The Impact of the Changes of the World Crude Oil Prices On the Natural Rubber Industry in Malaysia

Aye Aye Khin, Zainalabidin Mohamed and Amna Awad Abdel Hameed

1Department of Economics, Faculty of Management, Multimedia University (MMU), 63100 Cyberjaya, Selangor, Malaysia
2Department of Agribusiness and Information Systems, Faculty of Agriculture, Universiti Putra Malaysia (UPM), 43400 UPM Serdang, Selangor, Malaysia
3Institute of Agricultural and Food Policy Studies (IKDPM), Universiti Putra Malaysia (UPM), 43400 UPM Serdang, Selangor, Malaysia

Abstract: This paper investigates the impact of world crude oil price on the supply, demand, stock, synthetic rubber and natural rubber (NR) prices (represented by SMR20) of the Malaysian NR industry using econometric system of equations. The study utilises monthly data from January 1990 – December 2010. A preliminary data analysis focused on univariate properties of the data series for unit root. The Granger causality test is conducted to examine the direction and relationship between the variables. The time series model is estimated using Vector Error Correction Method (VECM) with co-integration method for residual error correction of the system of equations. The results indicate that crude oil price and the supply, demand, stock, synthetic and natural rubber (SMR20) prices are significantly co-integrated, which means that the long-term equilibrium between the variables are met.

Key words: System of equations • Unit-root • VECM • Co-integration • Crude oil price • Natural rubber

INTRODUCTION

The high price of crude oil continues to be an issue of concern all over the world, particularly, developing agri-based countries. This is inevitable because the determination of agricultural commodities prices is based on complex interactions among multiple factors including crude oil prices, exchange rates, time-lag, demand and supply situations and slowing growth in agricultural productivity as well as governments’ policies. Similarly, the energy crisis, bad weather and international trade policy diversities made by nations of the world also influenced the prices of agricultural commodities.

In the last decade, the world natural rubber (NR) industry has experienced very rapid and fundamental changes with the expansion of some traditional suppliers and the appearance of new ones. Much of the changes and consequent challenges, both internally and externally, have affected Malaysia's comparative and competitive advantages in NR Industry [1]. Malaysia is a major exporter of natural rubber and it also leads the world in the dipped goods industry both in volume and quality. Besides, Malaysia is the world largest supplier of medical gloves, catheters and latex threads. There are over 300 companies making a wide variety of rubber products that are exported to over 60 countries. With the intrinsic high quality of Malaysian rubber as well as a strong R&D support in design, development and manufacturing, Malaysian rubber products have found wide global recognition.

Nevertheless, Malaysian NR production decreased from more than a million tonnes in 2004 to 970 thousand tonnes in 2010, when it accounted for 9.4 percent of world NR production. Meanwhile, domestic consumption of NR had shown significant increment indicating an expanding rubber downstream sector. Domestic consumption of Malaysian NR recorded an increase from 403 thousand tonnes in 2004 to 480 thousand tonnes in 2010 (about 19 percent increment) and it accounted for 4.5 percent of the world NR consumption. Meanwhile, the Malaysian
synthetic rubber consumption increased from 90 thousand tonnes in 2004 to 393 thousand tonnes in 2010 where it accounted for 2.8 percent of the world synthetic rubber consumption. The stock of NR was 195 thousand tonnes in 2004 and it declined to 120 thousand tonnes in 2010 [2]. The increase and decrease of stocks led to decrease and increase of NR prices respectively and this can be seen clearly during the period of 2004-2010 as shown in Figure 1. Variations in a price series can arise from long term trends or short term fluctuations (instability) in the market variables or both together. Uncertainty in a market is generally stem from short-term fluctuations rather than long term trends.

