crisis. This indicates that gold can be used as a hedge against stock market volatility in stable periods but it fails to be a safe haven in case of extreme stock price movements. Their sample starts at January 2000 and ends at March 2014.

In contrast to Choudhry et al. (2015) paper's result regarding to the safe haven property Baur and Dermott (2010) found that in the recent crisis stock market returns of European countries and the United States correlates negatively with gold return using a

GARCH model, so the safe have effect is present for these countries. For China, Japan, Australia and developing countries positive co-movement was observed, so the safe haven property is not present. When they investigated the entire sample from 1979 to 2009 then gold did not co-moved or moved in the opposite direction with the French, the German, the Italian, the British and the US index in general and in case of extreme movements too. For these countries gold was a hedge and safe haven too. For Japan and Australia a general co-movement was observed with a positive coefficient so for these markets gold was not a hedge against stock market risk. In case of extreme price movements the co-movement was not significant or had negative coefficients so a weak safe haven property can be identify for these countries too. Hood and Malik (2013) also find that gold was a safe haven for the US stock market between November 1995 and November 2010 using partly the same methodology as Baur and Dermott (2010).

Arouri et al. (2015) uses a VAR–GARCH framework to investigate the relationship between Chinese stock market and gold daily returns and volatility between March 2004 and March 2011. They also found significant dependence between stock and gold prices even before the crisis. According to their results gold can be a useful asset to improve the risk-adjusted return of a Chinese stock portfolio. In contrast to Baur and Dermott (2010) they found that gold is a safe haven for the Chinese stock market in the recent crisis.

Patel (2013) analyzes the co-movement of gold price and Indian stock market indices (BSE 100, Sensex, S&P CNX Nifty) between January 1991 and December 2011. The author found cointegration with Johansen's test between gold price and all of the stock market indices. These results show long-run co-movement between Indian stock prices and gold. On the other hand, Smith (2001) did not found cointegration between US stock market indices and gold prices with Engle-Granger tests. This sample started in January 1991 and ended in October 2001.

The effect of oil price changes on stock markets is also analyzed by several papers. According to Apergis and Miller (2009) different types of oil price shocks significantly affect monthly stock market returns but the magnitude of the effect was small in eight developed country (Australia, Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States) between 1981 and 2007. Park and Ratti (2008) also found that oil prices significantly affected monthly stock returns between December 1986 and January 2005 in the US and thirteen European countries using a multivariate VAR approach. For a country of this study, Norway the effect was positive.

Gupta and Modise (2013) analyzes the effect of different oil price shocks and the South African stock returns between January 1973 and July 2011. They used sign restriction SVAR method. They found oil price increases caused by aggregate demand increase stock prices while other price changes decrease them. This study found significant effect for a developing country too.

Chiou and Lee (2009) investigated the effect in different types of periods. They found that oil price changes have significant effect on daily stock returns when their fluctuation is high between January 1, 1992 and November 7, 2006 using an Autoregressive Conditional Jump Intensity model. This negative effect was insignificant in the case of low fluctuation periods.

Not just the type of oil price shock or the time period are important for investigating the effect on stock prices, the composition of stock market index can change the results too. Arouri (2011) examines the effect of oil price shocks on stock indices of different sectors in Europe between January 1998 and June 2010. The author find that oil price changes have strong negative effect on the financial sector's stock prices due to changes in consumer and investor confidence. Due to the same reasons the effect on technology and telecommunication sectors is also negative. These results shows that oil price changes can have effect sectors which are not related to oil directly. As expected oil price has strong positive effect on oil and gas sector stocks. For automobile stocks the effect is negative but weak due to government interventions and hedging through financial derivatives. The effect is negative too for basic materials, utilities, health care and food and beverages sectors. For personal and household goods sector the negative effect is asymmetric due to the fact that this sector can transmit cost increases on their consumers. Cointegration was found for three of sectors which is a lower ratio than expected.

In contrast to the latter result of Arouri (2011), Li et al. (2012) found significant cointegration between sector stock indices, crude oil prices and interest rates. In this paper 13 Chinese sectors were analyzed between July 2001 and December 2010. The applied methodology was a panel cointegration test which allowed for structural breaks. For Indian stock exchange index (SENSEX) Ghosh and Kanjilal (2015) did not find cointegration between January 2, 2003 and July 29, 2011. When they cut the sample into three periods and apply the threshold cointegration test to these periods then cointegration is found in the third period which starts at May 29, 2009. Granger causality from oil prices to stock prices is observed in the second most volatile and the last period. Through they analysis they used the exchange rate as a control variable. One can conclude that in this case the relationship between asset prices was not stable through the different periods.

The literature has inconsistent results about the co-movement of commodity prices and stock market indices. Both the long-run and the short-run co-movement vary through different countries and time periods. The estimation methodology can also affect the results. A significant part of the studies found that the effects become stronger and more volatile or in crisis periods. In this study I will analyze the co-movements in different periods of the recent crisis and in the preceding years both for oil exporting and oil importing countries and countries with riskier and safer assets.

2. DATA

The data is collected from Bloomberg terminal. The variables are collected from January 1, 2000 to December 31, 2015 in daily frequency. The main variables are the Brent crude oil return (roil), the gold return (rgold), the BUX (Hungarian stock exchange index) return (rbux), the Nikkei (Japanese stock exchange index) return (rnky), the OBX (Norwegian stock exchange index) return (robx), the RTS (Russian stock exchange index) return (rrts) and the FTSE 100 (British stock exchange index) return (rftse). The control variable is the S&P 500 return (rspx_index). All returns are calculated from the daily closing price. For the oil prices and the gold prices generic prices were downloaded, which are calculated from future prices. Brent oil price is used for crude oil price. It is closely commoving with other crude oil prices so can be used as an indicator of all crude oil prices. Weekends are not included in the dataset but non-trading weekdays are included and the closing price of the previous day is carried over for these days.

Before the analysis one should check if the series are stationary because the Granger causality test is for stationary time series and the cointegration test is for integrated time series. I calculated the logarithm of the prices and the log returns (first difference of the log price) and checked their stationarity with the Augmented Dickey Fuller test. The tests are carried out for the different periods because unit root tests can be sensitive for structural breaks. The Augmented Dickey Fuller test was used with an intercept and without trend. The results are similar to the case when the test is conducted with an intercept and trend for the logarithm of the prices. The results for the logarithms and the level series are also similar. The p-values for the logarithm of the prices and the log returns are in the Table 1, Table 2 and Table 3 below.

Table 1: The unit root tests with periods for Hungary

	LBUX	LOIL	LGOLD	RBUX	ROIL	RGOLD
1/01/2002 4/28/2006	0.9833	0.8327	0.9900	0.0000	0.0000	0.0000
9/01/2006 9/30/2008	0.8305	0.8184	0.7468	0.0000	0.0000	0.0000
10/01/2008 09/01/2010	0.8168	0.2727	0.8062	0.0000	0.0000	0.0000
3/01/2012 6/29/2014	**0.0175**	**0.0214**	0.6234	0.0000	0.0000	0.0000
6/30/2014 12/31/2015	0.9269	0.7404	0.5286	0.0000	0.0000	0.0000

As one can see in the last three columns of Table 1 the return series are stationary with the Hungarian periods at all common significance levels, so Granger causality test can be applied to the return series. The other part of the table shows that in the first three periods one cannot reject the null hypothesis of the existence of a unit root for the logarithm of the prices. Each time series can be treated as integrated in these periods. In the fourth period the logarithm of the Hungarian stock exchange index is stationary at the 5% significance level so cointegration cannot be tested for these time series in this period. In the last period the time series are integrated again at all conventional significance levels.

Table 2: The unit root tests for the logarithms of the series with periods for the world

	LOIL	LGOLD	LNKY	LOBX	LRTS	LFTSE
1/05/2000 5/01/2006	0.8988	0.9993	0.4746	0.9974	0.9884	0.4166
1/01/2007 12/31/2008	0.9136	0.5022	0.9299	0.9618	0.9870	0.9356
1/01/2009 8/31/2011	0.4990	0.9696	0.1689	0.2526	0.2715	0.5304
9/01/2011 6/27/2014	**0.0106**	0.5210	0.8663	0.8623	**0.0459**	0.4703
6/30/2014 12/31/2015	0.7404	0.5286	0.3723	*0.0766*	0.2735	0.2426

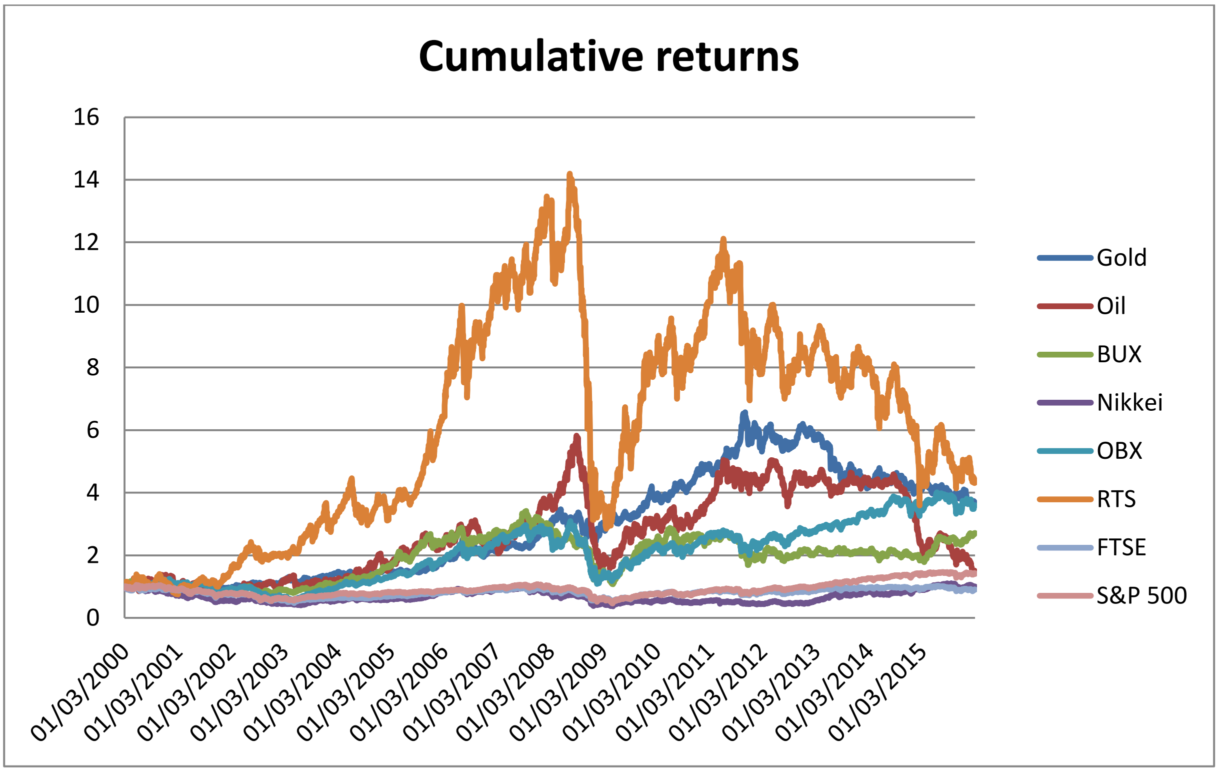
Table 2 shows that in the first three periods one cannot reject the null hypothesis of the existence of a unit root, so the logarithm of each time series can be treated as integrated in these periods. In the fourth period oil and the Russian stock exchange index is stationary so cointegration cannot be tested for these time series in this period. In the last period the Norwegian index is stationary at the 10% significance level but in the most common 5% significance level it contains a unit root so this time series can be handled as an integrated process. Other time series are integrated in these periods too. In conclusion cointegration can be tested in the first three and the last period for all time series. In the fourth period it can be tested for gold with all but the Russian index.

