

## CRITICAL FACTORS OF THE NATURAL RUBBER PRICE INSTABILITY IN THE WORLD MARKET

Aye Aye Khin\*, Raymond Ling Leh Bin, Ooi Chee Keong, Foo Win Yie, Ng Jye Liang

Faculty of Accountancy & Management (FAM), Universiti Tunku Abdul Rahman (UTAR), Jalan Sungai Long, Bandar  
Sungai Long, Cheras, 43000 Kajang, Selangor, Malaysia.

\*ayekhin@utar.edu.my

Article History: Received on 02<sup>nd</sup> January, Revised on 30<sup>th</sup> March, Published on 15<sup>th</sup> April 2019

### Abstract

**Purpose:** Natural rubber (NR) production has a long history and has been contributing as one of the most important economic sectors in Malaysia recently. In enhancing the Malaysian rubber economy, it is crucial to find a balance between supply-side and demand-side considerations in order to stabilize the NR price in the worldwide market. This has raised the motivation and objectives of this research is to investigate the critical factors affecting the NR price instability in the world market, and to estimate and predict the NR price instability and to examine the most related factors that influence the price model by using ex-post and ex-ante forecast analysis.

**Methodology:** Number of profound research methods Vector Error Correction Method (VECM) by Gujarati and Porter; cointegration rank test by Dwyer; and ex-post forecast method by Pindyck and Rubinfeld have been utilized in this study. The data used from 2008 January to 2016 December: monthly time series data.

**Results:** The results show that the explanatory variables of NR production, total NR consumption, crude oil price, and Shanghai NR price indicate a significant relationship with Malaysian NR price (SMR20), on the contrary, the exchange rate is not significant.

**Implications:** The outcome of the study is closely related to the current situation of the exchange rate appreciation in the late of 2017 that may benefit the decision-making process of economic planning for the NR production stability, and price in the worldwide NR market as well.

**Keywords:** *Production, Price Instability, Exchange Rate, Crude Oil Price, Natural Rubber*

### INTRODUCTION

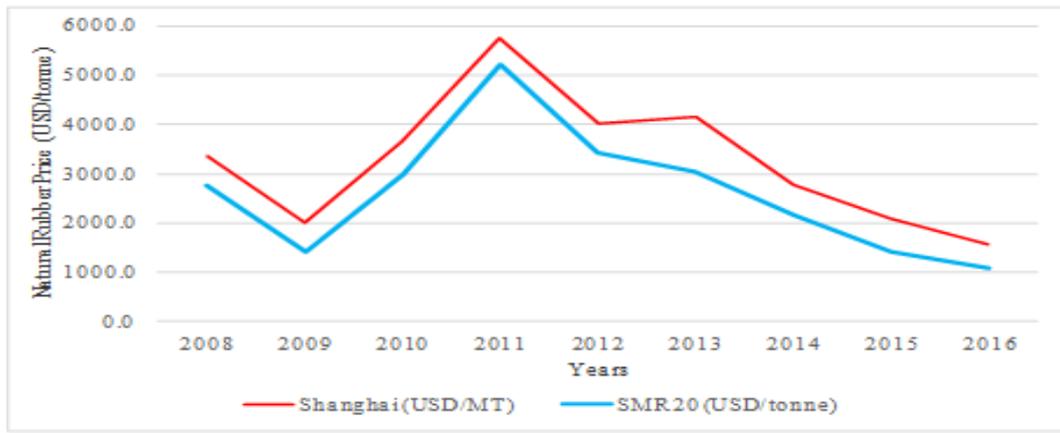
According to (Venkatachalam *et al.*, 2013) *Hevea brasiliensis* has been the plant resource for commercial natural rubber production. The seeds that were brought from Brazil was later introduced and planted in tropical Asia in 1876 across the Kew garden. Natural rubber plantation has been contributing as one of the most important economic sectors in Malaysia recently. As elucidated by Mustafa *et al.* (2016) one of the initiatives as envisioned by the Malaysian government in vision 2020 and its 10th Malaysia Plan (MP) is to improve the competitiveness and productivity level of natural rubber sector.

Figure 1 shows the NR prices' trends for both Shanghai and SMR20 from the year 2008 to 2016. From the figure, Shanghai NR Price has been experienced a sudden slump in 2009 from USD 3,364 to USD 2,007. As for SMR20, NR price had increased drastically from USD 1,419 per tonne in 2009 to USD 5,230 per tonne in 2011. However, the NR prices were started to decrease severely to USD 1,090 per tonne in 2016. Shanghai NR prices were experiencing similar overall trends with SMR20. Both Shanghai and SMR20 NR prices achieved the highest prices at USD 5,757 per metric tonne and USD 5,230 per tonne respectively in 2011.