The Malaysian NR price began to show downwards trend from late July 2008 with recovery starting as early as 2009 (Figure 1). During that period, crude oil price also decreased around USD 40 per barrel. Natural rubber SMR20 price in Kuala Lumpur market increased to USD 4584 per ton in 2010. Likewise, synthetic rubber price in New York market increased to USD 2573 per ton in the same period [3]. It is observed that rubber prices generally follow the trend of crude oil prices. As such, crude oil prices will most likely be a determinant of the direction of the natural rubber market. High crude oil prices will result in high synthetic rubber prices which will, ultimately, affect the natural rubber prices. On the other hand, low crude oil prices will make synthetic rubber prices more competitive and it is putting further pressure on natural rubber prices.

The year 2008 has brought a host of economic catastrophes ranging from the spill over effects from the subprime crisis, the food crisis and more significantly the extraordinary surge in international oil prices. Previously, the 1970s oil crisis showed that high oil prices severely affect economies in both the developed and developing countries [4]. Among all the commodity prices that are breaching record high prices, the price of crude oil emanates the highest concern from governments and citizens across the globe. Additionally, when the price of crude oil goes and stays up, it has a negative effect on the entire economy because crude oil is used in the production of almost everything, including steel, aluminium, plastics, rubber, fabrics, transportation and food [5]. Thus the objectives of the study is to determine the inter-relationships between world crude oil price on the supply, demand, stock, synthetic rubber and natural rubber prices using system of equations.

MATERIALS AND METHODS

Earlier studies examined and reviewed the crude oil price (COP) and NR industry relationship based on simultaneous equations [6-9] and others authors examined the relationship of COP and NR by using multivariate analysis [10, 11] to forecast the COP on NR prices. These research papers attempt to investigate the impact of crude oil prices (COP) would bring to Malaysian NR
industry and to determine whether the COP have a significant effect on the NR supply, demand, stock, synthetic rubber and NR prices are significantly cointegrated indicating that the long-term equilibrium between the variables are met. System of equations including both endogenous and exogenous variables [12-14] will be employed to clearly explain the interrelationships within a set of variables. The preliminary data analysis focused on the univariate properties of the data series. Unit root [15] and the Granger causality tests [16, 17] are conducted for the direction and relationship between the variables. The data are then tested using Vector Error Correction Method (VECM) [18, 19] and co-integration method [20] for residual error correction of the system of equations. The study used secondary data of monthly data from Jan: 1990 to Dec: 2010.

Model Specification: A short-term model of the NR price system of equations as a function of related factors (in logs) as follow:

$$\text{PSMR}_{t,0} = f(\text{TPNR}_{t,0}, \text{TCNR}_{t,0}, \text{STONR}_{t,0}, \text{COP}_{t,0}, \text{PSR}_{t,0}, \text{PSMR}_{20,0}, \text{COP}_{t,0}, \text{T}, \epsilon_{t})$$

(1)

where:

- $\text{PSMR}_{t,0}$ = Real price of SMR20 in Malaysia (USD/tonne) deflated by the CPI
- $\text{TPNR}_{t,0}$ = Total production of natural rubber (NR Supply) (’000 tonnes)
- $\text{TCNR}_{t,0}$ = Total consumption of natural rubber and synthetic rubber (Total Demand) (’000 tonnes)
- $\text{STONR}_{t,0}$ = Stock of natural rubber (’000 tonnes)
- $\text{COP}_{t,0}$ = World crude oil price (USD/barrel)
- $\text{PSR}_{t,0}$ = Real price of synthetic rubber in New York (USD/ton) deflated by the CPI
- $\text{T}$ = Time trend
- $\epsilon_{t}$ = Time period and error terms respectively

Moreover, we can write the other variables’ system of equations as follows:

$$\text{TPNR}_{t} = f(\text{TCNR}_{t}, \text{STONR}_{t}, \text{COP}_{t}, \text{PSR}_{t}, \text{PSMR}_{20, t}, \text{TPNR}_{t-1}, \text{T}, \epsilon_{t})$$