Table 3: The unit root tests for the logarithms of the series with periods for the world

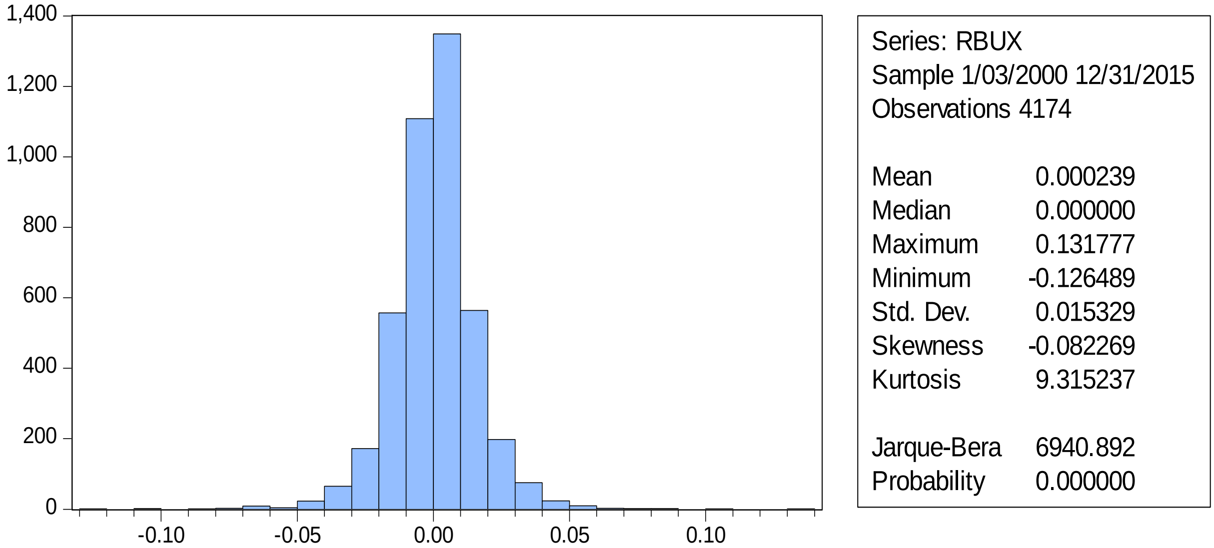
	ROIL	RGOLD	RNKY	ROBX	RRTS	RFTSE	RSPX_INDEX
1/05/2000 5/01/2006	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
1/01/2007 12/31/2008	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1/01/2009 8/31/2011	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9/01/2011 6/27/2014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6/30/2014 12/31/2015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

As one can see in Table 3 the return series are stationary with the world periods at all common significance levels. Due to these results Granger causality test can be applied to the return series.

On the Graph 1 one can see how the different assets' price changed relative to their value in starting point of the sample. The Russian stock exchange index reaches the highest cumulative returns but its volatility is also high. In the first year of the crisis it lost around 75% of its value. Its co-movement with oil prices also seems strong. In the Norwegian and in the Hungarian stock exchange indices a drop can be observed too when oil prices lost two third of their value. In other periods this co-movement is not that significant. The Hungarian stock market should move to the opposite direction as oil price due to the fact that this is an oil importing country but this short co-movement can be caused by exogenous world market processes. For the stock market index of the United States, the United Kingdom and Japan the returns and the volatility are both smaller than for other markets.



Graph 1: The cumulative returns for the different time series



Graph 2: The distribution of the BUX returns

Graph 2 presents the distribution for the BUX returns. Other return distributions are similar to the plot above; the only difference is that for commodity returns and returns of more liquid stocks the negative and positive probabilities around zero have similar probabilities. The distributions of the return series are not normal for any of the variables. Their skewness are not far from zero but their kurtosis are significantly different from three. Their means and medians are also close to zero, they are arbitrarily small positive numbers. The maximums and the minimums are not high in magnitude but high related to the standard deviations of the distributions. They are usually seven or eight times as much as the standard deviation of the appropriate distribution and this is not possible for this sample size if the underlying distribution is the normal distribution.

Sample: 1/03/2000 12/31/2015
Included observations: 4174

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.045	0.045	8.3486	0.004
		2	-0.063	-0.065	25.059	0.000
		3	-0.024	-0.018	27.395	0.000
		4	0.077	0.075	52.213	0.000
		5	0.022	0.012	54.185	0.000
		6	-0.047	-0.041	63.616	0.000
		7	-0.017	-0.008	64.841	0.000
		8	0.020	0.012	66.578	0.000
		9	-0.002	-0.010	66.596	0.000
		10	-0.039	-0.032	73.050	0.000
		11	0.006	0.013	73.204	0.000
		12	0.024	0.015	75.538	0.000
		13	0.002	-0.001	75.554	0.000
		14	-0.023	-0.014	77.718	0.000
		15	-0.009	-0.007	78.071	0.000
		16	0.020	0.013	79.803	0.000
		17	0.021	0.017	81.671	0.000
		18	0.014	0.020	82.529	0.000
		19	0.002	0.005	82.540	0.000
		20	-0.008	-0.011	82.784	0.000

Graph 3: Autocorrelation and partial autocorrelation for BUX returns

Sample: 1/03/2000 12/31/2015
Included observations: 4174

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.310	0.310	402.27	0.000
		2	0.217	0.134	599.04	0.000
		3	0.166	0.074	713.65	0.000
		4	0.155	0.073	813.73	0.000
		5	0.149	0.066	906.73	0.000
		6	0.198	0.120	1070.6	0.000
		7	0.168	0.055	1189.1	0.000
		8	0.227	0.130	1405.5	0.000
		9	0.257	0.135	1682.2	0.000
		10	0.263	0.119	1970.9	0.000
		11	0.145	-0.030	2059.2	0.000
		12	0.151	0.026	2155.3	0.000
		13	0.172	0.061	2279.6	0.000
		14	0.165	0.029	2394.3	0.000
		15	0.165	0.026	2508.6	0.000
		16	0.197	0.058	2670.6	0.000
		17	0.150	-0.006	2764.8	0.000
		18	0.192	0.048	2919.6	0.000
		19	0.137	-0.027	2998.8	0.000
		20	0.139	0.012	3080.3	0.000

Graph 4: Autocorrelation and partial autocorrelation for the square of BUX returns

The returns and their squares are both serially correlated for all of the return series. Graph 3 and Graph 4 shows this for the BUX returns. Partial serial correlation is also present both for returns and there squares. These results suggest that these series are not pure autoregressive or moving average processes. Probably they are the mixture of the two.

3. METHODOLOGY

I investigated the relationship with Granger causality (Granger, 1969). I tested that if oil returns or gold returns Granger cause the stock market index returns and if the stock market index returns Granger cause oil returns or gold returns. Granger causality was tested with an autoregressive - distributed lag (AR-DL) model with control variables. When oil returns' effect on the BUX index returns was analyzed the following equation was estimated:

$$rbux_t = \beta_0 + \sum_{i=1}^{p} \beta_i * rbux_{t-i} + \sum_{j=1}^{n} \beta_{j+p} * roil_{t-j} + \sum_{k=1}^{q} \beta_{k+p+n} * rspx\_index_{t-k} + u_t$$

The S&P 500 returns are included to control for the effects of the changes in the global economy. The lag length of the different variables was selected with the Akaike information criterion through the following procedure. First, I regressed the dependent variable on its first five own lags, the first five lags of that variable which effects was investigated and the first five lag of the control variable. Then I checked if the information criterion can be decreased by dropping any of the last lags from the regression. I repeated this last step as long as the decrease was not possible. When I selected the lag length then I did not dropped those lags which has smaller order then the lag length even if the information criterion could be improved by this. Because of the fact that for testing the causality the joint significance of the explanatory variables is important. Multicollinearity has small effect on this, but if an important lag is dropped then the results can be misleading. The first lag of the explanatory variable was always included to check the significance of the effect and calculate a p-value for it.

I checked the main diagnostic tests, the serial correlation LM test and the Breusch-Pagan-Godfrey test for heteroscedasticity. For financial data regression errors are often heteroskedastic. In this case White robust standard errors were used. If serial correlation LM test was not passed then I added more lags of the dependent variable to check that if serial correlation appeared due to dropping an important lag. If serial correlation cannot be eliminated in this way then I added autoregressive or moving average processes to the error term. In the last step I checked if there is an effect by a Wald test on the remaining lags of the explanatory variable.

For testing cointegration between the variables of Engle-Granger test (Engle and Granger, 1987) was used in each period. The test was applied for the logarithm of each series in those periods when the logarithms of the variables were integrated because cointegration analyzes the relationship of integrated time series processes. In the first step this test estimates one of the variables' effect on the other one with ordinary least squares. Such as in the equation below for the logarithms of BUX index and oil price.

$$lbux_t = \beta_0 + \beta_1 * loil_t + u_t$$

Then in the second step it checks if the residuals (u_t) are stationary with an augmented Dickey-Fuller test with corrected critical values. The correction is necessary because the residuals are not an original time series; they are calculated from a regression. Under the null hypothesis of no cointegration residuals should not be stationary.

4. GRANGER CAUSALITY

4.1. Hungary

Hungary is an oil importing country with very small own production so oil price increases have negative effects on its economy. Its oil import is a small share of the world market so in the other direction causality should not be present. In the Hungarian stock exchange index companies from oil and gas sector, financial sector and pharmaceutical sector have large shares. Oil price changes affect oil and gas sector in the opposite way as they affect the other two sectors so this can reduce the effects (Arouri, 2011). From gold prices global portfolio allocation can create causality. The effect from Hungarian stocks is also less likely due to Hungary’s smaller role in global markets.

The pre-crisis period is divided into two periods for Hungary because after the 2006 parliamentary elections the Hungarian government introduced several austerity measures which could cause a structural break in the sample and can change the causal relationships. One of these measures was the interest rate tax which could have strong impacts on the Hungarian stock market. The pre-crisis period ends in September 30, 2008 because the effect of the crisis appeared a bit later in Hungary than in the United States. The first pre-crisis period is from January 1, 2002 to April 28, 2006. In commodity markets this was a stable period with slight trends. In the second period both commodity prices are more volatile and oil has large trends. Table 4 shows the p-values for the causality tests in the second period. One can find the residual diagnostic test p-values in Table 34 and the regressions in Table 59-62.

Table 4: Granger causality test p-values for Hungary in the period from January 1, 2002 to April 28, 2006

	effect on RBUX	**p-value**	**RBUX' effect on it**	**p-value**
roil	no effect	0.5586	no effect	0.3582
rgold	*effect at 10%*	0.0724	*effect at 10%*	0.0832

In the first period one out of the four regressions had heteroskedastic error term. This ratio is higher for financial data in most of the cases. This regression was that one which analyzed the BUX returns effect on oil returns. The serial correlation LM test was passed for the regressions with the highest information criterion in all of the cases.

For oil returns Granger causality was not significant in any of the directions at any common significance level. This could happen due to the fact that in this period oil prices were less volatile and that oil and gas sector also has a large share in the index as it was mentioned above. Because Hungarian oil import is small, it is the expected result that its stock market returns does not affect oil prices.

For gold returns Granger causality cannot be observed in any of the directions at the most common 5% significance level. At the 10% significance level Granger causality can be observed in both of the directions. The effect is positive which suggests that gold was not a perfect hedge in this period.

Table 5: Granger causality test p-values for Hungary in the period from September 1, 2006 to September 30, 2008

	effect on RBUX	**p-value**	**RBUX' effect on it**	**p-value**
roil	no effect	0.7632	no effect	0.6312
rgold	no effect	0.4911	no effect	0.4099

The p-values for the causality tests in the second period are in the Table 5. One can find the residual diagnostic test p-values in Table 35 and the regressions in Table 59-62. In this period all but one regression had heteroskedastic error term. The exception was the regression which analyzed the Hungarian stock market index returns' effect on oil returns. The serial correlation LM test was passed for all regression.

In this period no Granger causality was found at any common significance levels for both of the commodities. This result is in line with efficient market hypothesis of Fama (1991). Choudhry et al. (2015) paper also did not find causal relationships between stock and gold returns in the pre-crisis period but in their analysis this period started and ended earlier. For oil prices this is a volatile period with strong trend, so the fact that no causality was found is not in line with the Chiou and Lee (2009) paper's result.

The crisis period is also cut into subsamples because after the 2010 parliamentary elections the new Hungarian government changed a lot of economic regulations for example it introduced a flat tax rate and terminated the private pension funds. These funds had stock market investments and when they were terminated their savings where directed into the budget of Hungary. The latter measure could decrease the Hungarian investments in the stock market while the former could increase. Probably the total effect was a decrease, but in all cases these measures have affected the Hungarian households' financial wealth so they could have an effect on stock prices too. A third measurement was that the Hungarian government made it possible to repay early the foreign currency (mostly Swiss franc and euro) loans. This measurement also decreased Hungarian households' investments in the stock market. So it is worth to cut the crisis period in September 1, 2010. Because from that date to March 1, 2012 mostly the measurements of Hungarian government moved the BUX index it is worth to leave out this period from the investigation.

The first crisis period for Hungary starts at October 1, 2008 and ends at September 1, 2010. In this period both commodity price were volatile with steep trends. The p-values for the first crisis period are in Table 6, the diagnostic test p-values are in Table 36 and the regressions are in Table 59-62.

Table 6: Granger causality test p-values for Hungary in the period from October 1, 2008 to September 1, 2010

	effect on RBUX	p-value	RBUX' effect on it	p-value
roil	*effect at 10%*	0.0951	no effect	0.9734
rgold	no effect	0.6408	no effect	0.1337

In this period one out of the four regressions passed the White heteroscedasticity test. That one in which the oil return was the dependent variable. The error term was serially correlated in that regression which analyzed the BUX return's effect on gold prices. This serial correlation can be removed if two extra BUX return lags were added to the regression. The other three regressions passed the serial correlation LM test.

