Chapter 5:

The Empirical Results

5.1 Initial Findings on the Relationship Between Oil Prices, Gold Prices and GDP in Malaysia and the US.

Below is the result of the Original Least Square (OLS) for Malaysia and the U.S.:

Malaysia:

$$\Delta LNMGDP = 0.5218 + 0.9626\ LNMGP\Delta - 0.5689\ \Delta LNMOILP \qquad (5.1)$$

(0.6161) (0.0450) (0.0000)

$R^2 = 0.46$ SER = 0.5892 DW = 1.1745

F-statistics =12.8904 (prob = 0.0001)

The U.S.:

$$\Delta LNUSGDP = 7.3511 + 0.4210\ \Delta LNUSGP - 0.3033\ \Delta LNUSOILP \qquad (5.2)$$

(0.0000) (0.0012) (0.0000)

$R^2 = 0.58$ SER = 0.1961 DW = 0.4447

F-statistics = 20.3351 (prob = 0.0000)

Notes: the probability values are in parentheses.

The OLS regression produced from E-views for both Malaysia and the US shows high R^2 and therefore, the changes in the real annual GDP can be explained by the changes in the oil prices and the gold prices in both countries. In other words, 46% variation in the Malaysia's GDP and 58% variation in the US's GDP can be explained by the changes in the oil prices and the gold prices. In both regressions, oil prices and gold prices are significant at 5% level. Hence, at this stage, we can see that the oil prices and gold prices have significant relationship with the GDP in Malaysia and the US. In both cases, gold prices are positively related to the GDP while the oil prices are negatively related to the GDP.

5.2 VAR, IRF and VD Results

Before embarking on VAR, we test the variable for unit roots using the Augmented Dickey Fuller (ADF) test[1]. These tests include a constant and time trend. The general form of Augmented Dickey Fuller ADF test for a unit root is based on the following regressions:

$$\Delta X_t = c + \alpha X_{t-1} + \sum_{j=1}^{p} \beta_j \ \Delta X_{t-j} + \gamma t + \varepsilon_t \qquad (5.3)$$

$$\Delta \Delta X_t = c + \alpha \Delta X_{t-1} + \sum_{j=1}^{p} \beta_j \ \Delta\Delta X_{t-j} + \gamma t + \varepsilon_t \qquad (5.4)$$

where Δy is the first differences of the series, p is the number of lags and t is time trend. ε_t represents a sequence of uncorrelated stationary error terms with zero mean and constant variance.

The null hypothesis of non-stationary is tested against the alternative of the series that the series are trend stationary. The hypothesis can be written as:

H_o : The series ut has a unit root (or u_t is non-stationary)

H_A : The series ut has no unit root (or u_t is stationary).

[1] The Augmented Dickey Fuller (ADF) test is used as opposed to the Dickey Fuller (DF) test as it incorporates lagged left-hand side variables as additional explanatory variables to approximate the possible autocorrelation in error processing u_t (McKinnon & James, 1993)

The Augmented Dickey Fuller (ADF) test is performed to test the stationary of individual series and the results are as in Table 5.1. As seen, both variables were found to be stationary in level[2]. Plotting of the level suggested no evidence of changing means and therefore the series are stationary. This indicates that the prices of gold, prices of oil and the GDP series for Malaysia and the US may be integrated of order 0.

Supporting evidence for this can also be found by looking at the correlograms of the two series at levels and of the differenced series. These plots (not presented in the paper) show that the estimated autocorrelations die down only slowly for the original series (in logarithms) and for the level series die down to zero very quickly, and then appears to fluctuate in a non-systematic way around and close to zero. Consequently, the conclusion is that, to achieve stationarity, we need to use at least the level series both production and prices.