(2)

$$\text{TCNR}_{t} = f(\text{TPNR}_{t}, \text{STONR}_{t}, \text{COP}_{t}, \text{PSR}_{t}, \text{PSMR}_{20, t}, \text{TCNR}_{t-1}, \text{T}, \epsilon_{t})$$

(3)

$$\text{STONR}_{t} = f(\text{TPNR}_{t}, \text{TCNR}_{t}, \text{COP}_{t}, \text{PSR}_{t}, \text{PSMR}_{20, t}, \text{STONR}_{t-1}, \text{T}, \epsilon_{t})$$

(4)

$$\text{PSR}_{t} = f(\text{TPNR}_{t}, \text{TCNR}_{t}, \text{STONR}_{t}, \text{COP}_{t}, \text{PSMR}_{20, t}, \text{PSR}_{t}, \text{T}, \epsilon_{t})$$

(5)

Model Identification

Unit-Root Test: Pindyck and Rubinfeld [13], Gujarati [14] and Enders [15] explained that most of time series variables are non stationary, with non constant mean and variance (unit root). If the data contain unit root, the data are called non stationary, which lead to spurious regression results. Hence the natural rubber SMR20 price (PSMR20), world crude oil price variable (COP) and other related variables have been tested for stationarity, using Augmented Dickey Fuller (ADF) and Phillips-Peron’s tests (PP) for unit root. The results of the unit root test are presented in Table 1. The natural rubber SMR20 price (PSMR20), world crude oil price variable (COP) and other related are not stationary at levels i.e. they have r unit root but they are significantly stationary at the first difference form at the 0.01 level of significant using Augmented Dickey Fuller (ADF) and Phillips-Peron’s tests (PP) for unit root.

Model Estimation

Vector Error Correction Method (VECM) with Cointegration Characteristics: A vector error correction method (VECM model) is a restricted vector autoregression (VAR) designed for use with non-stationary series that are known to be cointegrated [18, 19]. The VECM model has cointegration equation specified in such a way so that it restricts the long-term behaviour of the endogenous variables to converge to their cointegrating relationship while allowing for short-term adjustment dynamics. The cointegration equation is known as the error correction model (ECM) since the deviation from long-term equilibrium is corrected steadily through a series of partial short-term adjustments [20]. The corresponding VECM model can be specified as:

$$\Delta y_{1,t} = \alpha_{1} (y_{2,t-1} - \beta y_{1,t-1}) + \epsilon_{1,t}$$

(6)

$$\Delta y_{2,t} = \alpha_{2} (y_{2,t-1} - \beta y_{1,t-1}) + \epsilon_{2,t}$$

(7)

where; $\alpha_{1}$ is a vector of intercept terms, $\beta$ is the coefficient matrices and $\epsilon_{t}$ is the disturbance term. Therefore, the VECM model includes a vector of intercept terms ($\alpha_{1}$) and the disturbance terms ($\epsilon_{t}$). In the error correction method (ECM model), the only right-hand side variable is the error
Table 1: Unit-Root Tests for the Monthly Crude Oil Price and Related Factors

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF</th>
<th>P-P</th>
<th>ADF</th>
<th>P-P</th>
<th>Stationary</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSMR20</td>
<td>-1.9</td>
<td>-1.9</td>
<td>-6.4***</td>
<td>-9.1***</td>
<td>St</td>
</tr>
<tr>
<td>TPNR</td>
<td>-1.9</td>
<td>-4.1**</td>
<td>-12.3***</td>
<td>-55.9***</td>
<td>St</td>
</tr>
<tr>
<td>TCNR</td>
<td>-1.3</td>
<td>-1.7</td>
<td>-9.9***</td>
<td>-24.4***</td>
<td>St</td>
</tr>
<tr>
<td>STONR</td>
<td>-1.4</td>
<td>-1.1</td>
<td>-12.1***</td>
<td>-11.9***</td>
<td>St</td>
</tr>
<tr>
<td>COP</td>
<td>-2.5</td>
<td>-1.9</td>
<td>-7.5***</td>
<td>-7.7***</td>
<td>St</td>
</tr>
<tr>
<td>PSR</td>
<td>-2.4</td>
<td>-1.8</td>
<td>-5.1***</td>
<td>-8.8***</td>
<td>St</td>
</tr>
</tbody>
</table>

