# The impact of macroeconomic variables on the crude palm oil export: Malaysian evidence based on ARDL approach

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# The impact of macroeconomic variables on the crude palm oil export: Malaysian evidence based on ARDL approach

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**Abstract:**

With the expectation of the substitution of crude brent oil for crude palm oil, Malaysia as one of the largest suppliers of crude palm oil should be up in the arms to take advantage of exporting the maximum volume of the crude palm oil to meet the demand of the commodities. Thus this paper is studying the impact of macroeconomic variables on the volume of the crude palm oil export to assess if inflation rate and interest rate do increase or decrease the export volume of the crude palm oil. Our results based on the generalized variance decomposition tend to indicate that, both macroeconomic variables being relatively endogenous do not have a direct impact on the export volume, but the exchange rate being the most exogenous variable has a significant impact. Nevertheless, we can say that, the inflation rate and interest rate do have an indirect impact on the export volume of the crude palm oil.

**Keywords**: crude palm oil export, macroeconomic variables, ARDL, Malaysia

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# 1. Introduction

Essentially, the purpose of this study is to find out the relationship that the macroeconomic variables have on the volume of crude palm oil that Malaysia exports to meet the demand of the world. This paper also provides the empirical evidence of the relative relationship of whether a particular macroeconomic variable has a significant effect in explaining the demand of the crude palm oil thus indirectly resulting in the volume of Malaysia's crude palm oil exports.

The following three questions that arise from the theoretical relationship:

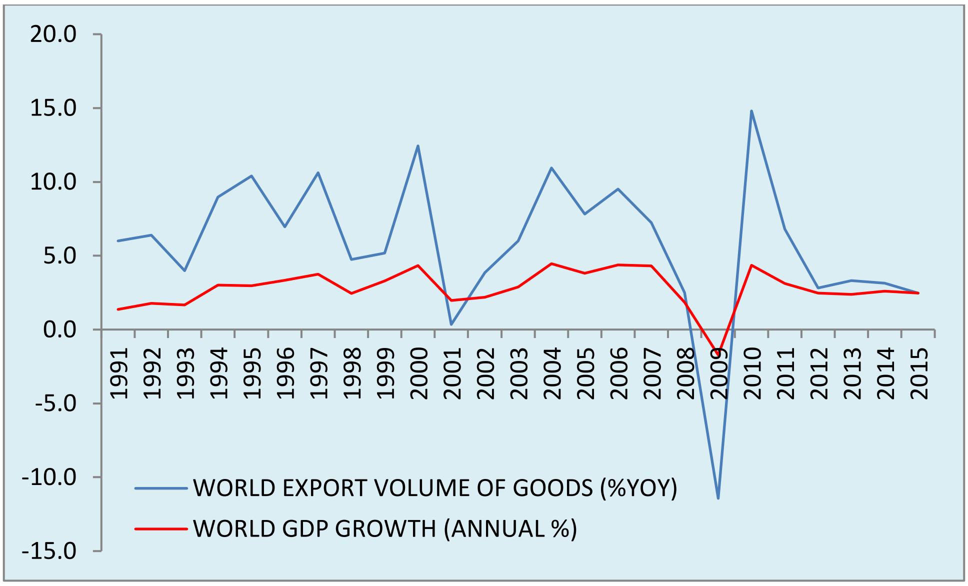
1. Do inflation increase and decrease Malaysia exports volume of crude palm oil?
2. Do interest rates have any significant effect on export of crude palm oil? – for example through appreciation or depreciation of Ringgit Malaysia exchange rate; and
3. What are the monetary policy effects of this causality studies?

## 1.1 Exports and Gross Domestic Product

The world merchandise exports have ranked Malaysia the 23rd leading exporters in the world merchandise trade and the 10th leading exporters in Asia merchandise trade (WTO, 2015). The world merchandise exports grew by an average of 7 per cent in volume terms annually from 1995 to 2000 and the world GDP increases annually at an average of 3 per cent. During the period of year 2000 to year 2005, the exports increase significantly by an average of 5 per cent per year and the annual average GDP growth was 3 per cent, GDP growth rate continue to increase slower than exports growth rate. However, from 2005 onwards until 2010, the growth slowed down to an average of 3 per cent per year and 2 per cent average GDP growth rate. The export plunged by 12 per cent and GDP by 2 per cent during the subprime mortgage crises. This was followed by a quick bounce back of 14 per cent of merchandise exports and 4 per cent increase of GDP growth in 2010 recovering from the downward sloping during the financial crises (WTO, 2015).