For the oil returns in this period causality is significant at the 10% significance level only. It is observed when oil returns' effect on BUX returns was analyzed. The effect is not only insignificant at the most common 5% significance level but it has positive sign (Table 59) which is the opposite of the expected. This is a high fluctuation period so the absence of significant co-movement contradicts to the Chiou and Lee (2009) paper's results. For oil prices other papers (Apergis and Miller, 2009 and Park and Ratti, 2008) also found significant effect so this result contradicts to the biggest part of the literature too. This can be caused by the change in the oil price's trend during the period, in the beginning of this period it decreases while later it increases. The different types of shocks could also implicate this result.

For gold return Granger causality is insignificant at all significance levels. The absence of significant co-movement between stock and gold returns during the financial crises is not in line with other papers' results (Choudhry at al., 2015 and Arouri et al. 2015).

After July, 2014 a huge drop could be observed in the oil prices and the volatility of the returns also increased in this period and stayed high through 2015 too. This long trend could have different effect than smaller price changes so it worth to analyze it separately and cut the remaining part of the crisis into two periods. One from March 1, 2012 to June 30, 2014 and another from July 1, 2014 to December 31, 2015. The p-values for the second crisis period are in Table 7, the diagnostic test p-values are in Table 37 and the regressions are in Table 59-62.

Table 7: Granger causality test p-values for Hungary in the period from March 1, 2012 to June 30, 2014

	effect on RBUX	p-value	RBUX' effect on it	p-value
roil	no effect	0.1409	no effect	0.5940
rgold	no effect	0.6193	no effect	0.4396

In this period only none of the regressions had heteroskedastic error term and all of the regressions passed the serial correlation LM-test. Causal relationship was not found at any conventional significance levels for any of the commodities. Even if there is no trend in it, this is a high fluctuation period for oil so this result is not in line with the Chiou and Lee (2009) paper's results. For gold according to the Choudhry et al. (2015) paper significant correlation should be found during the crisis with stocks but here this is also not the case.

The p-values for the last period are in the Table 8. The diagnostic test p-values are in Table 38 and the regressions are in Table 59-62. In this period all but one regressions had heteroskedastic error term and all regressions passed the serial correlation LM-test.

Table 8: Granger causality test p-values for Hungary in the period from July 1, 2014 to December 31, 2015

	effect on RBUX	**p-value**	**RBUX' effect on it**	**p-value**
roil	no effect	0.1945	no effect	0.1278
rgold	no effect	0.9494	no effect	0.9343

In this period of the crisis causal relationship cannot be detected between gold returns and BUX returns at any conventional significance level. It could happen due to the fact that gold price was less volatile and did not have a trend in this period. So the co-movement of gold returns and stock exchange returns did not become significant in most periods of the crisis for Hungarian stocks which is not in line with the Choudhry et al. (2015) paper's results.

In contrast to a significant part of the literature (Chiou and Lee, 2009 and Apergis and Miller 2009) the oil price's co-movement with the stock exchange was insignificant in the Hungarian case even when oil price had a strong trend and was more volatile.

In conclusion causal relationship between Hungarian stock returns and commodity prices was not significant in any of the periods at the 5% significance level. This result is not in line with crude oil's and energy's share in the Hungarian export. This insignificance can be caused by the fact that three sectors have large share in the BUX index and oil price shocks affect these sectors in the opposite way. For gold the results suggests that hedging effects do not create causal relationship. Efficiency of markets is another possible explanation for these results.

4.2. Japan

Japan is one of the biggest importers of crude oil without own production. On the one hand, its economy depends on crude oil prices because oil is an important factor of production. On the other hand, crude oil price depends on Japanese economy because Japan is a significant important importer. These relationships can cause mutual dependence between oil and Japanese stock prices. For gold returns hedging can cause mutual dependence because Japanese stocks are a significant share of the world's assets. The change of Japanese stock prices is measured with the Nikkei (NKY) index.

For other parts of the world the periods were selected according to the movement of commodity prices and global economic processes. The first period was between January 5, 2000 and May 1, 2006. In this period both the oil and the gold prices had low fluctuations with a small upward trend. The p-values for the different Wald tests of the first period are in the Table 9. The diagnostic test p-values are in Table 39 and the regressions are in Table 63-66.

Table 9: Granger causality test p-values for Japan in the period from January 5, 2000 to May 1, 2006

	effect on RNKY	**p-value**	**RNKY's effect on it**	**p-value**
roil	*effect at 10%*	0.0953	no effect	0.5713
rgold	*effect at 10%*	0.0954	no effect	0.1664

In this period all but one regressions have heteroskedastic error term. The exception was Nikkei's return's effect on gold returns. All regressions passed the serial correlation LM test.

In the pre-crisis period Japanese stock returns does not Granger cause commodity returns. This results shows that Japanese oil demand was not big enough to significantly affect the world market prices in a stable period. Crude oil returns Granger cause stock market returns at the 10% significance level only. This shows that in this period crude oil has a moderate effect on the Japanese stocks. The same is true for gold returns because their returns Granger cause stock market returns at the 10% significance level only.

The second period is between January 1, 2007 and December 31, 2008. This period starts before the crisis and contains the beginning of it. In this period commodity prices especially oil prices were much more volatile. Oil price increased until the middle of 2008 and later a huge drop can be observed in the time series. Gold price showed similar patterns but its movements were less intensive and it stagnated for a quarter before its drop. I also tried different periods when the cut was in the peak of the different countries stock market indices. This did not change the results for cointegration and Granger causality was observed a bit fewer cases. The p-values for the causality tests of the second period for Japan are in Table 10. The diagnostic test p-values are in Table 40 and the regressions are in Table 63-66.

Table 10: Granger causality test p-values for Japan in the period from January 1, 2007 to December 31, 2008

	effect on RNKY	**p-value**	**RNKY's effect on it**	**p-value**
roil	no effect	0.7696	*effect at 10%*	0.0646
rgold	no effect	0.1752	**effect**	0.0397

For the second period all regression had heteroskedastic error term and all regression passed the serial correlation LM test. This period contains the beginning of the global crisis and commodity prices were volatile in other parts of the period, despite this volatility commodity returns does not Granger cause stock market returns at any common significance level. This result for oil contradicts to the Chiou and Lee (2009) paper's result because this is the highest fluctuation period.

On the other hand Japanese stock market returns Granger cause commodity returns at the 10% significance level. For oil this could happen due to that after the beginning of the crisis the decrease of the global demand caused the drop in the oil prices and Japan is an important part of this demand.

For gold prices the effect is significant at the 5% significance level too. This can happen due to the fact that Japanese savings are is also significant globally and maybe Japanese investors tried to use gold as safe asset against uncertainty. Because Tokyo is one of the world financial centers global portfolio allocation could also cause this phenomenon.

The third period is between January 1, 2009 and August 31, 2011. In this period both of the commodity prices showed upward trend. For oil prices the trend was not as strong as previous period's trends but for gold prices the trend in this period was stronger than in the previous one. The p-values for the regressions of the third period are in the Table 11. The diagnostic test p-values are in Table 41 and the regressions are in Table 63-66. In this period again all but one regressions had heteroskedastic error term and all of them passed the serial correlation LM test.

Table 11: Granger causality test p-values for Japan in the period from January 1, 2009 to August 31, 2011

	effect on RNKY	p-value	RNKY's effect on it	p-value
roil	no effect	0.2957	no effect	0.3251
rgold	no effect	0.7794	*effect at 10%*	0.0540

For this period no Granger causality was found for any of the directions at the most common 5% significance level. For gold these results contradict our previous expectations because one can observe the strongest trend in gold prices in this period and in the previous period Granger causality was observed between gold and Japanese stocks in one of the directions. The Choudhry et al. (2015) paper also found that using Japanese and other stocks that the causal relationship between gold and stocks is significant during the crisis.

For oil the trend in this period is weaker than in the previous period but stronger than in the pre-crisis one. The volatility is also high. The fact that in this period no Granger causality was found is not in line with the largest part of the literature (Chiou and Lee 2009, Apergis and Miller, 2009 and Park and Ratti, 2008).

The fourth period is between September 1, 2011 and June 29, 2014. In this period oil prices are stable but their volatility is higher than in the pre-crisis period. One larger drop can be observed in gold prices in the second quarter of 2013 but before and after this drop gold prices are also stable. Their volatility is also higher in this period than in the pre-crisis one. The p-values for the causality tests of the fourth period for Japan are in the Table 12. The diagnostic test p-values are in Table 42 and the regressions are in Table 63-66.

Table 12: Granger causality test p-values for Japan in the period from September 1, 2011 to June 29, 2014

	effect on RNKY	**p-value**	**RNKY's effect on it**	**p-value**
roil	no effect	0.8268	no effect	0.6825
rgold	**effect**	0.0022	**effect**	0.0109

In this period two regressions had heteroskedastic error term, those which investigated the commodity price changes effects on Japanese stock returns. For that regression which analyzed the gold price changes effects on Japanese stock returns the error term is serially correlated if it is specified with the highest information criterion. By adding one more lag of the dependent variable this serial correlation can be removed. Other regressions passed the serial correlation LM test.

No significant causal relationship is found in this period between oil and Japanese stocks. This result is quite surprising regarding to the fact that during this period a short but steep jump can be observed in the Nikkei index but even this stronger movement was not able to influence the oil market significantly.

The causal relationship between gold and Japanese stocks is significant in both directions. This is in line with the Choudhry et al. (2015) paper's results. The effect is negative in both directions which supports the hypothesis that gold can be used as an insurance against stock market movements.

The fifth period is between June 30, 2014 and December 31, 2015. In the beginning of this period a huge drop can be observed in oil prices and their volatility also increased and stayed high through this period. Gold prices are a bit more volatile than in the pre-crisis period with a slight downward trend. The p-values for the regressions of the fifth period are in Table 13. The diagnostic test p-values are in Table 43 and the regressions are in Table 63-66.

Table 13: Granger causality test p-values for Japan in the period from June 30, 2014 to December 31, 2015

	effect on RNKY	**p-value**	**RNKY's effect on it**	**p-value**
roil	no effect	0.6283	no effect	0.1505
rgold	**effect**	0.0070	**effect**	0.0257

In this period all but one regressions have heteroskedastic error term and that exception was the Nikkei's return's effect on gold returns. All regressions passed the serial correlation LM test.

This period was characterized by a large drop in oil prices but despite this fact Granger causality cannot be observed between oil and Japanese stock prices in any of the directions. These results also suggest that the feedback between oil and stock returns does not become more significant during the crisis.

For gold returns Granger causality is significant in both direction at the 5% significance level and from gold to Japanese stocks it is significant at the 1% significance level too. This results shows that the co-movement was the strongest in this period despite the fact that gold price's trend or volatility is not significantly higher than in previous periods. If one compares this period to the pre-crisis one than he can state that the feedback become more significant in one period of the crisis which is line with the Choudhry et al. (2015) paper's results.

In conclusion Japanese stock market returns correlate more with gold returns than with oil returns. For gold returns the causality is more significant in two of the three crisis periods than in the pre-crisis one. The more stable relationship was the Nikkei's effect on gold prices. This shows that Japanese economy can influence the world market prices. While for oil returns causality is not significant in any of the periods at the most common 5% significance level which is an unexpected result. The results are similar for the other oil importer country, Hungary.

4.3. Norway

Norway is an exporter of crude oil but its export is one third of the Russian so its effect on the world market is smaller. Crude oil is an important part of Norwegian export so this would suggest that oil prices changes cause changes in Norwegian stock prices. From gold causality can arise through investment decisions and hedging. The effect in the other direction is also less likely due to Norway's smaller role in the global markets. The change of Norwegian stock prices is measured with the OBX index. In this index oil and gas sector has an important share so this can strengthen the causal relationship from oil price changes to stock returns.

The p-values for the causality tests of the first period for Norway are in Table 14. The diagnostic test p-values are in Table 44 and the regressions are in Table 67-70. For this period all of the regressions had heteroskedastic error term and all of them passed the serial correlation LM test.

Table 14: Granger causality test p-values for Norway in the period from January 5, 2000 to May 1, 2006

	effect on ROBX	**p-value**	**ROBX' effect on it**	**p-value**
roil	**effect**	0.0000	no effect	0.2188
rgold	no effect	0.1468	no effect	0.5621

For Norway in the pre-crisis period no significant causality can be observed between gold and stock returns. For the effect of the Norwegian stock market on gold returns this can arise due to the fact that Norway has a small effect on the global economy. On the other direction the lack of relationship can arise due to the stability of the period and smaller demand for alternative investments such as gold. These results are in line with Choudhry et al. (2015).

On the other hand oil returns Granger cause Norwegian stock returns at any common significance level. This can be caused by oil's effect on Norwegian economy and the large share of oil companies in the Norwegian stock market and its index. On the other direction the effect is not significant and that can happen due to the fact that Norwegian export is not that significant share of the world's oil supply.

The p-values for the causality tests of the second period are in Table 15. The diagnostic test p-values are in Table 45. One can find the regressions in Table 67-70.