Source: Own Data Calculation;
St: Stationary included; **: Statistically significant at the 0.05 level; ***: Statistically significant at the 0.01 level;
ADF: Augmented Dickey-Fuller test statistic; P-P: Phillips-Peron test statistic

In order to judge whether these conditions hold, Sims [17] employed the following F-statistic to be applied to equations (4) and (5) relative to equations (6) and (7):

\[ F = \frac{\left( R_{UR}^2 - R_X^2 \right)}{\left( n - 2m - 1 \right)} / \left( 1 - R_{UR}^2 \right) \]  

where:

- \( R_{UR}^2 \) = The coefficient of determination of unrestricted equation
- \( R_X^2 \) = The coefficient of determination of restricted equation
- n = The number of observations
- m = The number of lagged periods

With Sims [17] test, the direction of causality is judged as follows:

The Result of F Test | Direction of Causality:
--- | ---
1. (8) holds, (9) does not hold | X causes Y (X \rightarrow Y)
2. (8) does not hold, (9) holds | Y causes X (Y \rightarrow X)
3. Both (8) and (9) hold | Feedback between X and Y (X \leftrightarrow Y)
4. Neither (8) nor (9) holds | X and Y are independent.

RESULTS AND DISCUSSIONS

System of Equations of Short-term Natural Rubber Price SMR20 Model: Table 2 shows the results of the system of equations of short-term natural rubber price SMR20 model. Firstly, all the estimated coefficients in the equations show the expected signs and the explanatory variables accounted for about 85 percent of the variation in the natural rubber price (PSMR20) model. Estimations reveal that the explanatory variables, namely the crude oil price (COP), synthetic rubber price (PSR), total production of natural rubber (NR supply)(TPNR), total consumption of natural rubber and synthetic rubber (total demand)
### Table 2: Results of System of Equations of NR Price Model

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Coefficients</th>
<th>Standard Errors</th>
<th>t-statistics</th>
<th>Adjusted R-squared</th>
<th>Durbin-Watson Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSMR20 (t-1)</td>
<td>PSMR20</td>
<td>1.113***</td>
<td>(0.032)</td>
<td>34.328</td>
<td>0.075</td>
<td>1.805</td>
</tr>
<tr>
<td></td>
<td>TPNR</td>
<td>0.685**</td>
<td>(0.415)</td>
<td>4.668</td>
<td>0.118</td>
<td>1.716</td>
</tr>
<tr>
<td></td>
<td>TCNR</td>
<td>0.666**</td>
<td>[-.2.342]</td>
<td>[-0.2.971]</td>
<td>1.190</td>
<td>1.749</td>
</tr>
<tr>
<td></td>
<td>COP</td>
<td>0.524**</td>
<td>(.0.055)</td>
<td>[0.4.002]</td>
<td>0.017</td>
<td>0.923**</td>
</tr>
<tr>
<td></td>
<td>PSR</td>
<td>0.156**</td>
<td>(.0.041)</td>
<td>[.3.886]</td>
<td>1.190</td>
<td>0.927</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24.688</td>
<td>(75.847)</td>
<td>[0.3.25]</td>
<td>1.190</td>
<td>0.927</td>
</tr>
<tr>
<td></td>
<td>R-squared</td>
<td>0.852</td>
<td>0.815</td>
<td>0.851</td>
<td>1.716</td>
<td>1.749</td>
</tr>
</tbody>
</table>

| Source: Own Data Calculation |

Note: Adjustment coefficients are in bold. Standard errors in ( ) and t-statistics in [ ].

Note: *** Statistically significant at the 0.01 level, ** at the 0.05 level and * at the 0.10 level.