Malaysia merchandise exports grew by year-to-year average of 10 per cent in volume terms and GDP growth rate increases at an average of approximately 6 per cent from 1995 to year 2000 despite the Asian Financial Crisis in 1997. ). In 1998, the GDP growth rate for Malaysia plunged to negative 7.4 per cent. However, Malaysia recovered the following year with GDP growth rate in 1999 recorded at 6 per cent. The exports growth rate then grew 8 per cent per annually and GDP grows at an average of 5 per cent for year ranging from 2000 to 2005. However, due to the subprime mortagage crises that took palce from 2007 – 2009, the average exports growth rate from 2005 to 2010 plunged to negative 0.9 per cent. In 2009, the export growth for Malaysia was recorded at negative 13 per cent and GDP fell to negative 2 per cent. The following year, the exports jumped up to 10 per cent and GDP grew 4 per cent as a sign of recovering well from the financial crises. Currently, the export growth has been on a steady growth of 4 per cent every year since 2011 and GDP has increases steadily on average of 5 per cent year on year

The last 20 years have confirmed that world gross domestic product (GDP) and world merchandise exports move in tandem but export growth is much more volatile than GDP growth (WTO, 2015). From the graphs, we can see that Malaysia's gross domestic product and goods exports have been extremely volatile as an after effect of the spill-over of two extreme financial crises i.e. Asian Financial Crisis and Subprime Mortgage Crisis that took place in 1997 and 2007 respectively.




## 1.2 Palm Oil in Malaysia

Palm oil has been the most important agricultural crop of Malaysia. Overall, the palm oil industry is the fourth largest contributor to the country's GNI, accounting for about 8 percent or over RM 80 billion of GNI. Globally, Malaysia is the second largest producer and the largest exporter of crude palm oil (AIM, 2013). The palm oil industry is the back bone of the Malaysia's economic growth. Indisputably, Malaysia is an essential source of this commodity. With its stellar performance recorded high in key indicators, Malaysia managed to provide a continuous supply of high-grade quality crude and processed palm oil around the globe (Awalludin et. al. 2015).

Total exports of oil palm products increased marginally by 1.2% to 25.37 million tonnes in 2015 from 25.07 million tonnes exported in 2014. Total export revenue, however, declined by 5.4% to RM60.17 billion compared to the RM63.62 billion achieved in 2014 due to lower export prices. Palm oil export revenue declined by 7.3% to RM41.26 billion as against RM44.50 billion in 2014. Palm oil off-take increased marginally by 0.9% to 17.45 million tonnes as compared to 2014 due to higher demand, especially from India, Turkey, Philippines and South Africa (MPOB, 2015).

India maintained its position as the largest Malaysian palm oil export market in 2015, with an intake of 3.69 million tonnes or 21.1% of total palm oil exports. Followed by the European Union (EU) 2.43 million tonnes (13.9%), China, P.R 2.38 million tonnes (13.6%), Pakistan 0.73 million tonnes (4.2%), USA 0.70 million tonnes (4.0%), Philippines 0.65 million tonnes (3.7%) and Vietnam 0.58 million tonnes (3.3%). These seven (7) markets combined accounted for 11.16 million tonnes or 64.0% of total Malaysian palm oil exports in 2015 (MPOB, 2015).

## 2.0 Literature Review

The immediate benefits from larger production of biodiesel will be the revenues generated from the exportation of the products to other countries (Lim and Lee, 2010). Malaysia’s total exports of oil palm products increased marginally by 1.2% from 25.07 million tonnes exported in 2014 to 25.37 million tonnes in 2015 (MPOB, 2015). In order to capture this advantage to reach the goal of ‘Wawasan 2020’ for the country, it is important to study on the causal effect of monetary policy in terms of the palm oil exports in Malaysia. Malaysia has price stability as primary objective, but does not have an explicit inflation targeting framework. Malaysia has a managed float exchange rate regime and has been able to keep the inflation rate under control (Mehrotra and Sanchez-Fung, 2011). Inflation targeting, as a normative statement, is usually associated with floating exchange rates (Clarida et. al, 2001).

Monetary policy affects firm entry, exit, and export decisions (Cooke, 2016). Firms that export face product price risk in foreign currency, uncertain costs in home currency, and exchange rate risk. If prices and exchange rates in different countries interact, natural hedges of exchange rate risk might result (Korn and Koziol, 2011). Two key parameters to determine optimal monetary policy when firms make decisions to enter the domestic and export markets: the elasticity of substitution between home and foreign goods and the dispersion of firm productivity (Cooke, 2016). In his studies, the results show that high inflation and an abundance of natural resources tended to be associated with low exports and slow growth (Gylfason, 1997). High exports countries are generally characterized by i) small population, ii)large GNP per capita, iii) small agriculture, iv) little inflation, v) less-than-average dependence on primary exports, vi) more-than-average investment; and vii) more than average growth of real per capita GNP (Gylfason, 1997).

# 3.0 Data and Methodology

## 3.1 Data

This paper uses secondary data that consist of monthly data for period of 18 years starting from  January 1997.. The data obtained was the fundamental economic variables for Malaysia that was collected from the Datastream of Thomson Reuters.