Table 15: Granger causality test p-values for Norway in the period from January 1, 2007 to December 31, 2008

	effect on ROBX	p-value	ROBX' effect on it	p-value
roil	**effect**	0.0389	no effect	0.4126
rgold	**effect**	0.0029	no effect	0.2007

For this period all of the regressions had heteroskedastic error term. The regression which analyzed the gold returns' effect on the OBX returns had serially correlated error term, but with an autoregressive and moving average term the serial correlation can be removed. All other regressions passed the serial correlation LM test.

For this period no significant causality can be observed from Norwegian stock returns to commodity returns such as in the pre-crisis period. The gold return's effect on Norwegian stock returns becomes significant in this period at any common significance level. This strengthened relationship could arise due to the increases uncertainty and need for alternative investments in the beginning of the crisis. The oil return's effect on Norwegian stock returns is significant in this period too at the 5% significance level. This result shows the oil dependence of the largest Norwegian companies.

The p-values for the causality tests of the third period are in Table 16. The diagnostic test p-values are in Table 46 and the regressions are in Table 67-70. For this period all but one regressions had heteroskedastic error term and all of them passed the serial correlation LM test.

Table 16: Granger causality test p-values for Norway in the period from January 1, 2009 to August 31, 2011

	effect on ROBX	p-value	ROBX' effect on it	p-value
roil	no effect	0.4597	no effect	0.5378
rgold	no effect	0.2402	*effect at 10%*	0.0943

For this period the causal relationship from commodity returns to Norwegian stock returns became insignificant. Norwegian stock returns' effect on oil returns is also insignificant again so during this period of the crisis the Norwegian stocks co-movement with oil prices is less significant than in the pre-crisis period. Norwegian stock returns effect on gold returns is significant in this period at the 10% level. This weaker co-movement could arise due to the euro crisis and due to the fact Norwegian krone and Norwegian investments were also looked as a safe investment during this period.

The p-values for the causality tests of the fourth period are in Table 17. The diagnostic test p-values are in Table 47 and the regressions are in Table 67-70. In this period two of the four regressions had heteroskedastic error term, those which analyzed commodity price changes effect on the OBX returns. All regressions passed the serial correlation LM test.

Table 17: Granger causality test p-values for Norway in the period from September 1, 2011 to June 29, 2014

	effect on ROBX	p-value	ROBX' effect on it	p-value
roil	*effect at 10%*	0.0592	**effect**	0.0067
rgold	**effect**	0.0072	no effect	0.2902

The causal relationship from Norwegian stock returns to oil returns become significant at any common significance level in this period. This is quite surprising regarding the fact that Norway's market share in the oil market is not as big. Causality in the other direction is significant at the 10% significance level only.

Gold price changes Grange Granger cause OBX returns at any common significance level. This is a stronger co-movement than in the pre-crisis period so this result is in line with the Choudhry et al. (2015) paper. In the other direction causality was insignificant.

The p-values for the Wald tests of the fifth period are in Table 18. The diagnostic test p-values are in Table 48. One can find the regressions in Table 67-70.

Table 18: Granger causality test p-values for Norway in the period from June 30, 2014 to December 31, 2015

	effect on ROBX	p-value	ROBX' effect on it	p-value
roil	**effect**	0.0209	no effect	0.9985
rgold	no effect	0.8612	no effect	0.1551

In this period all but one regressions have heteroskedastic error term. The exception was the Norwegian stock returns' effect on gold returns. All regressions passed the serial correlation LM test.

In this period of the crisis no Granger causality can be observed between Norwegian stock returns and gold returns. This contradicts to the Choudhry et al. (2015) paper's results but for other periods causality arose which weakens this contradiction.

Oil returns Granger caused Norwegian stock returns at the 5% significance level such as in two previous periods out of four. At the 10% significance level the effect was significant in one more previous period. This shows a quite stable causal relationship before and through the crisis. Such as in all previous periods no causal relationship was found in the other direction.

In conclusion Norwegian stocks tend to correlate with crude oil more often than with gold while for other stock markets the correlation with gold was the stronger. This shows that oil price has an important impact on the Norwegian economy.

4.4. Russia

Russia is one of the major exporters of crude oil and crude oil is the most important element of Russian export. In the case of Russian stock market index (RTS index) mutual dependence can arise with oil prices. Russia is also a main exporter of gold but gold does not play an important role in the Russian export so its price changes are less likely to have effect on the Russian real economy than oil. Russian stocks are considered as risky investments so if investors consider gold as a safe haven then it can be a useful asset to reduce the portfolio's risks. If investors change the risk of their portfolio then through global portfolio allocation gold price can affect Russian stock prices too. The effect in the other direction is less likely because Russia's role is not as important in the global financial markets as in the global oil market.

The p-values for the causality tests of the first period are in Table 19. The diagnostic test p-values are in Table 49. One can find the regressions in Table 71-74.

Table 19: Granger causality test p-values for Russia in the period from January 5, 2000 to May 1, 2006

	effect on RTS	p-value	RTS' effect on it	p-value
roil	**effect**	0.0020	no effect	0.5973
rgold	**effect**	0.0164	no effect	0.3294

In the first period three out of the four regressions had heteroskedastic error term. The serial correlation LM test was passed in all of the cases.

In the pre-crisis period both commodity returns Granger cause Russian stock returns at the 5% significance level. Oil price has significant effect even at the 1% significance level. On the other hand Russian stock market index returns does not Granger cause commodity returns at any common significance level. The same result was observed in this period for

Japan, so not just a big exporter but a big importer also could not influence prices in the pre-crisis period. This phenomenon could be caused by the fact that in this period none of the countries had huge shocks which has higher influence on the world market. This is a low fluctuation period so the significance of causality between stock and oil returns contradicts to the Chiou and Lee (2009) paper's results. This result could have arisen due oil's important role in the Russian economy. For Norway in the pre-crisis period oil price changes effect at stock return was also significant even at the 1% level. This result also underpins that for oil exporting countries where oil has large share in the export causality can arise in stable periods too. For other countries Choudhry et al. (2015) did not find causality between gold and stock returns in the pre-crisis period while for Russian in this case causality can be found for one of the directions.

The p-values for the causality tests of the second period are in Table 20. The diagnostic test p-values are in Table 50. One can find the regressions in Table 71-74.

Table 20: Granger causality test p-values for Russia in the period from January 1, 2007 to December 31, 2008

	effect on RTS	**p-value**	**RTS' effect on it**	**p-value**
roil	*effect at 10%*	0.0966	no effect	0.4552
rgold	**effect**	0.0086	no effect	0.2339

In this period all of the regressions had heteroskedastic error term. Those regressions which analyzed the commodity returns' effects on the Russian stock returns had serially correlated errors too. This serial correlation disappeared if an autoregressive and a moving average term was added to the regressions.

At the 10% significance level in this period commodity returns Granger cause Russian stock market returns. For oil returns in this period no causality can be observed at the 5%

significance level even if oil prices are much more volatile. For gold prices the effects are significant even at the 1% significance level. In the other direction Ganger causality cannot be observed for any of the commodities. A Russian stock returns does not Ganger cause commodity returns.

This is the highest fluctuation period for oil prices in the sample so the insignificance of causality between stock and oil returns at the most common 5% significance level contradicts to the Chiou and Lee (2009) paper's results. The strong significance of the causal relationship from gold returns to Russian stock returns can arise due to the beginning of the crisis. In such periods uncertainty usually increases and this can raise the demand for less volatile and less risky assets.

One can find the p-values for the causality tests of the third period in Table 21. The diagnostic test p-values are in Table 51 and the regressions are in Table 71-74. In this period only one regression had heteroskedastic error term which is a lower ratio than previously expected. The serial correlation LM test was passed in all of the cases.

Table 21: Granger causality test p-values for Russia in the period from January 1, 2009 to August 31, 2011

	effect on RTS	**p-value**	**RTS' effect on it**	**p-value**
roil	no effect	0.2850	no effect	0.8199
rgold	**effect**	0.0244	no effect	0.1124

In this period Granger causality was not observed between oil returns and the Russian stock market returns at any common significance level in either direction. While in the pre-crisis period oil returns Granger caused Russian stock market returns at all common significance levels and in the beginning of the crisis this Granger causality was significant at the 10% level only. In the third period this causal relationship weakened again and became insignificant at any common significance levels.

For gold returns Granger causality can be observed in only one of the directions again. Gold returns Granger cause Russian stock returns at the 5% significance level such as in previous periods. This causal relationship stayed significant after the beginning of the crisis too.

The p-values for the causality tests of the fourth period are in Table 22, the diagnostic test p-values are in Table 52 and the regressions are in Table 71-74. In this period only one regression had heteroscedastic error term, that one which was analyzing the effect of Russian stocks on gold returns. All regressions passed the serial correlation LM test.

Table 22: Granger causality test p-values for Russia in the period from September 1, 2011 to June 29, 2014

	effect on RTS	**p-value**	**RTS' effect on it**	**p-value**
roil	no effect	0.1135	*effect at 10%*	0.0761
rgold	*effect at 10%*	0.0753	no effect	0.6839

At the 5% significance level no Granger causality can be observed in the fourth period. This could happen due to the fact that there are no systematic changes in the variables in this time period. At the 10% significance level causal relationship can be observed from RTS index to oil prices. Gold also Granger cause the RTS index at the 10% significance level. For this relationship the effect is positive, gold price increases indicate RTS index increases. This result contradicts to the safe haven assumption regarding to gold because it shows parallel movements with stock prices. In conclusion in this periods the effects are not significant at the 5% significance level and they can have unexpected sign.

In the fifth period due to the Russia military intervention in Ukraine the United States, the European Union and other western countries imposed sanctions on Russia. These measurements could have influenced the Russian economy and affect the relationship between oil returns and Russian stock returns because some of the sanctions were imposed on Russian oil companies such as Rosneft which is part of the RTS index.

The p-values for the causality tests of the fourth period are in Table 23, the diagnostic test p-values are in Table 53 and the regressions are in Table 71-74. In this period also one regression out of four had heteroscedastic error term, which is smaller ration than expected. All regressions passed the serial correlation LM test.

Table 23: Granger causality test p-values for Russia in the period from June 30, 2014 to December 31, 2015

	effect on RTS	**p-value**	**RTS' effect on it**	**p-value**
roil	no effect	0.3264	no effect	0.6685
rgold	no effect	0.6941	no effect	0.9201

In this period no Granger causality can be observed at any common significance level in all of the cases. For oil return despite the clear trend no significant causality was found just as in the third period. In the beginning of the crisis and in the fourth period Granger causality between oil and stock market was significant at 10% significance level only. While in the pre-crisis period this effect was significant at 1% significance level too. These results suggest that the causal relationship of oil and Russian stock returns became weaker and less significant during the crisis.

In previous periods gold Granger caused Russian stock market returns at the 10% significance level while in this period the p-value is much larger than any common significance level. This result shows that in that period of the crisis when gold price movement was less trended and volatile its return's causal relationship with Russian stock became insignificant.

In conclusion gold returns Granger cause Russian stock market in three periods out of five at the 5% significance level. For oil prices at the 5% significance level Granger causality can be observed in only one period. Russian stock market returns does not Granger cause commodity returns in any of the periods despite Russia's important role in their export in the world market. The fact that gold returns Granger caused Russian stock market returns more often is a bit surprising because in the RTS index companies from the oil and gas sector have significant share. Crude oil is also a much larger share of Russian import and has larger effect on the real economy than gold. In contrast to these facts, gold is proven to be a more significant lead variable due to its hedging properties.

4.5. United Kingdom

The United Kingdom is also a big member of the oil market. It has a significant consumption and it is also an important producer of oil. In some periods it is a net exporter while in others it is a net importer. There are oil companies such as BP or Shell among the biggest listed companies London Stock Exchange and oil industry is an important tax payer. These relationships suggest that the British stock market index should co-move with oil prices in the same way as other exporter countries. On the other hand, the number of oil companies in the British stock market index is not high and oil is a cost of production for other parts of the economy. London is also a financial center and oil price changes affect this sector negatively according to Arouri (2011). This could indicate movements which are more specific to oil importing countries. Due to London's role in the financial markets mutual dependence can arise with oil. The p-values for the causality tests of the first period for the

United Kingdom are in Table 24, the diagnostic test p-values are in Table 54 and the regressions are in Table 75-78.

Table 24: Granger causality test p-values for the United Kingdom in the period from January 5, 2000 to May 1, 2006

	effect on RFTSE	p-value	RFTSE's effect on it	p-value
roil	no effect	0.2382	no effect	0.6818
rgold	no effect	0.1394	**effect**	0.0130

In this period all but one regressions have heteroskedastic error term and that exception was the British stock returns' effect on gold returns. All regressions passed the serial correlation LM test.

In the pre-crisis period short run causality cannot be observed between British stock returns and oil returns in either direction. This result can come from the fact that the net export or import of the country is not as high due to the fact that its consumption and production has the same magnitude. The lower net trade from oil can reduce oil price changes' effect in British stock market index.