(TCNR) and stock of natural rubber (STONR) were the most important explanatory variables with statistical significance at the 0.05 level and the natural rubber price (SMR20) in the previous period (PSMR20) was highly significant at the 0.01 level in the NR price system of equations model.

Likewise, the explanatory variables accounted for about 54 percent of the variation in the total production of natural rubber (TPNR) in the NR price system of equations model. Estimations reveal that the explanatory variables, namely the stock of natural rubber (STONR) and total production of natural rubber in the previous period (TPNR), were the most important explanatory variables with statistical significance at the 0.01 level and the natural rubber price (SMR20) was significant at the 0.05 level.

Moreover, the explanatory variables accounted for about 81 percent of the variation in the total consumption of natural rubber and synthetic rubber (total demand) (TCNR) in the NR price system of equations model. Estimations reveal that the explanatory variables, namely the total consumption of natural rubber and synthetic rubber in the previous period (TCNR) was the most important explanatory variable with statistical significance at the 0.01 level and the crude oil price (COP) and total production of natural rubber (TPNR) were significant at the 0.05 level.

Furthermore, the explanatory variables accounted for about 75 percent of the variation in the stock of natural rubber (STONR) in the NR price system of equations model. Estimations reveal that the stock of natural rubber in the previous period (STONR) was the most important explanatory variable with statistical significance at the 0.01 level and the natural rubber price (SMR20) was significant at the 0.05 level.

Finally, the explanatory variables accounted for about 88 percent of the variation in the synthetic rubber price (PSR) in the NR price system of equations model. Estimations reveal that the explanatory variables, namely the crude oil price (COP) and synthetic rubber price in the previous period.
Results of VECM Equation of Short-term Natural Rubber Price SMR20 Model: Equation 15 shows that Vector Error Correction Method (VECM) equation of the short-term natural rubber price SMR20 model. The explanatory variables which accounted for about only 22 percent of the variation of the short-term natural rubber price SMR20 model in the equation (15). From the VECM equation (15), estimations revealed that the explanatory variables, namely total consumption of natural rubber and synthetic rubber (total demand)(TCNR), the crude oil price (COP) and the natural rubber price (PSMR20) in previous period were the most important explanatory variables in the model with significance at 0.05 and 0.01 level, respectively. It meant that there was a significantly short-term relationship between the natural rubber price (PSMR20) and total consumption of natural rubber and synthetic rubber (total demand)(TCNR), the crude oil price (COP) and the natural rubber price (PSMR20) in previous period in the short-term natural rubber price SMR20 model.

\[
\Delta(PSMR20) = C + \Delta(TPNR) -0.201 + \Delta(TCNR) -0.033 + \Delta(STONR) +1.085 + \Delta(COP) -0.149 + \Delta(PSR) +0.454 + \Delta(TPNR) -0.014 + 0.027 -0.087 -0.004 +1.335 +0.002 = 0 \quad (15)
\]

\[
\text{t statistics} = [1.144, -7.201, -0.201, -0.033, 1.085, 0.149, 0.454, 0.039]
\]

\[
R^2 = 0.219 \quad \text{Adj. R-squared} = 0.196
\]

Results of Co-integration Equation of Short-term Natural Rubber Price SMR20 Model

<table>
<thead>
<tr>
<th>( \Delta(PSMR20) )</th>
<th>( \Delta(TPNR) )</th>
<th>( \Delta(TCNR) )</th>
<th>( \Delta(STONR) )</th>
<th>( \Delta(COP) )</th>
<th>( \Delta(PSR) )</th>
<th>( \varepsilon )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.014</td>
<td>+0.027</td>
<td>-0.087</td>
<td>-0.004</td>
<td>+1.335</td>
<td>+0.002</td>
<td>0</td>
</tr>
<tr>
<td>(0.002)</td>
<td>(0.042)</td>
<td>(0.003)</td>
<td>(0.075)</td>
<td>(0.003)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[-0.493]</td>
<td>[+9.506***]</td>
<td>[-2.157**]</td>
<td>[-4.399**]</td>
<td>[+5.547***]</td>
<td>[+0.154]</td>
<td></td>
</tr>
</tbody>
</table>

(Source: Own Data Calculations)

Note: Adjustment coefficients are in bold at statistically significant. Standard errors in ( ) and t-statistics in [ ].