Exports - Crude Palm Oil as a measure for the monthly volume of crude palm oil exports and Consumer Price Index as a measure of monthly inflation rate collected from the Department of Statistics, Malaysia. Money Market Rate as a measure of the monthly interest rate, Gross Domestic Product as a measure of quarterly output gap and Commodity Prices, Palm Oil as a measure of monthly crude palm oil price (USD/tonnes) collected from the IMF - International Financial Statistics. Malaysian Ringgit to United States Dollar rate as a measure of the daily exchange rate of Ringgit Malaysia per unit of US Dollar collected from the Bank Negara Malaysia.

## 3.2 Methodology

This paper employs a time series technique, in particular, the Autoregressive Distributed Lag (ARDL) model. We ran several tests to achieve the empirical evidence to support our study, in particular, the co-integration test, the error correction model and the variance decomposition. The purpose of this paper is to study the causal effect of macroeconomic variables towards Malaysia's crude palm oil exports in order to meet the increasing demand of the commodities and to identify which of the macroeconomic variables gives stronger effect to the export of the crude palm oil.

The functional form of the model is as per below

$$VOL = f(CPO, INT, CPI, GDP, EXC)$$

where,

CPO = monthly crude palm oil price

INT = monthly interest rate

CPI = monthly inflation rate

GDP = monthly output gap

EXC = monthly exchange rate of MYR per unit of USD

In order to achieve the objectives of the paper, several test has been performed and the study will be continue using the Autoregressive Distributed Lag (ARDL) model approach due to reasons that will be discuss further in Empirical Result section.

In the case of this paper, we found that there are combinations of non-stationary and stationary variables in the log form and difference form. Thus, the study will use the ARDL model approach. The tests relevant to this approach after the unit root test are listed below:

1. Unit Root test (Augmented-Dickey Fuller)
2. Order of the VAR model (lags)
3. ARDL approach to co-integration
4. Error Correction Model (ECM)
5. Variance Decomposition (VDC)
6. Impulse Response (IRF)

## 4.0 Empirical Results

This section will discuss and analyse all the results of the relevant tests for the ARDL approach to co-integration that will identify whether there are long-run relationships between the macroeconomic variables to the Malaysia exports of crude palm oil.

### 4.1 Unit Root Tests

First, we determine the stationarity of the each macroeconomic variable that we used. Ideally, our variables should be I(1), which means that the variable are non-stationary in their original level form and they should be I(0) in their first differenced form, to show that they are stationary. The first differenced form for each of the variable used is created by taking the difference of their log form: for example, DCPI = $LCPI_t - LCPI_{t-1.}$ We then conducted the Augmented Dickey Fuller test for unit root testing of each macroeconomic variable in both their level form and differenced form. The table below shows the result of the test.

The result of the Augmented Dickey-Fuller unit root test shows that for log form of the variable VOL and EXC appears to be stationary. The t-statistics for LVOL is 5.985 in absolute term for AIC and SBC respectively which is greater than the critical value 3.431 in absolute term. The t-statistics for LEXC are 4.405 and 4.290 in absolute term for AIC and SBC respectively which is greater than the critical value 3.431 in absolute term. All the other variables t-statistics are lesser than the critical value, thus the log form of the variables are non-stationary.

The ADF test shows that the t-statistics for all the variables in their differenced form are greater than the critical value. This shows that the variables in differenced form are stationary. As a conclusion, the results shown in both tables indicates that the two variables in log form is in stationary form, which does not held the requirement for time series that all the variables have to be non-stationary in original level form and stationary once the variables is in differenced form. Due to this, we will continue with our study using the approach of ARDL modelling.

| | VARIABLE | ADF | VALUE | T-STAT. | C.V. |
|---|---|---|---|---|---|
| LOG FORM | LVOL | ADF(1)=SBC | 132.4735 | - 5.985 | -3.4312 |
| | | ADF(1)=AIC | 139.2789 | - 5.985 | -3.4312 |
| | LCPO | ADF(4)=SBC | 262.2317 | - 2.795 | -3.4312 |
| | | ADF(5)=AIC | 275.1535 | -2.3404 | -3.4312 |
| | LINT | ADF(2)=SBC | 271.4312 | -2.6069 | -3.4312 |
| | | ADF(5)=AIC | 281.4041 | -2.5268 | -3.4312 |
| | LCPI | ADF(1)=SBC | 920.5151 | -3.39 | -3.4312 |
| | | ADF(1)=AIC | 927.3205 | -3.39 | -3.4312 |
| | LGDP | ADF(3)=SBC | 648.114 | -2.8607 | -3.4312 |
| | | ADF(3)=AIC | 658.3220 | -2.8607 | -3.4312 |
| | LEXC | ADF(1)=SBC | 465.8468 | -4.2898 | -3.4312 |
| | | ADF(4)=AIC | 473.332 | -4.4045 | -3.4312 |