Gold returns does not Granger cause British stock returns at any common significance level but the causality is significant in the other direction at the 5% significance level. The feedback is negative, British stock return decrease indicates a gold return increase. This result suggests that in the pre-crisis period British stocks were looked as a riskier investment and gold were looked as a safe haven against their risk.

One can find the p-values for the Wald tests of the second period for the United Kingdom are in Table 25. The diagnostic test p-values are in Table 55 and the regressions are in Table 75-78. For this period all of the regressions had heteroskedastic error term and all of them passed the serial correlation LM test.

Table 25: Granger causality test p-values for the United Kingdom in the period from January 1, 2007 to December 31, 2008

	effect on RFTSE	p-value	RFTSE's effect on it	p-value
roil	no effect	0.1770	**effect**	0.0131
rgold	no effect	0.3808	no effect	0.1606

For this period no significant Granger causality can be observed between gold and British stock returns in any of the directions, while in the pre-crisis period the effect was significant from British stock returns to gold returns. So the feedback between British stocks and gold price changes becomes insignificant in this period.

The causal relationship from British stock returns to oil returns becomes significant in the beginning of the crisis. The effect is negative again which suggests that in this period the oil demand effects were dominating in the country. Such as in previous period oil does not has an effect on British stock returns which is quite surprising regarding the fact that this is the highest volatility period for oil with huge trends.

The p-values for the causality tests of the third period are in Table 26, the diagnostic test p-values are in Table 56 and the regressions are in Table 75-78. For this period all of the regressions had heteroskedastic error term and all of them passed the serial correlation LM test.

Table 26: Granger causality test p-values for the United Kingdom in the period from January 1, 2009 to August 31, 2011

	effect on RFTSE	p-value	RFTSE's effect on it	p-value
roil	no effect	0.1027	no effect	0.2188
rgold	**effect**	0.0208	**effect**	0.0381

The causal relationship between oil and British stock returns is not significant at any common significance level in both directions. This result contradicts to our previous expectations because throughout this period of the crisis the FTSE index and oil price move in the same direction.

The causal relationship between gold and British stock returns is significant in both directions at the most common 5% significance level. So in this period interdependence between the two assets' returns is increased. This is in line with the Choudhry et al. (2015) paper's results.

The p-values for the Wald tests of the fourth period are in Table 27. The diagnostic test p-values are in Table 57 and the regressions are in Table 75-78. For this period two of the regressions had heteroskedastic error term, those which analyzed commodity returns' effect on FTSE 100 return. All regressions passed the serial correlation LM test.

Table 27: Granger causality test p-values for the United Kingdom in the period from September 1, 2011 to June 29, 2014

	effect on RFTSE	p-value	RFTSE' effect on it	p-value
roil	no effect	0.8463	**effect**	0.0019
rgold	**effect**	0.0306	**effect**	0.0297

In this period such as in previous ones oil returns do not Granger cause British stock returns at any common significance level. In the other direction the effect is significant at all common significance levels. The feedback is negative.

The causal relationship between gold and British stock returns is significant in both directions at the most common 5% significance level again. In this is period interdependence between gold and British stock returns become stronger than in the pre-crisis period. This evidence also supports the Choudhry et al. (2015) paper's results.

In this period causal relationship between gold and Japanese stock returns is also significant in both directions and gold price changes Granger caused Norwegian stock returns too. These results show that for countries with safer asset causal relationship between gold and stock price strengthened in this period. The fact that gold price reached its peak in this period suggests that increased uncertainty caused these results. For riskier countries the effect was not significant in any of the directions. This result can be explained by the fact that in these countries investors consider foreign assets as safe investment too.

The p-values for the causality tests of the fifth period are in Table 28. The diagnostic test p-values are in Table 58 and the regressions are in Table 75-78.

Table 28: Granger causality test p-values for the United Kingdom in the period from June 30, 2014 to December 31, 2015

	effect on RFTSE	p-value	RFTSE's effect on it	p-value
roil	no effect	0.3927	effect at 10%	0.0641
rgold	no effect	0.5347	**effect**	0.0373

In this period all but one regressions have heteroskedastic error term and that exception was FTSE index' return's effect on gold returns. All regressions passed the serial correlation LM test.

Such as in all previous periods in this period oil returns do not Granger cause British stock returns either. This result shows that oil market does not have a significant effect on the largest listed British companies throughout the entire sample. On the other direction the effect is significant at the 10% significance level only and now the feedback is positive in contrast to previous periods of the crisis.

Gold returns' effect on British stocks is not significant while in the previous two period of the crisis it was. In the other direction the effect is significant at the most common 5% significance level such as in most periods of the sample.

To sum it up, in British stock market causality goes from stocks to commodity returns more often. This result is different from other countries' results and not in line with the fact that some of the analyzed countries has larger market share in commodity markets than the United Kingdom. British stocks correlate with gold more often than with oil which was often the case for other countries too. The co-movement between British stocks return and commodity prices changes was significant more often in the periods of the recent financial crisis.

5. COINTEGRATION

5.1. Hungary

The existence of cointegration was tested between the logarithm of BUX index and the logarithm of crude oil price and between the logarithm of BUX index and logarithm of gold price for each period when they were stationary. The p-values for the Engle-Granger tests are presented in Table 29. Table 79 shows the cointegrating coefficients.

Table 29: Engle-Granger test p-values for Hungary

	LBux on LOil	LOil on LBux	LBux on Lgold	Lgold on LBux
1/01/2002 4/28/2006	**0.0197**	**0.0118**	0.6082	0.7086
9/01/2006 9/30/2008	0.8640	0.8124	0.8584	0.7233
10/01/2008 9/01/2010	**0.0424**	**0.0026**	0.1617	0.1665
6/30/2014 12/31/2015	0.8352	0.6166	0.4804	0.2065

The Hungarian stock exchange tends to co-move in the long-run with crude oil price more often than with gold price. One can realize that there is no cointegration between gold prices and the BUX index in any of the periods. The p-values are often very high and always higher than any conventional significance levels. For oil prices in the first and most stable period cointegration can be observed at the 5% significance level. As Table 79 shows the cointegrating coefficient is positive. This is not the expected sign for an oil importing country. The effect of global economic processes can explain this co-movement. For the beginning of the recent crisis in Hungary (between October 1, 2008 and September 1, 2010) cointegration can be observed in the 5% significance level again. The cointegrating coefficient is positive in this case too (Table 79). For the other two periods the p-values are high, no cointegration can be observed. In conclusion cointegration between oil prices and the BUX index can be observed in half of the periods. For gold price the long-run co-movement with the BUX index cannot be observed.

5.2. Japan

The p-values for the cointegration tests of Japanese stock market index and commodity prices are presented in Table 30.

Table 30: Engle-Granger test p-values for Japan

	LNKY on LOil	LOil on LNKY	LNKY on Lgold	Lgold on LNKY
1/05/2000 5/01/2006	0.4755	0.8902	0.7907	0.9999
1/01/2007 12/31/2008	0.9708	0.9505	0.9499	0.5778
1/01/2009 8/31/2011	0.5310	0.8988	0.4387	0.9931
9/01/2011 6/27/2014			**0.0375**	**0.0173**
6/30/2014 12/31/2015	0.5968	0.8239	0.5322	0.5807

The cointegration of Japanese stock prices with gold price is observed in one period out five at the 5% significance level. The period in which the co-movement is significant is the fourth period. The cointegrating coefficient is negative (Table 79), this suggests that gold could be used as an hedge against Japanese stocks volatility. The fact that the co-movement is not significant in other periods at any common significance levels weakens this result. But an asset which does not correlate with the original portfolio can also be used as a weak hedge to improve the risk adjusted return of the portfolio.

For oil prices cointegration cannot be observed at any common significance levels in any of the periods. The p-values are often higher than 0.80 and always higher than 0.45 which are very high values. This result is a bit surprising regarding the fact that Japan imports all of its oil consumption from the world market, so oil price shocks should affect its economy. Its oil import is a significant share of the world market which could cause co-movement from the other direction. The fact that this co- movement is not observed with cointegration test can be caused by other shocks which are moving the Japanese stock market.

5.3. Norway

The p-values for the cointegration tests of Norwegian stock market index and commodity prices are presented in Table 31.

Table 31: Engle-Granger test p-values for Norway

	LOBX on LOil	LOil on LOBX	LOBX on Lgold	Lgold on LOBX
1/05/2000 5/01/2006	0.5384	0.3443	0.9018	0.9456
1/01/2007 12/31/2008	0.9453	0.8825	0.9822	0.6851
1/01/2009 8/31/2011	0.4950	0.7373	0.6800	0.9473
9/01/2011 6/27/2014			0.2705	0.1410
6/30/2014 12/31/2015	0.2086	0.9271	0.1955	0.7302

For Norway cointegration of stock prices and gold price cannot be observed at any common significance level. This result shows that different shocks move gold prices and Norwegian stock prices too or if some of the shocks are similar a lot of them are different. This does not contradict to the weak safe have property so gold can be useful asset to improve the risk adjusted return of a portfolio from Norwegian stocks.

With oil prices the co-movement is not significant either in any of the periods. This resulted is unexpected regarding the importance of oil revenues for this economy. Even if in the last period at the 10% significance level the logarithm of Norwegian stock prices was stable the Engle-Granger test did not find cointegration in that period for any of the commodities.

5.4. Russia

The p-values for the cointegration tests of Russian stock market index and commodity prices are presented in Table 32.

Table 32: Engle-Granger test p-values for Russia

	LRTS on LOil	LOil on LRTS	LRTS on Lgold	Lgold on LRTS
1/05/2000 5/01/2006	0.5790	0.4928	**0.0016**	**0.0029**
1/01/2007 12/31/2008	0.9563	0.7797	0.9960	0.7557
1/01/2009 8/31/2011	0.3521	0.4901	0.7797	0.9650
9/01/2011 6/27/2014				
6/30/2014 12/31/2015	*0.0523*	0.1375	0.2910	0.4231

For Russian stocks cointegration can be observed with gold in one of the periods and in none of the periods with oil at the 5% significance level. The co-movement between gold prices and RTS index is significant at all significance level in the pre-crisis period. The coefficients of the cointegrating vector are positive (Table 79) so gold price and Russian stock market index tend to move in the same direction. This results shows that gold is not a hedge in this period. But the co-movement is not significant in different periods of the crisis at the 5% significance level which is in line with the weak safe haven property.

In the first three periods cointegration between oil prices and the RTS index was never significant, nor in the pre-crisis period, neither in the periods of the crisis. In the last period cointegration is significant at the 10% significance level if the test is conducted with the logarithm of RTS index as a dependent variable. In this period the two asset prices are moving in the same direction, the coefficients of the cointegrating vector are positive. The result that cointegration can be observed at 10% significance level in one period out of four is a lower ratio than previously expected for a country where oil has such an important role as in Russia. This result contradicts to our previous expectations based on the interdependence between oil and Russian economy. On the other hand, when co-movement is observed at a higher significance level it has the expected sign.

5.5. United Kingdom

The p-values for the cointegration tests of British stock market index and commodity prices are presented in Table 33.

Table 33: Engle-Granger test p-values for the United Kingdom

	LFTSE on LOil	LOil on LFTSE	LFTSE on Lgold	Lgold on LFTSE
1/05/2000 5/01/2006	0.6285	0.9502	0.8708	1.0000
1/01/2007 12/31/2008	0.9397	0.9511	0.9104	0.6180
1/01/2009 8/31/2011	0.3854	0.3841	0.7422	0.9383
9/01/2011 6/27/2014			**0.0428**	**0.0492**
6/30/2014 12/31/2015	0.2924	0.7656	0.1088	0.2161

These results are quite similar to the Japanese one. In case of the United Kingdom cointegration of stock prices with gold price is observed in one period out five at the 5% significance level. The period in which the co-movement is significant is the fourth one. Gold price reached its peak in this period of the crisis. In most part of the period gold price was stable. The cointegrating vector has negative coefficients (Table 79) which shows in this period gold was a hedge against British stocks' risk. In the other periods cointegration is not significant at any common significance levels. For the first three periods the p-values are very high, so the residuals are clearly not stable. In the last period the p-values are not that high but still higher than the common significance levels.

For oil prices p-values are also often very high and always higher than any common significance level. So the existence of cointegration with oil price can be rejected. In the United Kingdom none of the sectors is dominating the stock market index and different sectors have different reaction to oil prices. In this country oil production and oil consumption are also high and have effect on the economy. These can be the reasons which cause that the oil prices shocks does not have a clear long-run effect on British stock market prices.

The effect of shocks from different source can be an explanation for the result that cointegration can be observed only between oil prices and the Hungarian stock exchange index in more than one period. The other commodity, gold co-moves in the same period with the British and the Japanese stock markets. In this period Granger causality was also significant in both direction among these assets. These results suggest that the increased uncertainty throughout this period caused long-run co-movement between gold and stock prices of countries with important financial centers. For countries with riskier assets or smaller stock market, foreign assets could have been a more liquid safe haven. One cannot conclude that cointegration arises in the financial crisis more often because there are more crisis periods in the sample and the ratio of periods with cointegration do not increased in the crisis.