Table 5.1: Augmented Dickey-Fuller Test Results for Oil Prices, Gold Prices and GDP

	LEVEL			1st DIFFERENCE		
	GDP	OILP	GP	GDP	OILP	GP
Malaysia	-1.50[a]	-2.40[a]	-3.35[a]	-6.20	-4.92	-4.18
US	-0.45[a]	-2.21[a]	-3.70[a]	-4.66	-4.28	-3.97

[a]rejection of the unit root at the 1% level
[b]rejection of the unit root at the 5% level
[c]rejection of the unit root at the 10% level

Next, the estimation of a VAR model requires the explicit choice of lag length in the equations of the model. Following Judge et al (1988) and Mc Millin (1988), Akaike's AIC

2 In transforming a variable, a usual question arises as to whether one should do an appropriate differencing to identify the stationarity structure of the process. Doan (1989) noted that differencing a variable is 'important' in the case of Box-Jenkins ARIMA Modeling. However, he also observed that it is not desirable to do so in VAR models. Fuller (1976) has shown that differencing the data may not produce any gain so far as the 'asymptotic efficiency' of the VAR is concerned 'even if it is appropriate'. Furthermore, Fuller (1976) has argued that differencing a variable 'throws information away' while producing no significant gain. Thus, following Doan and Fuller, the level rather than the difference was preferred.

criterion is used to determine the lag length of the VAR model. The result of employing this technique shows that for the US's data, the AIC criterion is minimized for order 3 and for the Malaysia's data, AIC criterion is minimized for order 2 (see table 5.2). This suggests that, for this study, the VAR model should be of order 3 for the US's data and of order 2 for the Malaysia's data.

Next, we shall look at the VAR results. The estimates VAR along with their t-values are presented in Table 5.3. Although the estimates of individual coefficients in VAR do not have a straightforward interpretation, a glance at the table generally shows that most of the t-values are not significant and all the equations have high R-squares. Past GDP innovations do not contain any significant information about the variation of either gold prices or oil prices. It confirms the assertion that GDP and oil prices do not contribute much in the supporting role of supplementing information about current and future output movement.

The estimated coefficient of a VAR are difficult to interpret, hence we shall look at the impulse response functions (IRF) and variance decompositions (VD) of the system to draw conclusion about the VAR. The impulse response functions for one innovation measures the effect of one standard deviation shock today on current and future values of each endogenous variables. Meanwhile, the variance decomposition of the VAR gives information about the relative importance of the random innovations.

Since unrestricted VAR assumes recursivity, the IRF and VD depend on the ordering. The testing corresponds to the following ordering of equations: LNGDP, LNGP and LNOILP. Generally speaking, this ordering reflects the fact that the GDP and gold prices have an influence on the oil prices.

Table 5.2: Akaike Information Criteria (AIC) Values

For Malaysia's data:

Lag	LNUSGDP	LNUSOILP	LNUSGP
1	**-1.169092**	**-2.070779**	-3.153625
2	-1.068006	-1.955731	**-3.468065**
3	-0.935401	-1.729592	-3.253043
4	-0.986055	-1.818823	-3.288861

For the US's data:

Lag	LNUSGDP	LNUSOILP	LNUSGP
1	-7.666653	**-2.430719**	-3.068165
2	-7.471657	-2.254875	**-3.577812**
3	**-7.771907**	-2.130627	-3.560513
4	-7.566666	-1.932972	-3.446236

Table 5.3: t-Statistics for Vector Autoregression (VAR) Test

For Malaysia's data:

	LNMGDP	LNMOILP	LNMGP
LNMGDP(-2)	-1.66796	(-1.29044)	-1.62565
LNMOILP(-2)	-0.04327*	(-0.19019)	-3.65504
LNMGP(-2)	-0.05902	(-0.68502)	(-2.34876)

For US's data:

	LNMGDP	LNMOILP	LNMGP
LNUSGDP(-3)	-2.02191	(-1.18389)	(-1.67895)
LNUSOILP(-3)	-0.8067	(-0.42328)*	(-0.04613)*
LNUSGP(-3)	-2.26067	(-0.54167)	(-0.26709)