**Table 1 Augmented Dickey Fuller Test for Logged Variables**

| | VARIABLE | ADF | VALUE | T-STAT. | C.V. |
|---|---|---|---|---|---|
| 1ST DIFF. FORM | DVOL | ADF(1)=SBC | 119.7741 | - 13.596 | - 2.875 |
| | | ADF(4)=AIC | 128.5026 | - 9.936 | - 2.875 |
| | DCPO | ADF(4)=SBC | 262.3976 | - 6.147 | - 2.875 |
| | | ADF(4)=AIC | 272.5921 | - 6.147 | - 2.875 |
| | DINT | ADF(1)=SBC | 285.9473 | - 8.859 | - 2.875 |
| | | ADF(3)=AIC | 291.0857 | - 7.918 | - 2.875 |
| | DCPI | ADF(2)=SBC | 911.1997 | - 8.108 | - 2.875 |
| | | ADF(4)=AIC | 920.3596 | - 7.718 | - 2.875 |
| | DGDP | ADF(2)=SBC | 646.6556 | - 6.309 | - 2.875 |
| | | ADF(2)=AIC | 653.4520 | - 6.309 | - 2.875 |

| | | | | | |
|---|---|---|---|---|---|
| | DEXC | ADF(1)=SBC | 456.7801 | - 10.133 | - 2.875 |
| | | ADF(3)=AIC | 463.0085 | - 6.315 | - 2.875 |

**Table 2 Augmented Dickey Fuller Test for Differenced Variables**

## 4.2 Order of VAR model

After we have tested for the stationarity and non-stationarity of the variables in differenced and logged form, we will proceed to look at the order of the vector auto regression (VAR) model, that is the number of lag to be used in this study, before continuing with the co-integration test. As per the table below, the highlighted rows show that following the Akaike Information Criterion (AIC), the maximum number of lag for the model is 4. Following the adjusted LR test, it shows that the number of lag for the model is 5 after the test stops being significant. However, the Schwarz Bayesian Criterion (SBC) test shows that the minimum number of lag for the model is 0.

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model
******************************************************************************

| Order | LL | AIC | SBC | LR test | Adjusted LR test |
|---|---|---|---|---|---|
| 6 | 2947.8 | 2725.8 | 2348.6 | ------ | ------ |
| 5 | 2918.9 | 2732.9 | 2416.9 | CHSQ(36) = 57.7764[.012] | 48.1034[.086] |
| 4 | 2889.6 | 2739.6 | 2484.8 | CHSQ(72) = 116.3502[.001] | 96.8708[.027] |
| 3 | 2838.2 | 2724.2 | 2530.5 | CHSQ(108)= 219.1135[.000] | 182.4293[.000] |
| 2 | 2800.3 | 2722.3 | 2589.8 | CHSQ(144)= 294.9446[.000] | 245.5648[.000] |
| 1 | 2759.6 | 2717.6 | 2646.2 | CHSQ(180)= 376.4718[.000] | 313.4426[.000] |
| 0 | 2677.0 | 2671.0 | 2660.8 | CHSQ(216)= 541.6666[.000] | 450.9803[.000] |

******************************************************************************
AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

**Table 3 Order of VAR table**

## 4.3 ARDL approach to co-integration

Once we have tested for the stationary and non-stationarity of the variables and we have determined that the VAR order as 4, we then test for ARDL bound tests for co-integration. The test shows the long run relationship and the short run dynamic interactions among the each of the tested variables. This test has three advantages as compared with other traditional co-integration methods – Phillips Perron and KPSS. First, the ARDL does not require all variables in original level form to be non-stationary. Second, the test is relatively more efficient in the case of small and finite sample data sizes. Lastly, by applying the ARDL technique we obtained unbiased estimated of the long-run model. The result shows that the dependent variable VOL has a long run or short run relationship to the independent variables as reflected by the f-statistics value, 13.640, that is greater than the 95% upper bound, 3.962. It also shows that the dependent variable EXC has a long run or short run relationship to the independent variables as reflected by the f-statistics value, 4.341, that is greater than the 95% upper bound, 3.863. The following test will confirm whether the independent variables have a significant long run or short run relationship to our focus dependent variable, VOL.

| Function Model | F-statistics | 95% Lower Bound | 95% Upper Bound |
|---|---|---|---|
| F(LVOL\|LCPO, LINT, LCPI, LGDP, LEXC) | 13.6397 | 2.6537 | 3.9625 |
| F(LCPO\|LVOL, LINT, LCPI, LGDP, LEXC) | 3.1361 | 2.6537 | 3.8625 |
| F(LINT\|LVOL, LCPO, LCPI, LGDP, LEXC) | 2.9494 | 2.6537 | 3.8625 |
| F(LCPI\|LVOL, LCPO, LINT, LGDP, LEXC) | 3.5964 | 2.6537 | 3.8625 |
| F(LGDP\|LVOL, LCPO, LINT, LCPI, LEXC) | 2.7026 | 2.6537 | 3.8625 |
| F(LEXC\|LVOL, LCPO, LINT, LCPI, LGDP) | 4.3411 | 2.6537 | 3.8625 |