CONCLUSION

In this paper Granger causality and cointegration between commodity prices and stock market indices were analyzed for different countries between January 1, 2000 and December 31, 2015. In general one can conclude that markets are not efficient, causality was present in several periods of the sample for different countries. Causal relationship between gold and stock market was observed more often than for oil. Cointegration was also observed between stocks and gold more often, mostly in the pre-crisis period and in that period of the crisis when asset prices did not have that large trend.

For a small oil importing country which assets are considered risky such as Hungary Granger causality was insignificant at the most common 5% significance level in all cases. On the other hand, cointegration with oil was observed in two of the four cases in which the variables where integrated. These results suggest that oil price shocks affect the Hungarian stock prices in the long-run and the effect of gold price changes is insignificant at both time horizons. For Hungary the co-movement did not become more significant in the crisis.

For a large oil importing country with safer assets such as Japan Granger causality between gold and stock returns was observed in both directions in the last two crisis periods and from Japanese stock returns to gold returns in the second period. Causal relationship between oil and stock prices was not observed at the most common 5% significance level in all cases. These results suggest that Japanese stocks tend to co-move with gold and their co-movement becomes strengthens in the crisis. Cointegration was observed only in one crisis period between gold and stock prices. This result suggests that the long-run co-movement is not significant. This can happen due to the fact that other shocks also affect Japanese stock prices.

For a small oil exporting country with safer assets such as Norway Granger causality between oil and stock returns was present more often. The effect was significant mostly from oil returns to stock returns. This relationship was significant before the crisis and become insignificant in some crisis periods. Due to this result one can conclude that this effect did not strengthen in the recent crisis. Cointegration with commodity prices was not observed at all. This latter result suggests less significant long-run co-movement between Norwegian stocks and oil price shocks. The effect of other shocks could also cause this.

For a large oil exporting country with risky assets such as Russia Granger causality was observed from commodity price changes to stock returns. From gold price changes to stock returns the effect was significant in three periods out of five at the 5% significance level. This effect was also significant in the pre-crisis period and become insignificant in the last two crisis period. Granger causality from oil price changes to stock returns was observed in the pre-crisis period only. These results contradict those part of the literature which sad that the causal relationships between commodity prices and stock prices become stronger in crisis or more volatile periods (Choudhry et al., 2015 and Chiou and Lee, 2009). Cointegration was observed only in the pre-crisis period with gold.

The United Kingdom has the same magnitude of oil consumption and production and has safer assets. Granger causality was observed for this country the most often at the 5% significance level. The direction of the causality was more often from stock returns to commodity prices. The FTSE return’s effect on gold returns was significant in four cases out of five at the 5% significance level. This effect was also significant before the crisis two. The gold return’s effect on FTSE return was significant in two cases. These results show co-movement between the two assets’ returns. For oil return one can observe significant effect less often but the direction of these effects is also goes from stock returns. Cointegration was observed only in one crisis period with gold prices.

The methodology of this paper investigated linear effects of the aggregate shocks on the aggregate variables. Further research can improve the analysis if it considers non-linear effects or separates different kinds of commodity price shocks. Investigating the effects on different sectors of the economy can give new insights for both commodities.

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APPENDIX

Table 34: The p-values of the residual diagnostic tests for Hungary in the period from January 1, 2002 to April 28, 2006

	effect on RBUX		RBUX' effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	0.6133	0.5834	**0.0002**	0.3687
rgold	0.3870	0.8219	0.3652	0.4099

Table 35: The p-values of the residual diagnostic tests for Hungary in the period from September 1, 2006 to September 30, 2008

	effect on RBUX		RBUX' effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0000**	0.2460	0.5400	0.8921
rgold	**0.0000**	0.1693	**0.0001**	0.2362

Table 36: The p-values of the residual diagnostic tests for Hungary in the period from October 1, 2008 to September 1, 2010

	effect on RBUX		RBUX' effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0001**	0.5581	0.1352	0.1786
rgold	**0.0061**	0.5174		**0.0060**
rgold (7 lag model)			**0.0350**	0.0516

Table 37: The p-values of the residual diagnostic test for Hungary in the period from March 1, 2012 to June 30, 2014

	effect on RBUX		RBUX' effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	0.1497	0.2420	0.1966	0.3613
rgold	0.1032	0.2917	0.4396	0.3550

Table 38: The p-values of the residual diagnostic tests test for Hungary in the period from July 1, 2014 to December 31, 2015

	effect on RBUX		RBUX' effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0059**	0.5983	**0.0019**	0.1819
rgold	**0.0008**	0.7161	*0.0517*	0.2545

Table 39: The p-values of the residual diagnostic tests for Japan in the period from January 5, 2000 to May 1, 2006

	effect on RNKY		RNKY's effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0018**	0.3046	**0.0265**	0.5694
rgold	**0.0007**	0.1882	*0.0504*	0.6121

Table 40: The p-values of the residual diagnostic tests for Japan in the period from January 1, 2007 to December 31, 2008

	effect on RNKY		RNKY's effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0000**	0.2278	**0.0000**	0.2011
rgold	**0.0000**	0.2368	**0.0069**	0.5958

Table 41: The p-values of the residual diagnostic tests for Japan in the period from January 1, 2009 to August 31, 2011

	effect on RNKY		RNKY's effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0000**	0.7352	**0.0053**	0.4979
rgold	**0.0000**	0.8151	0.5610	0.6385

Table 42: The p-values of the residual diagnostic tests for Japan in the period from September 1, 2011 to June 29, 2014

	effect on RNKY		RNKY's effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0035**	0.7193	0.5446	0.7029
rgold		**0.0397**	0.4725	0.8003
rgold (+1 lag)	**0.0012**	0.0762		

Table 43: The p-values of the residual diagnostic tests for Japan in the period from June 30, 2014 to December 31, 2015

	effect on RNKY		RNKY's effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0031**	0.5487	**0.0014**	0.1902
rgold	**0.0211**	0.9201	0.6186	*0.0592*

Table 44: The p-values of the residual diagnostic tests for Norway in the period from January 5, 2000 to May 1, 2006

	effect on ROBX		ROBX' effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0000**	0.2403	**0.0125**	0.6546
rgold	**0.0000**	0.1014	**0.0464**	0.5216

Table 45: The p-values of the residual diagnostic tests for Norway in the period from January 1, 2007 to December 31, 2008

	effect on ROBX		ROBX' effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0000**	0.3442	**0.0000**	0.3838
rgold		**0.0050**	**0.0067**	0.7606
rgold + ar(1) + ma(1)	**0.0002**	*0.0509*		

Table 46: The p-values of the residual diagnostic tests for Norway in the period from January 1, 2009 to August 31, 2011

	effect on ROBX		ROBX' effect on it	
	Heteroskedasticity	Serial correlation	Heteroskedasticity	Serial correlation
roil	**0.0004**	0.0774	**0.0030**	0.2195
rgold	**0.0004**	0.6199	0.1087	0.5280

Table 47: The p-values of the residual diagnostic tests for Norway in the period from September 1, 2011 to June 29, 2014

	effect on ROBX		ROBX' effect on it	
	Heteroskedasticity	Serial correlation	Heteroskedasticity	Serial correlation
roil	**0.0137**	0.3019	0.0872	0.7363
rgold	**0.0327**	0.1624	0.1617	0.4303

Table 48: The p-values of the residual diagnostic tests for Norway in the period from June 30, 2014 to December 31, 2015

	effect on ROBX		ROBX' effect on it	
	Heteroskedasticity	Serial correlation	Heteroskedasticity	Serial correlation
roil	**0.0021**	0.3350	**0.0010**	0.1437
rgold	**0.0017**	0.2897	*0.0552*	0.5597

Table 49: The p-values of the residual diagnostic tests for Russia in the period from January 5, 2000 to May 1, 2006

	effect on RRTS		RRTS' effect on it	
	Heteroskedasticity	Serial correlation	Heteroskedasticity	Serial correlation
roil	**0.0008**	0.3780	0.3024	0.9871
rgold	**0.0000**	0.6744	**0.0453**	0.5362

Table 50: The p-values of the residual diagnostic tests for Russia in the period from January 1, 2007 to December 31, 2008

	effect on RRTS		**RRTS' effect on it**	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil		**0.0007**	**0.0000**	0.2668
roil + ar(1) + ma(1)	**0.0000**	0.3687		
rgold		**0.0068**	**0.0000**	0.6688
rgold + ar(1) + ma(1)	**0.0000**	0.1033		

Table 51: The p-values of the residual diagnostic tests for Russia in the period from January 1, 2009 to August 31, 2011

	effect on RRTS		**RRTS' effect on it**	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	0.5573	0.3741	**0.0141**	0.2531
rgold	0.2564	0.3963	0.2342	0.6172

Table 52: The p-values of the residual diagnostic tests for Russia in the period from September 1, 2011 to June 29, 2014

	effect on RRTS		**RRTS' effect on it**	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	0.6086	0.1480	0.4865	0.8796
rgold	0.5761	0.2393	**0.0062**	0.1993

Table 53: The p-values of the residual diagnostic tests for Russia in the period from June 30, 2014 to December 31, 2015

	effect on RRTS		RRTS' effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	0.6217	0.2696	**0.0008**	0.1560
rgold	0.2778	0.2309	0.2142	0.5306

Table 54: The p-values of the residual diagnostic tests for the United Kingdom in the period from January 5, 2000 to May 1, 2006

	effect on RFTSE		RFTSE's effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0000**	0.3341	0.4402	0.6091
rgold	**0.0000**	0.1481	**0.0029**	0.6048

Table 55: The p-values of the residual diagnostic tests for the United Kingdom in the period from January 1, 2007 to December 31, 2008

	effect on RFTSE		RFTSE's effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0000**	0.7440	**0.0000**	0.6256
rgold	**0.0014**	0.9365	**0.0001**	0.8757

Table 56: The p-values of the residual diagnostic tests for the United Kingdom in the period from January 1, 2009 to August 31, 2011

	effect on RFTSE		RFTSE's effect on it	
	Heteroskedasticity	**Serial correlation**	**Heteroskedasticity**	**Serial correlation**
roil	**0.0000**	0.5533	**0.0026**	0.2278
rgold	**0.0001**	0.2882	**0.0000**	0.1140

Table 57: The p-values of the residual diagnostic tests for the United Kingdom in the period from September 1, 2011 to June 29, 2014

	effect on RFTSE		RFTSE's effect on it	
	Heteroskedasticity	Serial correlation	Heteroskedasticity	Serial correlation
roil	**0.0082**	0.1092	0.1375	0.6681
rgold	**0.0192**	0.1071	0.2446	0.5151

Table 58: The p-values of the residual diagnostic tests for the United Kingdom in the period from June 30, 2014 to December 31, 2015

	effect on RFTSE		RFTSE's effect on it	
	Heteroskedasticity	Serial correlation	Heteroskedasticity	Serial correlation
roil	**0.0000**	0.5782	**0.0003**	0.2566
rgold	**0.0000**	0.3447	0.7093	0.6143

Table 59: The oil return's effect on BUX return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.001175	0.0018	-0.000196	0.7231	0.000638	0.5509	-4.30E-05	0.9206	0.000816	0.1650
RBUX(-1)	-0.067484	0.0254	-0.067063	0.2882	-0.075073	0.3072				
RBUX(-2)	-0.006401	0.8323	-0.030535	0.5569	-0.145715	0.0148				
RBUX(-3)	-0.060599	0.0400	-0.086783	0.0893						
RBUX(-4)			0.115757	0.0217						
ROIL(-1)	0.010595	0.5586	-0.010376	0.7632	-0.029038	0.6217	-0.057654	0.1409	0.031077	0.2378
ROIL(-2)					-0.004661	0.9241			0.041922	0.0941
ROIL(-3)					0.110190	0.0257				
ROIL(-4)					0.071093	0.1019				
RSP(-1)	0.270093	0.0000	0.344747	0.0000	0.424265	0.0000	0.173424	0.0060	0.088658	0.3532
RSP(-2)	0.058584	0.1165			0.126413	0.1947	-0.056271	0.3316		
RSP(-3)	0.116756	0.0017					0.012388	0.8305		
RSP(-4)							-0.145738	0.0124		

Table 60: The BUX return's effect on oil return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.001121	0.0707	0.000710	0.3952	-0.000545	0.6831	-0.000132	0.7840	-0.003117	0.0128
RBUX(-1)	0.041859	0.3582	-0.031318	0.6312	0.001972	0.9734	-0.024410	0.5940	-0.191258	0.1278
ROIL(-1)	-0.071916	0.0365	-0.073442	0.0903	-0.171443	0.0009			-0.137278	0.0369
ROIL(-2)	0.051628	0.1047								
RSP(-1)			0.212872	0.0037	0.345701	0.0000			0.323206	0.0979
RSP(-2)									0.176838	0.2395
RSP(-3)									0.084807	0.6504
RSP(-4)									-0.194832	0.2993
RSP(-5)									-0.255552	0.1464