*significant at 5% level

Table 5.4: Impulse Response Functions (IFR)

Malaysia's data:

Period	LNMGDP	LNMGP	LNMOILP
Response of LNMGDP:			
1	0.467756	0	0
2	0.113569	0.051353	-0.145429
3	0.163894	0.048522	-0.159613
4	0.10104	0.042702	-0.117701
5	0.106752	0.038997	-0.065175
6	0.083932	0.041674	-0.042666
7	0.071936	0.042495	-0.03529
8	0.059055	0.040479	-0.029763
9	0.051403	0.036901	-0.021818
10	0.04461	0.033516	-0.014747
Response of LNMGP:			
1	-0.023782	0.138859	0
2	-0.000214	0.143237	-0.073096
3	0.021759	0.10244	-0.026909
4	0.050778	0.074503	0.039641
5	0.052142	0.066297	0.051686
6	0.044309	0.062055	0.029636
7	0.036903	0.054323	0.010875
8	0.033832	0.045082	0.006104
9	0.031721	0.037654	0.007026
10	0.028913	0.032494	0.006511
Response of LNMOILP:			
1	-0.083916	0.060647	0.281663
2	0.005619	0.100361	0.182074
3	-0.043347	0.096616	0.051924
4	-0.011866	0.064906	0.032297
5	0.000136	0.042567	0.050713
6	0.010312	0.033543	0.052518
7	0.008251	0.029917	0.035144
8	0.007087	0.025361	0.018941
9	0.006971	0.020099	0.011695
10	0.007702	0.015827	0.00967

US's data:

Period	LNUSGDP	LNUSGP	LNUSOILP
Response of LNUSGDP:			
1	0.014709	0	0
2	0.016667	-0.000721	0.002912
3	0.013461	-0.006841	-0.000453
4	0.013447	-0.007839	0.000358
5	0.010629	-0.002272	-0.002844
6	0.009817	0.001072	-0.006923
7	0.011687	0.001027	-0.005358
8	0.011963	-0.000793	-0.002437
9	0.011343	-0.002719	-0.000761
10	0.010714	-0.002592	-0.00031
Response of LNUSGP:			
1	-0.047632	0.111016	0
2	-0.051361	0.105979	-0.018336
3	0.005837	0.043202	0.066497
4	0.005003	-0.001013	0.11766
5	-0.012108	-0.023018	0.101311
6	-0.012853	-0.005656	0.074047
7	-0.014912	0.02267	0.038859
8	-0.007743	0.024251	0.020474
9	0.001905	0.008653	0.028275
10	0.000379	-0.004624	0.033996
Response of LNUSOILP:			
1	-0.042225	-0.03435	0.240857
2	-0.099171	0.017039	0.115174
3	-0.038641	0.061858	0.081326
4	-0.017941	0.072874	0.072889
5	-0.009847	0.013138	0.074086
6	-0.002301	-0.028643	0.098498
7	-0.022099	-0.017446	0.077313
8	-0.031291	0.008689	0.032399
9	-0.021557	0.025224	0.012816
10	-0.013942	0.020196	0.013154

Table 5.5: Variance Decompositions (VD)

For Malaysia's data:

Period	S.E.	LNMGDP	LNMGP	LNMOILP
Variance Decomposition of LNMGDP:				
1	0.467756	100	0	0
2	0.50545	90.68938	1.03223	8.278392
3	0.556931	83.35845	1.609274	15.03227
4	0.579705	79.97537	2.027917	17.99671
5	0.594325	79.31535	2.359902	18.32475
6	0.603178	78.9404	2.768483	18.29111
7	0.609959	78.58593	3.192646	18.22143
8	0.614867	78.25872	3.575291	18.16599
9	0.6185	78.03294	3.889373	18.07769
10	0.621186	77.87508	4.146918	17.978
Variance Decomposition of LNMGP:				
1	0.140881	2.849761	97.15024	0
2	0.213793	1.237552	87.07274	11.6897
3	0.239581	1.810328	87.61951	10.57016
4	0.259036	5.391323	83.2247	11.38398
5	0.277281	8.241268	78.34898	13.40975
6	0.289098	9.930431	76.68275	13.38682
7	0.296662	10.9778	76.17499	12.8472
8	0.302031	11.84575	75.71888	12.43537
9	0.306098	12.60698	75.23324	12.15979
10	0.309241	13.22615	74.81568	11.95817
Variance Decomposition of LNMOILP:				
1	0.30009	7.819659	4.084272	88.09607
2	0.365115	5.306091	10.31464	84.37927
3	0.383691	6.081085	15.68074	78.23818
4	0.39066	5.958311	17.88664	76.15505
5	0.396232	5.791951	18.54132	75.66672
6	0.401234	5.714468	18.78074	75.50479
7	0.403965	5.679207	19.07623	75.24456
8	0.405265	5.673406	19.34563	74.98096
9	0.405991	5.682603	19.52155	74.79585
10	0.406488	5.704632	19.6255	74.66987

For US's data:

Period	S.E.	LNUSGDP	LNUSGP	LNUSOILP
Variance Decomposition of LNUSGDP:				
1	0.014709	100	0	0
2	0.022431	98.21123	0.103276	1.68549
3	0.027043	92.3412	6.471158	1.187647
4	0.031204	87.92445	11.17038	0.905172
5	0.033165	88.10569	10.35763	1.536679
6	0.03529	85.55441	9.240223	5.205371
7	0.037573	85.14813	8.226144	6.625724
8	0.039515	86.15116	7.477853	6.370988
9	0.041208	86.79597	7.311625	5.892402
10	0.042657	87.30399	7.192098	5.503912
Variance Decomposition of LNUSGP:				
1	0.120804	15.54687	84.45313	0
2	0.169703	17.03794	81.79466	1.167402
3	0.187407	14.06792	72.38476	13.54732
4	0.22134	10.13627	51.89409	37.96964
5	0.24481	8.530516	43.30503	48.16445
6	0.256148	8.043792	39.60478	52.35143
7	0.260496	8.105207	39.05107	52.84372
8	0.262537	8.066682	39.29966	52.63366
9	0.264203	7.970418	38.91261	53.11697
10	0.266422	7.838424	38.29733	53.86424
Variance Decomposition of LNUSOILP:				
1	0.246931	2.924132	1.935053	95.14081
2	0.290457	13.77094	1.742683	84.48637
3	0.31032	13.61492	5.500269	80.88481
4	0.327481	12.52551	9.890872	77.58362
5	0.336158	11.97305	9.539604	78.48734
6	0.351468	10.95696	9.390766	79.65228
7	0.360971	10.76246	9.136424	80.10112
8	0.363874	11.33091	9.048238	79.62085
9	0.365608	11.57131	9.438567	78.99012
10	0.366667	11.64917	9.687508	78.66332

Figure 5.1a: IRF –Combined Response Graph

Malaysia's :

The US's :