**Table 4 Estimation of Co-integration**

## 4.4 Error Correction Model

After we have identified the existence of the dynamic relationship of the variables in previous test, we will now investigate the long run and short run equilibrium of the model. The error correction model will tell us the degree of the relationship of the short run series dynamics to return to equilibrium. The f-statistics (13.640) shows that the value is higher than the upper bound at 95% (3.963). This means that there exists a dynamic relationship among the variables, which explains that the independent variables have an effect on the dependent variable, VOL, so we can assume that there are either short run or long run relationship among these variables. The diagnostic tests also shows that there are no autocorrelation issue at 1% critical value, no normality issue at 5% critical value and there is no heteroscedasticity issue at 10% critical value, hence, there are no apparent issue with this model.

| F-statistic | 95% Lower Bound | 95% Upper Bound |
|---|---|---|
| 13.6397 | 2.6537 | 3.9625 |

Diagnostic Tests

| Test Statistics | LM Version | F Version |
|---|---|---|
| A:Serial Correlation | CHSQ(12) = 33.6103[.001] | F(12,207) = 2.9980[.001] |
| B:Functional Form | CHSQ(1) = 1.0829[.298] | F(1,218) = 1.0449[.308] |
| C:Normality | CHSQ(2) = 6.5509[.038] | Not applicable |
| D:Heteroscedasticity | CHSQ(1) = 2.7682[.096] | F(1,225) = 2.7777[.097] |

**Table 5 F-statistics Test and Diagnostic Tests**

In order to assess the long run dynamics, we look at the result for the long run relationship which can be written as below model:

$$LVOL = 3.18 - 0.11LCPO - 0.12LINT - 0.57LCPI + 1.69LGDP - 0.23LEXC$$

The table below shows that there are two significant independent variables explaining their dynamic effect on the VOL; LINT and LGDP, at 10% critical value. This explains that the interest rate and the output gap have a long run relationship to the volume of crude palm oil exports.

Estimated Long Run Coefficients using the ARDL Approach
ARDL(1,0,0,1,0,0) selected based on Akaike Information Criterion

Dependent variable is LVOL

| Regressor | Coefficient | Standard Error | T-Ratio[Prob] |
|---|---|---|---|
| LCPO | -.10495 | .069973 | -1.4999[.135] |
| LINT | -.11561 | .062659 | -1.8451[.066] |
| LCPI | -.57291 | .65841 | -.87015[.385] |
| LGDP | 1.6920 | .43551 | 3.8850[.000] |
| LEXC | -.22729 | .19316 | -1.1767[.241] |
| INPT | 3.1780 | 1.3368 | 2.3774[.018] |

**Table 6 Estimation of Long Run Relationship**

The result for the short run relationship can be written as below model:

$$LVOL = -0.06LCPO - 0.06LINT - 3.42LCPI + 0.91LGDP - 0.12LEXC - 0.52ecm(-1)$$

The table below shows that there are two significant independent variables; LINT and LGDP, at 10% critical value. The coefficient of the ecm(-1) shows that there exists a partial adjustment and there is a slow speed of convergence to the equilibrium while the p-value of the ecm(-1) is lower than 5% thus this shows that the dependent variable LOV is an endogenous variable. In other table , the results shows that the independent variable CPO is exogenous as the p-value is greater than 5% while INT, CPI, GDP and EXC are endogenous variable because the p-value is lower than 5%.

**Error Correction Representation for the Selected ARDL Model**

```
       ARDL(1,0,0,1,0,0) selected based on Akaike Information Criterion
******************************************************************************
 Dependent variable is dLVOL
******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 dLCPO                    -.056326            .037429            -1.5049[.134]
 dLINT                    -.062047            .035052            -1.7701[.078]
 dLCPI                     -3.4170             2.2549            -1.5154[.131]
 dLGDP                      .90805             .24792             3.6628[.000]
 dLEXC                     -.12198             .10383            -1.1748[.241]
 ecm(-1)                   -.53668            .060610            -8.8546[.000]
******************************************************************************
 R-Squared                      .28197   R-Bar-Squared                   .25902
 S.E. of Regression             .12731   F-Stat.    F(6,220)    14.3333[.000]
 Mean of Dependent Variable   .0037925   S.D. of Dependent Variable      .14790
 Residual Sum of Squares        3.5497   Equation Log-likelihood       149.8447
 Akaike Info. Criterion       141.8447   Schwarz Bayesian Criterion    128.1449
 DW-statistic                   2.0691
******************************************************************************
F-statistic  95% Lower Bound  95% Upper Bound
   13.6397          2.6537          3.9625
******************************************************************************
```

Table 7 Error Correction Model for Long Run Coefficient

## 4.5 Variance Decomposition (VDC)

From previous test, we have established that the CPO is the exogenous variable, however, we have not yet able to say about the relative exogeneity and endogeneity of the variables. Variance decomposition explains the degree of the variable that is explained by its past lag. The table shows the variance decomposition for both the orthogonalized approach and the generalized approach.