Table 61: The gold return's effect on BUX return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.001130	0.0027	-0.000260	0.6315	0.000410	0.7069	-1.25E-05	0.9769	0.000593	0.2902
RBUX(-1)	-0.065213	0.0304	-0.069699	0.2693	-0.049073	0.5304				
RBUX(-2)	-0.006542	0.8283	-0.027005	0.5931	-0.087293	0.1325				
RBUX(-3)	-0.059106	0.0449	-0.087136	0.0805	0.018242	0.7317				
RBUX(-4)			0.115591	0.0231	0.096118	0.0570				
RGOLD(-1)	0.070727	0.0724	0.013494	0.8290	0.046355	0.6408	0.019294	0.6193	0.004072	0.9494
RGOLD(-2)			0.074078	0.2623						
RSP(-1)	0.277880	0.0000	0.350871	0.0000	0.376811	0.0000	0.133436	0.0229	0.108950	0.2486
RSP(-2)	0.053986	0.1485					-0.050858	0.3801	0.105534	0.1958
RSP(-3)	0.114422	0.0021					0.016219	0.7797		
RSP(-4)							-0.139133	0.0168		

Table 62: The BUX return's effect on gold return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
C	0.000721	0.0127	-0.049987	0.4099	0.000681	0.2969	-0.000445	0.3191	-0.000591	0.1963
RBUX(-1)	0.015231	0.4973			-0.022952	0.5230	-0.033215	0.4329	0.003436	0.9343
RBUX(-2)	-0.023009	0.3007			-0.017180	0.6537				
RBUX(-3)	0.046970	0.0348			0.060097	0.1060				
RBUX(-4)	0.033984	0.1280			0.069850	0.0581				
RGOLD(-1)	-0.072646	0.0158	0.024995	0.7291	0.015387	0.7825			-0.081987	0.1079
RGOLD(-2)			0.048849	0.4304	-0.037274	0.4834				
RGOLD(-3)			0.060595	0.2409	-0.055647	0.3216				
RGOLD(-4)			-0.078467	0.1197	0.060927	0.2236				
RGOLD(-5)			-0.080118	0.1449	0.106224	0.1122				
RGOLD(-6)					-0.087361	0.1475				
RGOLD(-7)					-0.053556	0.3901				
RSP(-1)	0.059468	0.0335	0.095436	0.2003	0.059341	0.2761				
RSP(-2)			0.110029	0.1361	-0.019226	0.7391				
RSP(-3)			-0.081174	0.2749	-0.065859	0.2356				
RSP(-4)					-0.070837	0.1253				

Table 63: The oil return's effect on Nikkei return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
C	-2.12E-06	0.9947	-0.000622	0.3335	-0.000447	0.3434	0.000223	0.6196	0.000608	0.2768
RNKY(-1)	-0.078059	0.0033	-0.359518	0.0000	-0.196585	0.0420	-0.153957	0.0001	-0.299633	0.0000
RNKY(-2)			-0.261885	0.0026	-0.100910	0.0741	0.044064	0.2881	-0.031040	0.5906
RNKY(-3)			-0.140255	0.0712					0.007872	0.9079
RNKY(-4)			-0.068877	0.4911					-0.113352	0.0342
ROIL(-1)	-0.025932	0.0953	-0.011046	0.7696	0.028939	0.2957	0.008592	0.8268	-0.011706	0.6283
RSP(-1)	0.441219	0.0000	0.813996	0.0000	0.597974	0.0000	0.727086	0.0000	0.801270	0.0000
RSP(-2)	0.063181	0.0784	0.482952	0.0000	0.169519	0.0284	0.141933	0.0158	0.285864	0.0007
RSP(-3)	0.016109	0.6109	0.337061	0.0002	0.105463	0.0420			0.024742	0.7590
RSP(-4)	0.032650	0.3151	0.117798	0.1623	0.077039	0.0580			0.003970	0.9613
RSP(-5)	0.056333	0.0976	0.124145	0.1997					0.234577	0.0029

Table 64: The Nikkei return's effect on oil return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.000738	0.1871	-0.000118	0.9153	0.001455	0.0864	0.000206	0.6623	-0.003288	0.0085
RNKY(-1)	0.023600	0.5713	0.035429	0.7113	0.036355	0.6380	-0.016056	0.6825	0.185022	0.1505
RNKY(-2)			-0.199183	0.0396	-0.090421	0.1929				
RNKY(-3)			0.088478	0.1817						
RNKY(-4)			0.109888	0.1903						
ROIL(-1)	-0.045412	0.1150	-0.122238	0.0231	-0.056388	0.2698	-0.077396	0.0593	-0.133404	0.0418
ROIL(-2)	0.004570	0.8656	0.086959	0.1611	-0.110532	0.0682				
ROIL(-3)	0.041032	0.1419	0.056385	0.3562						
ROIL(-4)	0.005490	0.8470	0.080778	0.1655						
ROIL(-5)	-0.052503	0.0632	-0.147748	0.0279						
RSP(-1)	0.067006	0.2040	0.343722	0.0004	0.092551	0.2994	0.018079	0.7572	0.207848	0.2418
RSP(-2)			-0.072863	0.5644	0.169049	0.1178	0.006580	0.9113	0.031446	0.8667
RSP(-3)			0.212477	0.0611			-0.157858	0.0024	0.043282	0.8171
RSP(-4)							-0.053237	0.3054	-0.200052	0.2804
RSP(-5)							-0.120090	0.0204	-0.263800	0.1389

Table 65: The gold return's effect on Nikkei return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	1.52E-05	0.9616	-0.000668	0.3009	-0.000402	0.3935	6.21E-05	0.8893	0.000508	0.3349
RNKY(-1)	-0.076119	0.0042	-0.364551	0.0000	-0.193697	0.0429	-0.166611	0.0000	-0.331847	0.0000
RNKY(-2)			-0.262053	0.0023	-0.100250	0.0743	0.039899	0.3346	-0.063950	0.2640
RNKY(-3)			-0.133104	0.0827					0.005244	0.9384
RNKY(-4)			-0.075053	0.4406					-0.101906	0.0556
RGOLD(-1)	-0.067973	0.0954	0.075273	0.1752	-0.012334	0.7794	-0.105166	0.0148	-0.126070	0.0607
RGOLD(-2)							-0.003630	0.9140	-0.171020	0.0052
RGOLD(-3)							-0.032442	0.3717		
RGOLD(-4)							-0.090692	0.0186		
RGOLD(-5)							-0.073485	0.0437		
RSP(-1)	0.435917	0.0000	0.813340	0.0000	0.620921	0.0000	0.763974	0.0000	0.792256	0.0000
RSP(-2)	0.064023	0.0750	0.477207	0.0000	0.171626	0.0264	0.174299	0.0042	0.297991	0.0002
RSP(-3)	0.018133	0.5684	0.340100	0.0002	0.105871	0.0445			0.049751	0.5337
RSP(-4)	0.033537	0.3016	0.118174	0.1630	0.076777	0.0576			0.019786	0.8062
RSP(-5)	0.057557	0.0899	0.124198	0.1950					0.223373	0.0053

Table 66: The Nikkei return's effect on gold return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.000555	0.0162	0.000691	0.2930	0.001192	0.0061	-0.000522	0.2318	-0.000580	0.2016
RNKY(-1)	-0.024900	0.1664	-0.015875	0.7370	-0.033099	0.3397	-0.000297	0.9936	0.022868	0.5303
RNKY(-2)			-0.087616	0.0312	-0.004364	0.8803	0.014502	0.6978	0.029983	0.4115
RNKY(-3)			0.056291	0.1800	-0.074415	0.0093	-0.100521	0.0070	0.034032	0.3513
RNKY(-4)			0.048997	0.2393			0.032698	0.3142	-0.091819	0.0122
RNKY(-5)							-0.062697	0.0511	0.069808	0.0559
RGOLD(-1)	-0.079287	0.0014			-0.002992	0.9371				
RGOLD(-2)					-0.082985	0.0290				
RGOLD(-3)					-0.054339	0.1575				
RSP(-1)	0.050408	0.0137	0.083990	0.1401	-0.021768	0.4972	0.097652	0.0458		
RSP(-2)	0.046264	0.0319			0.063643	0.0908	0.028313	0.6114		
RSP(-3)							-0.027012	0.6267		
RSP(-4)							0.136440	0.0136		

Table 67: The oil return's effect on OBX return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.000572	0.0405	-0.000619	0.5233	0.000757	0.2781	0.000722	0.0883	-2.02E-05	0.9712
ROBX(-1)	-0.130767	0.0002	-0.246004	0.0085	-0.207140	0.0023	-0.352943	0.0000	-0.177562	0.0144
ROBX(-2)			-0.184171	0.0474	-0.077481	0.2265	-0.242611	0.0003		
ROBX(-3)			-0.120890	0.1937	-0.017867	0.7623	-0.076525	0.2010		
ROBX(-4)					-0.060446	0.2678				
ROBX(-5)					-0.066978	0.1498				
ROIL(-1)	0.058839	0.0000	0.052046	0.4049	0.002662	0.9548	0.069820	0.0979	0.063972	0.0209
ROIL(-2)	0.019644	0.1155	0.045713	0.4274	0.058473	0.2545	0.071747	0.0688		
ROIL(-3)			0.154716	0.0129	0.002489	0.9542				
ROIL(-4)			0.031094	0.6091	0.074987	0.0847				
ROIL(-5)			-0.110289	0.0615						
RSP(-1)	0.400845	0.0000	0.594501	0.0000	0.274678	0.0006	0.461106	0.0000	0.418118	0.0000
RSP(-2)	0.098640	0.0016	0.192714	0.1904	0.128760	0.1408	0.259799	0.0007		
RSP(-3)	0.059620	0.0508	0.254221	0.0246			0.033504	0.6745		
RSP(-4)			0.026590	0.8038			-0.011932	0.8370		
RSP(-5)			0.146318	0.2034			-0.125470	0.0413		

Table 68: The OBX return's effect on oil return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
C	0.000610	0.2779	-0.000201	0.8580	0.001464	0.0830	0.000223	0.6346	-0.003238	0.0099
ROBX(-1)	0.092489	0.1274	-0.116083	0.2426	-0.048495	0.5378	-0.126386	0.0242	0.000271	0.9985
ROBX(-2)	0.029642	0.5833	-0.052753	0.5555			-0.038077	0.5116		
ROBX(-3)	0.091192	0.0659	-0.041672	0.6558			-0.037755	0.5166		
ROBX(-4)			0.066141	0.4519			0.146134	0.0094		
ROBX(-5)			-0.125809	0.0769						
ROIL(-1)	-0.051194	0.0769	-0.088198	0.1492	-0.046250	0.3769			-0.141508	0.0309
ROIL(-2)			0.089127	0.1932	-0.118406	0.0510				
ROIL(-3)			0.100427	0.1441						
ROIL(-4)			0.067547	0.2645						
ROIL(-5)			-0.116479	0.1284						
RSP(-1)			0.435681	0.0001	0.123706	0.2141	0.058560	0.3842	0.264994	0.2155
RSP(-2)			-0.026778	0.8150	0.190712	0.0582	0.059384	0.4103	0.158779	0.2970
RSP(-3)			0.130619	0.2391			-0.105210	0.1517	0.061185	0.7524
RSP(-4)			-0.006087	0.9587			-0.152864	0.0348	-0.203735	0.2783
RSP(-5)			0.176739	0.1444			-0.155807	0.0038	-0.265016	0.1403

Table 69: The gold return's effect on OBX return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.000621	0.0277	-0.001656	0.3618	0.000612	0.3820	0.000644	0.1185	-0.000199	0.7226
ROBX(-1)	-0.113264	0.0010	-0.372817	0.0164			-0.301665	0.0000	-0.147185	0.0462
ROBX(-2)			-0.314096	0.0335			-0.239614	0.0000		
ROBX(-3)			-0.208925	0.1093			-0.068147	0.1584		
ROBX(-4)			-0.187092	0.0873			-0.067866	0.1361		
ROBX(-5)			-0.193574	0.0165						
RGOLD(-1)	0.032378	0.3650	0.159824	0.0885	0.074898	0.2920	-0.059891	0.1122	0.010625	0.0462
RGOLD(-2)	-0.049506	0.0842	0.121068	0.1882	0.100835	0.1767	0.108230	0.0055		
RGOLD(-3)			0.066443	0.4184						
RGOLD(-4)			0.332463	0.0002						
RSP(-1)	0.395614	0.0000	0.576675	0.0000	0.250650	0.0007	0.492825	0.0000	0.453995	0.0000
RSP(-2)	0.088904	0.0043	0.201644	0.1830	0.118479	0.0743	0.277838	0.0001		
RSP(-3)	0.061327	0.0473	0.335332	0.0121						
RSP(-4)			0.215868	0.0928						
RSP(-5)			0.257320	0.0284						
AR(1)			0.807873	0.0000						
MA(1)			-0.653922	0.0135						