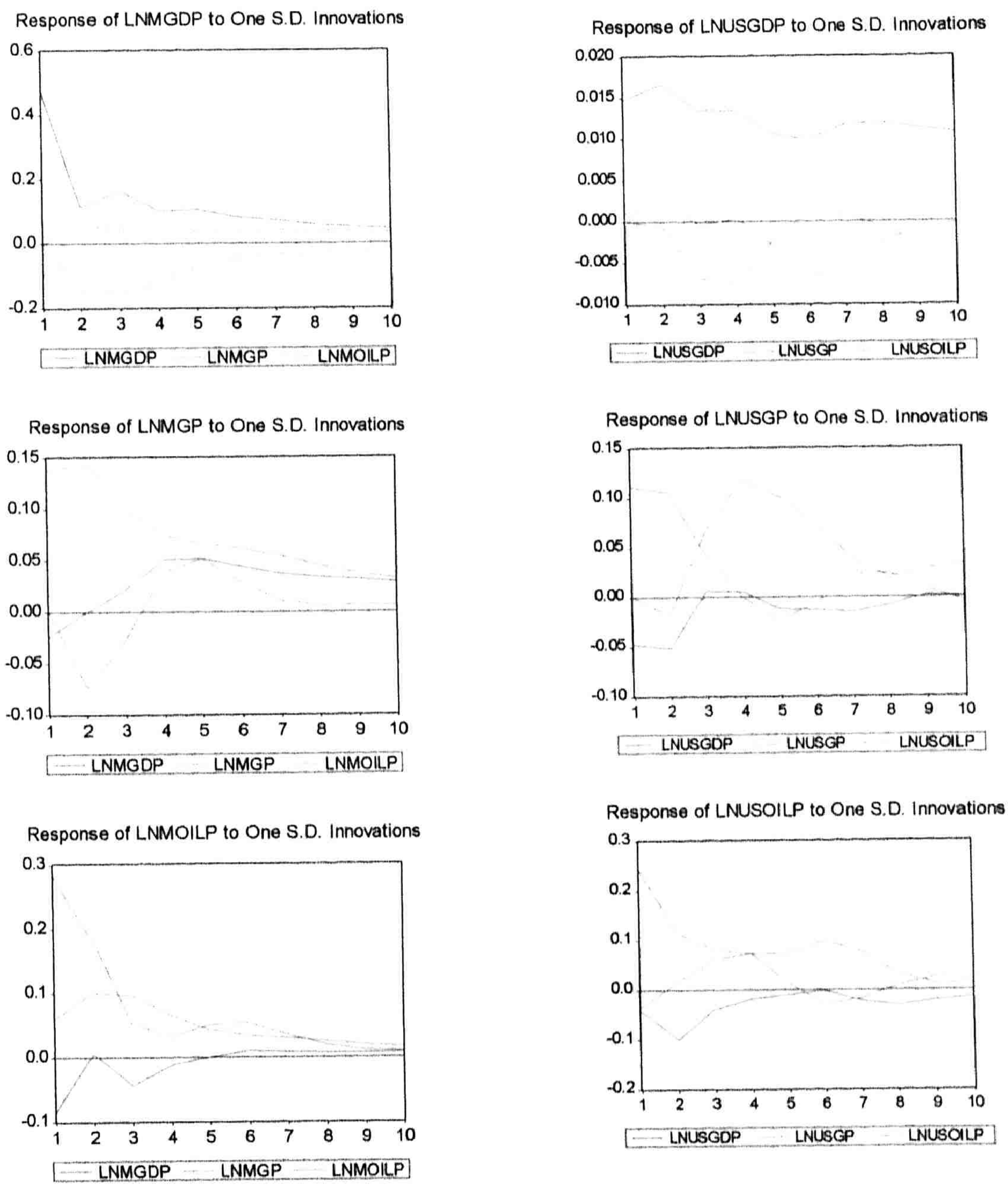

Figure 5.1b: VD –Combined Response Graph

Malaysia: The US:

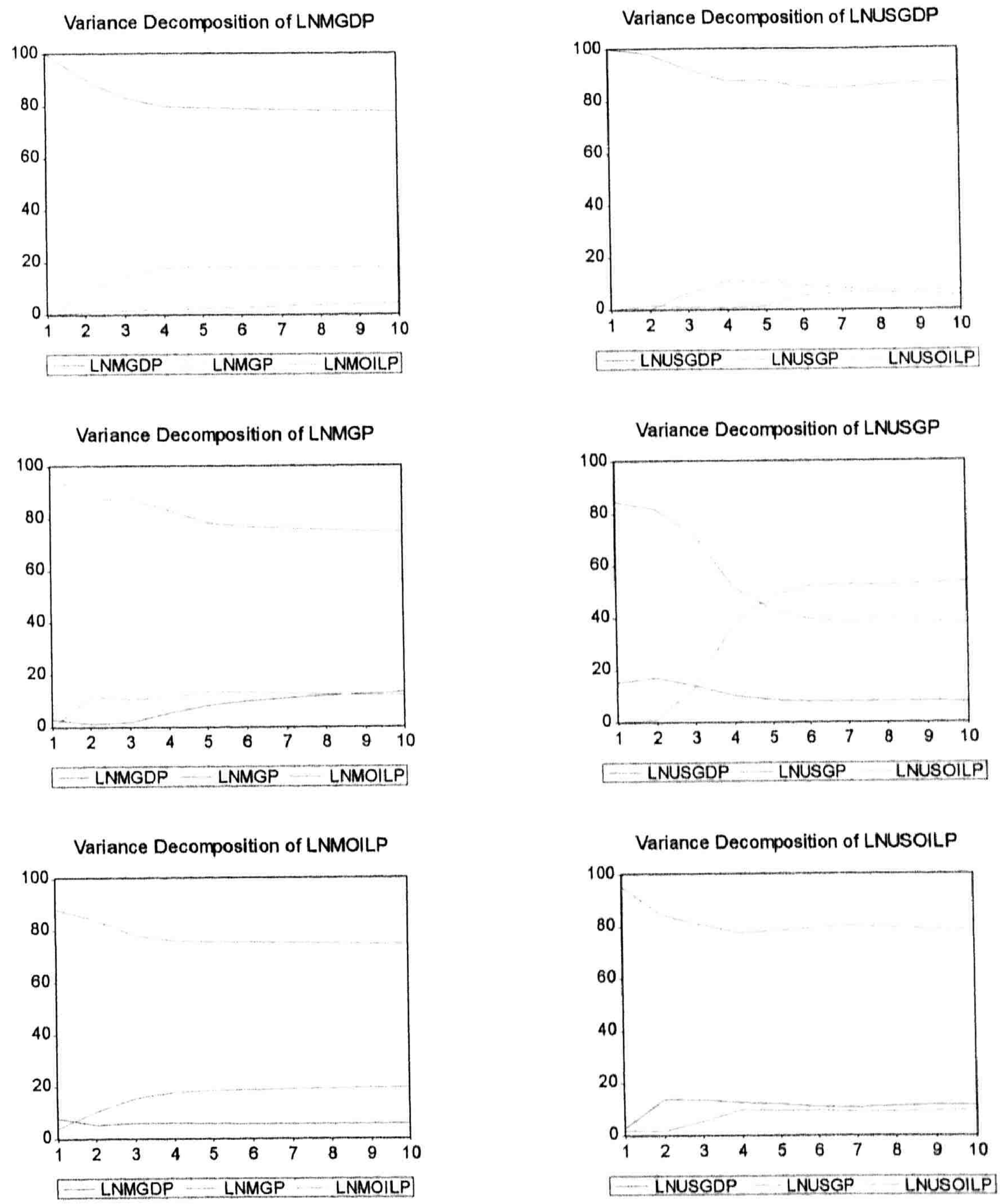

Table 5.4 and table 5.5 presents the IRF results and the VD results for the 10-lags ahead forecasts for both Malaysia and the US, while Figure 5.1a and 5.1b show IRF and VD combined response graphs for both countries.

Looking at the IRF for both countries (see Table 5.4 and Figure 5.1a), the IRF for the Malaysia's data declines monotonically toward zero that is, the IRF eventually dies out. The response of oil price on one standard deviation innovation dies out more quickly compared to the response of gold price and GDP in Malaysia. The response of gold price on one standard deviation innovation displayed the longest convergent time; dies out the slowest.