The two approaches show different result in terms of the exogeneity of the variables. LVOL is shown to be the most exogenous variable in the orthogonalized approach and ranked second in the generalized approach. Whereas LEXC shows that it ranked second in the orthogonalized approach and to be the most exogenous in generalized approach. Other variables ranking remains the same in both approaches. We can argue that the ranking are

**ORTHOGONOLIZED APPROACH**

| Horizon | Variable | LVOL | LCPO | LINT | LCPI | LGDP | LEXC |
|---|---|---|---|---|---|---|---|
| | LVOL | 89% | 7% | 2% | 1% | 1% | 1% |
| 12 | LCPO | 2% | 78% | 1% | 14% | 1% | 3% |
| months | LINT | 3% | 3% | 82% | 4% | 3% | 5% |
| | LCPI | 5% | 3% | 1% | 82% | 7% | 2% |
| | LGDP | 7% | 1% | 3% | 5% | 76% | 7% |
| | LEXC | 1% | 2% | 2% | 3% | 3% | 89% |
| | Exogeneity | 89% | 78% | 82% | 82% | 76% | 89% |
| | Ranking | 1 | 5 | 3 | 4 | 6 | 2 |

| Horizon | Variable | LVOL | LCPO | LINT | LCPI | LGDP | LEXC |
|---|---|---|---|---|---|---|---|
| | LVOL | 89% | 7% | 2% | 1% | 1% | 1% |
| 24 | LCPO | 2% | 78% | 1% | 14% | 1% | 3% |
| months | LINT | 3% | 3% | 82% | 4% | 3% | 5% |
| | LCPI | 5% | 3% | 1% | 81% | 7% | 2% |
| | LGDP | 7% | 1% | 3% | 5% | 76% | 7% |
| | LEXC | 1% | 2% | 2% | 3% | 3% | 89% |
| | Exogeneity | 89% | 78% | 82% | 81% | 76% | 89% |
| | Ranking | 1 | 5 | 3 | 4 | 6 | 2 |

| Horizon | Variable | LVOL | LCPO | LINT | LCPI | LGDP | LEXC |
|---|---|---|---|---|---|---|---|
| | LVOL | 89% | 7% | 2% | 1% | 1% | 1% |
| 36 | LCPO | 2% | 78% | 1% | 14% | 1% | 3% |
| months | LINT | 3% | 3% | 82% | 4% | 3% | 5% |
| | LCPI | 5% | 3% | 1% | 81% | 7% | 2% |
| | LGDP | 7% | 1% | 3% | 5% | 76% | 7% |
| | LEXC | 1% | 2% | 2% | 3% | 3% | 89% |
| | Exogeneity | 89% | 78% | 82% | 81% | 76% | 89% |
| | Ranking | 1 | 5 | 3 | 4 | 6 | 2 |

**GENERALIZED APPROACH**

| Horizon | Variable | LVOL | LCPO | LINT | LCPI | LGDP | LEXC |
|---|---|---|---|---|---|---|---|
| | LVOL | 89% | 7% | 2% | 1% | 1% | 1% |
| 12 | LCPO | 2% | 78% | 1% | 15% | 2% | 2% |
| months | LINT | 3% | 3% | 82% | 4% | 4% | 6% |
| | LCPI | 5% | 3% | 1% | 81% | 8% | 4% |
| | LGDP | 7% | 1% | 3% | 5% | 78% | 8% |
| | LEXC | 1% | 2% | 2% | 3% | 3% | 92% |
| | Exogeneity | 89% | 78% | 82% | 81% | 78% | 92% |
| | Ranking | 2 | 5 | 3 | 4 | 6 | 1 |

| Horizon | Variable | LVOL | LCPO | LINT | LCPI | LGDP | LEXC |
|---|---|---|---|---|---|---|---|
| | LVOL | 89% | 7% | 2% | 1% | 1% | 1% |
| 24 | LCPO | 2% | 78% | 1% | 15% | 2% | 2% |
| months | LINT | 3% | 3% | 82% | 4% | 4% | 6% |
| | LCPI | 5% | 3% | 1% | 81% | 8% | 4% |
| | LGDP | 7% | 1% | 3% | 5% | 77% | 8% |
| | LEXC | 1% | 2% | 2% | 3% | 3% | 92% |
| | Exogeneity | 89% | 78% | 82% | 81% | 77% | 92% |
| | Ranking | 2 | 5 | 3 | 4 | 6 | 1 |