Table 70: The OBX return's effect on gold return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.000550	0.0167	0.000615	0.3578	0.001174	0.0067	-0.000543	0.2112	-0.000608	0.1816
ROBX(-1)	0.013069	0.5621	0.027553	0.5229	-0.040169	0.0943	-0.025660	0.5938	-0.038774	0.3262
ROBX(-2)			-0.073730	0.1038			0.056774	0.1378	0.046283	0.2385
ROBX(-3)									-0.008548	0.8276
ROBX(-4)									-0.082833	0.0354
RGOLD(-1)	-0.081475	0.0220			0.006551	0.8637			-0.086511	0.0878
RGOLD(-2)					-0.082767	0.0293				
RSP(-1)	0.042447	0.0337	0.067411	0.2991			0.108952	0.0750		
RSP(-2)	0.030783	0.1527								

Table 71: The oil return's effect on RTS return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.001288	0.0112	-0.001778	0.1635	0.001104	0.1707	-0.000507	0.4123	-0.001447	0.2141
RRTS(-1)			-0.255510	0.6291			-0.087470	0.0395		
RRTS(-2)			0.121899	0.5392			-0.078098	0.0650		
RRTS(-3)			-0.116167	0.2888						
RRTS(-4)			-0.113185	0.2686						
ROIL(-1)	0.095076	0.0003	0.118207	0.0523	0.031345	0.4478	0.057057	0.0000	0.049125	0.3264
ROIL(-2)	0.038592	0.1468	0.195919	0.0967	0.059177	0.1494	0.102170	0.0596		
ROIL(-3)	-0.013183	0.6030	0.134265	0.1413						
ROIL(-4)	-0.035493	0.1507								
RSP(-1)	0.410821	0.0000	0.625080	0.0000	0.280142	0.0000	0.445093	0.0000	0.486311	0.0004
RSP(-2)			0.179067	0.5719	0.135199	0.0430	0.157604	0.0596		
RSP(-3)			-0.224400	0.1899			-0.053989	0.4422		
RSP(-4)			0.077731	0.6151			-0.085431	0.2089		
RSP(-5)			0.142887	0.3360			-0.167588	0.0135		
AR(1)			-0.607162	0.2886						
MA(1)			0.887759	0.0000						

Table 72: The RTS return's effect on oil return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.000661	0.2326	-0.000296	0.7887	0.001465	0.0833	0.000255	0.5929	-0.003213	0.0105
RRTS(-1)	0.013963	0.5973	-0.013893	0.8515	-0.013547	0.8199	-0.019444	0.5490	0.027869	0.6685
RRTS(-2)			-0.075417	0.2129			-0.003182	0.9206		
RRTS(-3)							-0.022662	0.4780		
RRTS(-4)							0.086176	0.0072		
ROIL(-1)	-0.045411	0.0656	-0.122150	0.0406	-0.053407	0.3134	-0.066344	0.1118	-0.149083	0.0258
ROIL(-2)			0.085903	0.2068	-0.116620	0.0535				
ROIL(-3)			0.087963	0.1658						
ROIL(-4)			0.125533	0.0393						
ROIL(-5)			-0.129283	0.0674						
RSP(-1)			0.368626	0.0005	0.100752	0.2655	0.021293	0.7334	0.243728	0.2171
RSP(-2)			-0.056747	0.5981	0.186599	0.0662	0.004521	0.9409	0.146474	0.3262
RSP(-3)			0.128383	0.2139			-0.133372	0.0297	0.062178	0.7454
RSP(-4)							-0.118863	0.0529	-0.201935	0.2851
RSP(-5)							-0.154170	0.0042	-0.266715	0.1373

Table 73: The gold return's effect on RTS return

ariable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
C	0.001226	0.0219	-0.002475	0.0337	0.000915	0.2568	-0.000460	0.4569	-0.001601	0.1672
RRTS(-1)	0.003516	0.9201	-0.142666	0.4947			-0.087146	0.0390		
RRTS(-2)	0.004205	0.9009	0.048929	0.6871			-0.078211	0.0626		
RRTS(-3)	-0.045218	0.1981	-0.105682	0.2986						
RRTS(-4)	0.036584	0.2189	-0.118579	0.2107						
RGOLD(-1)	0.141579	0.0238	0.363653	0.0007	0.144518	0.0411	0.050013	0.3449	-0.012871	0.9201
RGOLD(-2)	0.101861	0.0502	0.363710	0.0166	0.128666	0.0699	0.112122	0.0349		
RGOLD(-3)			0.113966	0.3198						
RGOLD(-4)			0.289069	0.0052						
RSP(-1)	0.415557	0.0000	0.665862	0.0000	0.300458	0.0000	0.479014	0.0000	0.526745	0.0001
RSP(-2)			0.177573	0.3239	0.191619	0.0009	0.193635	0.0151		
RSP(-3)			-0.076384	0.4964			-0.065264	0.3520		
RSP(-4)			0.159772	0.2045			-0.091966	0.1746		
RSP(-5)			0.154480	0.2695			-0.180899	0.0075		
AR(1)			-0.742799	0.0022						
MA(1)			0.893540	0.0000						

Table 74: The RTS return's effect on gold return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
C	0.000542	0.0181	0.000576	0.3800	0.001220	0.0050	-0.000494	0.2554	-0.000601	0.1894
RRTS(-1)	0.010824	0.3294	0.003735	0.9191	-0.025361	0.2066	0.014784	0.6839	-0.007688	0.6941
RRTS(-2)			-0.061511	0.0893	0.014122	0.4843				
RRTS(-3)					-0.041125	0.0404				
RGOLD(-1)	-0.082090	0.0205			0.004244	0.9112			-0.082254	0.1035
RGOLD(-2)					-0.087466	0.0222				
RSP(-1)	0.042840	0.0251	0.091519	0.1011			0.072211	0.2772		
RSP(-2)	0.031161	0.1435								

Table 75: The oil return's effect on FTSE return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	-4.46E-05	0.8642	-0.000304	0.6345	0.000223	0.6448	0.000110	0.7452	-0.000243	0.6081
RFTSE(-1)	-0.282296	0.0000	-0.509982	0.0000	-0.140392	0.0424	-0.382348	0.0000	-0.223880	0.0046
RFTSE(-2)	-0.156778	0.0008	-0.325113	0.0001	-0.122932	0.1376	-0.173914	0.0190	-0.064084	0.2754
RFTSE(-3)	-0.139582	0.0008	-0.179495	0.0627	-0.086864	0.2314	-0.094200	0.1259	0.048932	0.4667
RFTSE(-4)	0.014631	0.6637	-0.002030	0.9816						
RFTSE(-5)	-0.070076	0.0385	-0.137489	0.0318						
ROIL(-1)	0.004683	0.6748	-0.027166	0.4326	-0.036212	0.2667	0.006058	0.8463	0.019703	0.3927
ROIL(-2)	0.009002	0.4345	0.021989	0.5086	0.019641	0.5471				
ROIL(-3)	-0.021272	0.0853	0.041256	0.2108	-0.060761	0.0309				
ROIL(-4)			-0.008033	0.8330	0.035482	0.1603				
ROIL(-5)			-0.069672	0.0315						
RSP(-1)	0.414622	0.0000	0.630770	0.0000	0.238634	0.0001	0.485450	0.0000	0.429636	0.0000
RSP(-2)	0.152669	0.0001	0.269737	0.0074	0.138348	0.0794	0.217139	0.0020		
RSP(-3)	0.102971	0.0072	0.192348	0.0365	0.096911	0.1948	0.047071	0.4797		
RSP(-4)			0.029361	0.7436			-0.013607	0.7628		
RSP(-5)			0.182161	0.0287			-0.081417	0.0586		

Table 76: The FTSE return's effect on oil return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.000700	0.2054	-7.77E-05	0.9435	0.001490	0.0780	0.000180	0.7021	-0.002967	0.0171
RFTSE(-1)	-0.021827	0.6818	-0.276650	0.0357	0.062817	0.5407	-0.230848	0.0016	0.038024	0.8357
RFTSE(-2)			-0.234960	0.1082	0.179868	0.0870	-0.055418	0.4670	0.018596	0.9314
RFTSE(-3)			-0.214104	0.0839			-0.043632	0.5648	0.211385	0.2484
RFTSE(-4)			0.185865	0.0315			0.159784	0.0273	0.566983	0.0049
ROIL(-1)	-0.043471	0.0776	-0.091758	0.0955	-0.042153	0.4041			-0.143653	0.0189
ROIL(-2)			0.067378	0.2967	-0.108398	0.0744				
ROIL(-3)			0.111079	0.0832						
ROIL(-4)			0.063220	0.2690						
ROIL(-5)			-0.136008	0.0502						
RSP(-1)	0.084482	0.1144	0.483023	0.0000			0.115494	0.0982	0.236004	0.3349
RSP(-2)			0.158924	0.2671			0.092165	0.2344	0.129915	0.5539
RSP(-3)			0.279252	0.0320			-0.099865	0.2022	-0.129153	0.6194
RSP(-4)							-0.139110	0.0700	-0.611285	0.0099
RSP(-5)							-0.162750	0.0033	-0.413054	0.0279

Table 77: The gold return's effect on FTSE return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	-1.32E-05	0.9597	-0.000360	0.5821	-1.77E-05	0.9706	9.54E-05	0.7755	-0.000278	0.5592
RFTSE(-1)	-0.286643	0.0000	-0.524906	0.0000	-0.172587	0.0071	-0.362988	0.0000	-0.208082	0.0081
RFTSE(-2)	-0.165482	0.0004	-0.312432	0.0002	-0.082384	0.2454	-0.185207	0.0123		
RFTSE(-3)	-0.139581	0.0009	-0.166800	0.0852			-0.082831	0.1698		
RFTSE(-4)	0.015053	0.6550	-0.011423	0.8981						
RFTSE(-5)	-0.070284	0.0386	-0.182641	0.0053						
RGOLD(-1)	-0.015476	0.5996	0.043435	0.4866	0.084116	0.0806	-0.059856	0.0297	0.033701	0.5347
RGOLD(-2)	-0.057155	0.0489	0.086210	0.1815	0.119913	0.0270	0.046023	0.1632		
RSP(-1)	0.415945	0.0000	0.625774	0.0000	0.213224	0.0001	0.493802	0.0000	0.428407	0.0000
RSP(-2)	0.152135	0.0001	0.253566	0.0083	0.121298	0.0595	0.216273	0.0018		
RSP(-3)	0.111140	0.0040	0.198667	0.0285			0.040530	0.5337		
RSP(-4)			0.051062	0.5788			-0.019015	0.6679		
RSP(-5)			0.185567	0.0248			-0.076156	0.0702		

Table 78: The FTSE return's effect on gold return

Variable	1st period		2nd period		3rd period		4th period		5th period	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
C	0.000555	0.0151	0.000658	0.3157	0.001026	0.0162	-0.000550	0.2035	-0.000564	0.2137
RFTSE(-1)	-0.001545	0.9605	-0.011276	0.8750	-0.122009	0.0994	-0.129270	0.0343	0.059866	0.2883
RFTSE(-2)	-0.004916	0.8624	-0.065975	0.2528	-0.123837	0.1046	0.080018	0.0891	0.082495	0.0736
RFTSE(-3)	-0.013030	0.6338	-0.050857	0.3371	-0.142058	0.0187			0.046036	0.3167
RFTSE(-4)	-0.100986	0.0005	0.089906	0.0788	-0.051894	0.2309			-0.104219	0.0235
RFTSE(-5)	-0.042964	0.0759								
RGOLD(-1)	-0.085773	0.0133							-0.081067	0.1106
RSP(-1)	0.048487	0.0427	0.080085	0.2518	0.053812	0.4507	0.173993	0.0056	-0.098608	0.1157
RSP(-2)	0.037764	0.1804			0.156153	0.0396				
RSP(-3)	0.021504	0.4214			0.135116	0.0151				
RSP(-4)	0.059243	0.0360								
RSP(-5)	0.052863	0.0390								

Table 79: Cointegrating coefficients

	Lstock to Loil		**Loil to Lstock**		**Lstock to Lgold**		**Lgold to Lstock**	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
LBUX, 1/01/2002 4/28/2006	0.835133	0.0000	1.088742	0.0000				
LBUX, 10/01/2008 9/01/2010	0.714922	0.0000	1.147806	0.0000				
LNKY, 9/01/2011 6/27/2014					-0.491075	0.0000	-1.685039	0.0000
LRTS, 1/05/2000 5/01/2006					0.347863	0.0000	2.705077	0.0000
LRTS, 6/30/2014 12/31/2015	1.636205	0.0000	0.511563	0.0000				
LFTSE, 9/01/2011 6/27/2014					-1.247340	0.0000	-0.528907	0.0000