In the cointegration equation (16) of short-term natural rubber price SMR20 model, there is highly dependent on total production of natural rubber (NR supply)(TPNR), the crude oil price (COP), stock of natural rubber (STONR) and total consumption of natural rubber and synthetic rubber (total demand)(TCNR) with significance at 0.01 level and 0.05 level, respectively. Therefore, there was a statistically significant long-term relationship and cointegrated between the natural rubber price (PSMR20) and total production of natural rubber (NR supply) (TPNR), the crude oil price (COP), stock of natural rubber (STONR) and total consumption of natural rubber and synthetic rubber (total demand)(TCNR).

Table 3 shows the results of testing the number of cointegrating relations (cointegration rank). Two types of test statistics are reported. The first block reports the so-called trace statistics and the second block reports the maximum eigenvalue statistics. The results of trace test and maximum eigenvalue test indicated that 5 cointegrating equations were significant at 0.01 level, which meant that the long-term equilibrium between the variables were met. Abdul Rahim et al. [9] analyzed the short run and long run effects of the world crude oil prices on the Malaysian NR price and palm oil export price. The results reveal that there was evidence of cointegrating relationship between world crude oil prices and both commodities prices.

Table 4 shows the direction of a Granger causality test of NR price SMR20 model. The results indicate that crude oil price (COP) Granger-causes changes in the total natural rubber production (NR supply) (TPNR) and total consumption of natural rubber and synthetic rubber (total demand) (TCNR) with unidirectional causality relationship and, however, crude oil price (COP) Granger-causes changes in the synthetic rubber price (PSR) and SMR20 price of NR (PSMR20) with bidirectional causality relationship. Smit and Vogelvang [21] indicated that there was a linear dynamic relationship between the total demand for rubber (TCNR) and the price of natural rubber (in logs) (PSMR20) for United State Rubber Market. The Granger causality relationship between these two variables was from the price of natural rubber to total demand for rubber (PSMR20 – TCNR) with significance at 0.01 levels.
Table 3: Results of Cointegration Rank Test of NR Price (SMR20) Model

Unrestricted Cointegration Rank Test (Trace)

<table>
<thead>
<tr>
<th>Hypothesized No. of CE(s)</th>
<th>Eigenvalue</th>
<th>Trace Statistic</th>
<th>0.01 Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None *</td>
<td>0.682</td>
<td>627.719</td>
<td>77.819</td>
<td>0.000</td>
</tr>
<tr>
<td>At most 1 *</td>
<td>0.507</td>
<td>370.045</td>
<td>54.682</td>
<td>0.000</td>
</tr>
<tr>
<td>At most 2 *</td>
<td>0.398</td>
<td>211.078</td>
<td>35.458</td>
<td>0.000</td>
</tr>
<tr>
<td>At most 3 *</td>
<td>0.292</td>
<td>96.726</td>
<td>19.937</td>
<td>0.000</td>
</tr>
<tr>
<td>At most 4 *</td>
<td>0.081</td>
<td>18.996</td>
<td>6.635</td>
<td>0.000</td>
</tr>
<tr>
<td>At most 5</td>
<td>0.006</td>
<td>1.517</td>
<td>6.635</td>
<td>0.218</td>
</tr>
</tbody>
</table>