| Horizon | Variable | LVOL | LCPO | LINT | LCPI | LGDP | LEXC |
|---|---|---|---|---|---|---|---|
| | LVOL | 89% | 7% | 2% | 1% | 1% | 1% |
| 36 | LCPO | 2% | 78% | 1% | 15% | 2% | 2% |
| months | LINT | 3% | 3% | 82% | 4% | 4% | 6% |
| | LCPI | 5% | 3% | 1% | 81% | 8% | 4% |
| | LGDP | 7% | 1% | 3% | 5% | 77% | 8% |
| | LEXC | 1% | 2% | 2% | 3% | 3% | 92% |
| | Exogeneity | 89% | 78% | 82% | 81% | 77% | 92% |
| | Ranking | 2 | 5 | 3 | 4 | 6 | 1 |

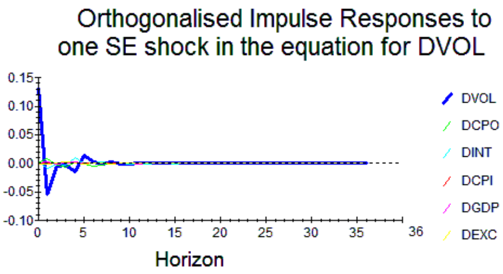
interchangeable because orthogonalized approach is biased towards the order of the variables and thus showing that LVOL ranked first as per according to the order in the model.

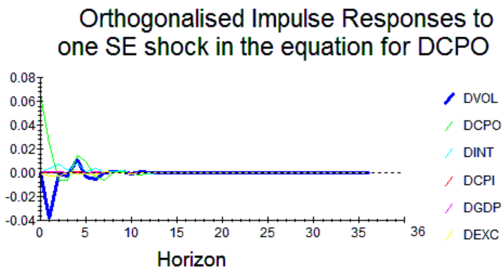
However, having said that, the result of the exogeneity and endogeneity of the variables differs from the ECM model result. In VDC table, we can see that CPO is most explained by the CPI which does explain theoretically as inflation does give effect to the price of the crude palm oil price. Instead in ECM, it shows that CPO is the leader and any shock to the variable will give spill over effect to the rest of the variable.

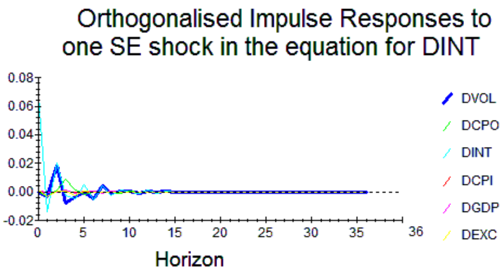
## 4.6 Impulse Response (IRF)

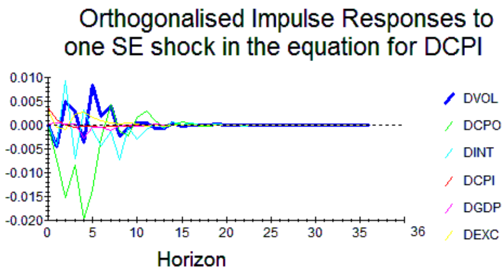
### 4.6.1 Orthogonalised Approach

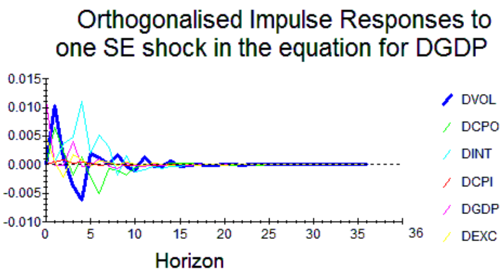
This approach shows for each variable that is shocked in the system, it assumes that all the other variables in the system are switched off. The graph shows that when VOL was shocked, it does not give significant effect to the other variables and it dies down to equilibrium after approximately 10 horizons. However, all the other variables shows that when each of them are shocked, they give effect to the other variables and the most volatile are CPI and GDP which also takes a longer time to dies down to equilibrium, approximately close to 15 horizon.

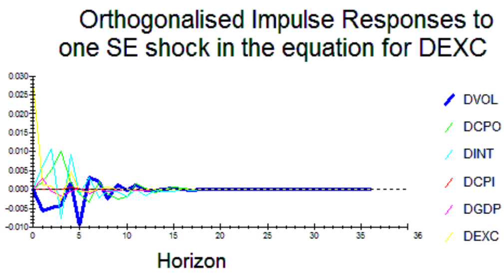

Orthogonalised Impulse Responses to
one SE shock in the equation for DVOL
Horizon
DVOL
DCPO
DINT
DCPI
DGDP
DEXC


Orthogonalised Impulse Responses to
one SE shock in the equation for DCPO
Horizon
DVOL
DCPO
DINT
DCPI
DGDP
DEXC