Meanwhile, for the US's data (see Table 5.4 and Figure 5.1a), the IRF dies down at a relatively slower rate compared to Malaysia's data. There is a large movement in the gold price and oil price throughout the ten years period observed. Hence, we can conclude that both the commodities' oil and gold have more far-reaching consequences to the economy. In other words, the response of an oil price and gold price shock are more long lasting in the US as oppose to Malaysia. In the US, the response of oil price on one standard deviation innovation also declines towards zero at a relatively faster speed compared to the gold prices. The gold price shock also does not correlate with the GDP.

Between the two commodities, the IRF for oil prices dies down at a faster rate compared to the gold prices for both countries. From these results, we can conclude that the oil price and gold price do not depict the movement in GDP very well in both countries, especially the US.

Meanwhile, the variance decomposition of the GDP shows that the oil price variables have a larger share in explaining the variance in GDP compared to the gold price variables (see Table 5.5 and Figure 5.1b). This is evident in both countries. The estimates at lag 2 for Malaysia's data indicate that a unit shock from oil price will generate a larger displacement compared to the gold price.

5.3 Granger Causality Results

Next, the Granger causality test is carried out the causal direction between GDP and oil prices as well as gold prices. The result of the test can be seen in Table 5.6a, and the F-statistics revealed that in Malaysia's oil prices does not Granger cause GDP and likewise. Gold prices also does not Granger causes GDP and likewise. However, oil prices do Granger causes gold prices. In the US's case (see Table 5.6b), oil prices also Granger causes gold prices. In addition, gold prices Granger causes GDP. All in all, there is uni-directional causality from oil prices to GDP in both Malaysia and the US case.

Table 5.6a: Granger Causality Test Results for Malaysia:

Null Hypothesis:	Lag	F-Statistic	Probability
LNMGP does not Granger Cause LNMGDP	2	1.3549	0.27559
LNMGDP does not Granger Cause LNMGP		0.08698	0.91696
LNMOILP does not Granger Cause LNMGDP	2	0.27342	0.76293
LNMGDP does not Granger Cause LNMOILP		1.51075	0.2395
LNMOILP does not Granger Cause LNMGP	2	5.57911	0.00964
LNMGP does not Granger Cause LNMOILP		1.59521	0.22209

Table 6b: Granger Causality Test Results for US:

Null Hypothesis:	Lag	F-Statistic	Probability
LNUSGP does not Granger Cause LNUSGDP	3	4.25854	0.01567
LNUSGDP does not Granger Cause LNUSGP		1.69491	0.19593
LNUSOILP does not Granger Cause LNUSGDP	3	0.53005	0.66616
LNUSGDP does not Granger Cause LNUSOILP		2.23257	0.11156
LNUSOILP does not Granger Cause LNUSGP	3	3.10344	0.04643
LNUSGP does not Granger Cause LNUSOILP		1.84149	0.16782

5.4 Conclusion

In initial OLS test, we found that the oil prices and gold prices have significant relationship with the GDP in Malaysia and the US. Both regressions, oil prices and gold prices are significant at 5% level. Gold prices are positively related to the GDP while the oil prices are negatively related to the GDP.

However, when the vector autoregression (VAR) test is carried out, we found that past GDP innovations do not contain any significant information about the variation of either gold prices or oil prices. A study on the impulse response function shows that the response of oil price on one standard deviation innovation dies out more quickly compared to the response of gold price in Malaysia and the US. Between the two countries, the impact of oil price and gold price shocks are more pronounced in Malaysia as compared to the US. In addition, through the variance decomposition, it is observed that the impact of oil price shock is more important compared to a gold price shock in both countries. Granger causality test also shows uni-directional causality from gold price and oil price to GDP in both Malaysia and the US case.

All in all, the results confirm the assertion that gold prices and oil prices do not contribute much in the supporting role of supplementing information about current and future output movement. The research also failed to find any significant difference between the impact of oil price shocks on the growth rate on an oil-exporting country, Malaysia and an oil-importing country, the US.