Trace test indicates 5 cointegrating eqn(s) at the 0.01 level

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

<table>
<thead>
<tr>
<th>Hypothesized No. of CE(s)</th>
<th>Max-Eigen Statistic</th>
<th>Critical Value</th>
<th>0.01</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None *</td>
<td>0.682</td>
<td>257.674</td>
<td>39.370</td>
<td>0.000</td>
</tr>
<tr>
<td>At most 1 *</td>
<td>0.507</td>
<td>158.967</td>
<td>32.715</td>
<td>0.000</td>
</tr>
<tr>
<td>At most 2 *</td>
<td>0.398</td>
<td>114.352</td>
<td>25.861</td>
<td>0.000</td>
</tr>
<tr>
<td>At most 3 *</td>
<td>0.292</td>
<td>77.729</td>
<td>18.520</td>
<td>0.000</td>
</tr>
<tr>
<td>At most 4 *</td>
<td>0.081</td>
<td>18.996</td>
<td>6.635</td>
<td>0.000</td>
</tr>
<tr>
<td>At most 5</td>
<td>0.006</td>
<td>1.517</td>
<td>6.635</td>
<td>0.218</td>
</tr>
</tbody>
</table>

Maximum Eigenvalue test indicates 5 cointegrating eqn(s) at the 0.01 level

* denotes rejection of the hypothesis at the 0.01 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: Own Data Calculations

Table 4: Results of the Direction of a Granger Causality Relationship Test for Variables

<table>
<thead>
<tr>
<th>Direction of a Granger Causality Relationship for Variables</th>
<th>Chi-Sq</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>COP causes TPNR (COP – TPNR)</td>
<td>8.236</td>
<td>0.000***</td>
</tr>
<tr>
<td>COP causes TCNR (COP – TCNR)</td>
<td>5.944</td>
<td>0.001***</td>
</tr>
<tr>
<td>COP causes STONR (COP – STONR)</td>
<td>1.282</td>
<td>0.279</td>
</tr>
<tr>
<td>COP causes PSMR20 (COP – PSMR20)</td>
<td>15.083</td>
<td>0.000***</td>
</tr>
<tr>
<td>COP causes PSR (COP – PSR)</td>
<td>11.445</td>
<td>0.000***</td>
</tr>
</tbody>
</table>

Directions of Total Variables

<table>
<thead>
<tr>
<th>COP – STONR (not significant)</th>
<th>COP – TPNR***</th>
<th>COP – TCNR***</th>
</tr>
</thead>
<tbody>
<tr>
<td>COP – PSMR20***</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Own Data Calculations

Note: COP causes TPNR which means that COP Granger-causes TPNR.

(COP – TPNR) means that the direction of a Granger causality relationship of COP to TPNR.

*** Statistically significant at the 0.01 level, ** at the 0.05 level and * at the 0.10 level.

CONCLUSION

The analysis shows that NR price (PSMR20) model was determined by the total production of natural rubber (NR supply) (TPNR), total consumption of natural rubber and synthetic rubber (total demand) (TCNR), stock of natural rubber (STONR), crude oil price (COP) and synthetic rubber price (PSR). These findings confirm our priori expectation, since crude oil is one of the major raw materials for the production of synthetic rubber and all the three prices that is crude oil, natural and synthetic rubber prices are highly correlated and they move in tandem with each other. This behaviour is not new and the trend has been in existence for a long time. However, the new trends that matters to natural rubber price are: (a) increase in volatility/instability of crude oil price due to uncertainty
in geopolitical factors in the Middle East and (b) expected ascending trend of crude oil price due to rapid increase in its consumption from new emerging economies such as China, India and Brazil as these countries strive for industrialisation. Moreover, Malaysia’s NR production has declined due to competition with palm oil and the shift towards non-agricultural activities. Malaysia has moved to the higher value chain or downstream sector by outsourcing raw materials from neighbouring countries. To maintain its competitiveness in the face of increasing cost of raw materials (NR) and crude oil prices, it is imperative that Malaysia continuously seeks methods that improve efficiency through productivity increase, in other words more focus on R&D and innovations is needed.

REFERENCES