Orthogonalised Impulse Responses to
one SE shock in the equation for DINT
Horizon
DVOL
DCPO
DINT
DCPI
DGDP
DEXC

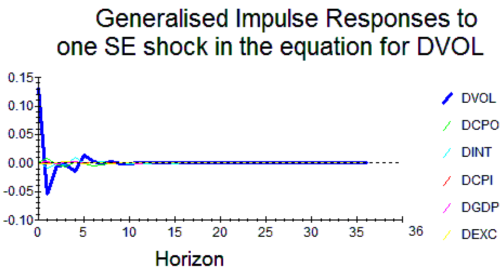

Orthogonalised Impulse Responses to
one SE shock in the equation for DCPI
Horizon
DVOL
DCPO
DINT
DCPI
DGDP
DEXC

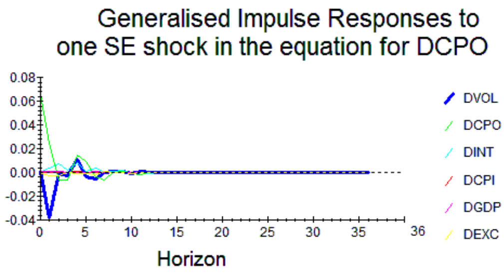

Orthogonalised Impulse Responses to
one SE shock in the equation for DGDP
Horizon
DVOL
DCPO
DINT
DCPI
DGDP
DEXC

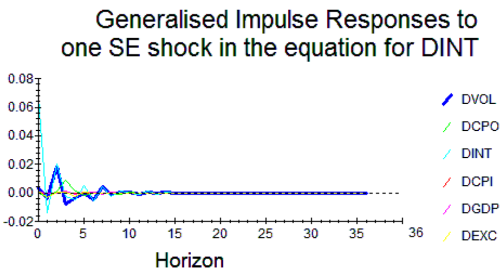

Orthogonalised Impulse Responses to
one SE shock in the equation for DEXC
Horizon
DVOL
DCPO
DINT
DCPI
DGDP
DEXC

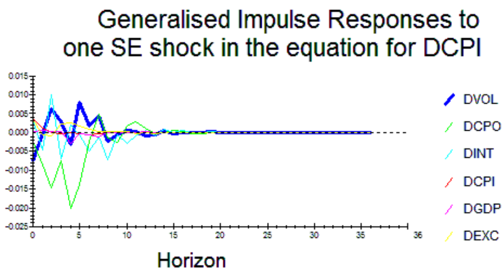
### 4.6.2 Generalised

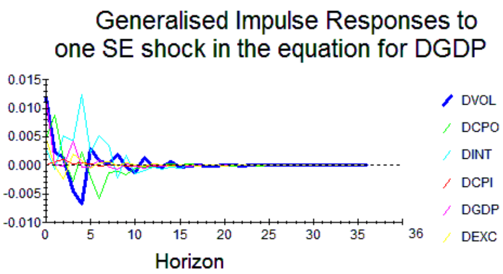
This approach shows for each variable that is shocked in the system, it does not assume that all the other variables in the system are switched off. The graph shows that when VOL was shocked, it does not give significant effect to the other variables and it dies down to equilibrium after approximately 10 horizons. Similar to the orthogonalized approach, when all the other variables are shocked, they give effect to the other variables and the most volatile are CPI and GDP, which also takes a longer time to dies down to equilibrium, approximately close to 15 horizon.

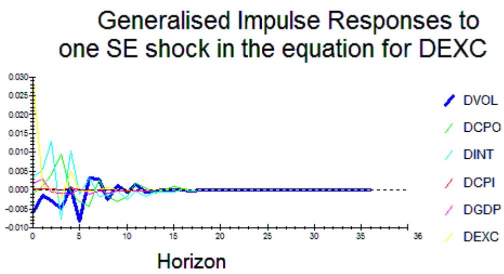


## 5.0 Conclusions

In order to address the purpose of this study, the result shows that inflation rate and interest rate does not have a direct impact to the export volume of crude palm oil for Malaysia to meet the world demand of crude palm oil. However, we know that theoretically, the inflation rate and interest rate has an effect to the price of goods and gives impact to the purchasing power parity. The advantage of this paper to this study is that, there are not many previous research that has studied the macroeconomic impact on the volume of crude palm oil export.

Through the VDC result, we can see that for 36 months, crude palm oil price (USD/tonne metric) (CPO) variance gives the most explanation of the volume of crude palm oil export. In addition to that, CPI variance affects the crude palm oil price (USD/tonne metric). This result is crucial to the policy makers in Malaysia. In order to take advantage of the higher demand of crude palm oil as a substitute for crude brent oil, the inflation rate needs to be maintained by the central bank so that the price of the crude palm oil can remain competitive in the market. Central bank can maintain the inflation rate in Malaysia by controlling the overnight rate policy and interest rate.

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