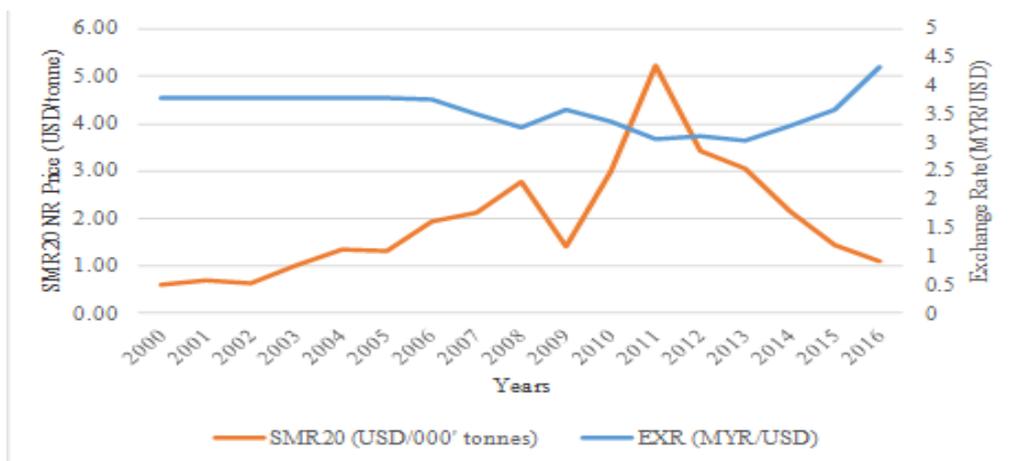
As referring to Figure 2, there is a negative relationship between exchange rate and SMR20 NR price. From 2008 till 2009, the real exchange rate had surged to RM 3.57 per USD from RM 3.27 per USD while the NR price decreased to USD 1,420 per tonne from USD 2,770 per tonne. Inevitably, there is a direct effect originated from the exchange rates movement that would affect the export price in the rubber trading countries.

As shown in Figure 3, the relationship between crude oil price and SMR20 NR price is positively related. SMR20 NR price had shown a downward trend from 2008 to 2009, decreasing from USD 2,725 per tonne to USD 1,419 per tonne. During this period, the crude oil price also declined from USD 87 per barrel to USD 35 per barrel. Surprisingly, the NR

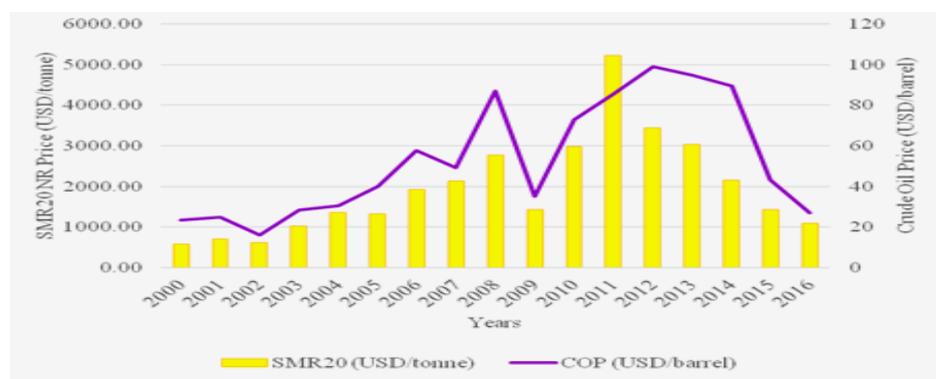
price began to increase sharply to USD 5,230 per tonne in 2011. At the same time, the crude oil price had also increased to USD 85 per barrel. The natural rubber prices in this case generally exhibit the same trend as for crude oil prices.



**Figure 1: Shanghai and SMR20 NR Prices Trends from 2008 to 2016**  
 Source: International Rubber Study Group (2017)



**Figure 2: Exchange Rate and SMR20 NR Price Trends from 2000 to 2016**  
 Source: International Rubber Study Group (2017)

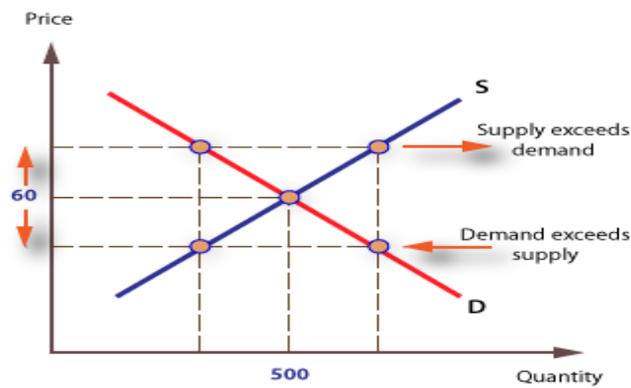


**Figure 3: Crude Oil Price and SMR20 NR Price Trends from 2000 to 2016**  
 Source: International Rubber Study Group (2017)

This paper will investigate the factors affecting natural rubber (NR) price instability in the world market. The relationship among the total production, total consumption, and exchange rate, the price of crude oil and Shanghai NR price towards the NR price volatility in the world market will be examined. These factors are significantly predicted to affect the natural rubber price. As evidenced by [Burger et al. \(2002\)](#) the immediate impact of a fall in the currency of a country is to enhance the profitability of exports and to discourage imports. World market prices respond to exchange rate changes on the supply side as well as on the importing consideration. When one currency depreciates, the prices will decrease as well. The international oil price is an important determinant in driving the NR price. When crude oil price increases, the price of synthetic rubber (SR) will increase and the demand for natural rubber will eventually increase and become more expensive. The novelty and comprehensiveness of this research focus on the factors affecting NR price instability that include production, consumption, exchange rate, crude oil price, and Shanghai NR price.

## LITERATURE REVIEW

Theoretically, the market price was determined by the interaction between market supply and demand, as illustrated in Figure 4. The supply curve shows the quantity of a good that producers are willing to sell at a given price. The demand curve, on the other hand, shows how many units of good consumers are willing to buy as the price per unit charges ([Pindyck and Rubinfeld, 2005](#)). Figure 4 also explains that the vertical axis shows the price of a good, 60 is the current price in which the seller wants to receive for a given quantity supplied and the price that buyers will pay for a given quantity demanded. The horizontal axis shows the total quantity demanded and supplied, which is 500.



**Figure 4: Market Equilibrium**  
 Source: [Pindyck and Rubinfeld \(2005\)](#)

[Khin et al. \(2016\)](#) had conducted a study on the impact of exchange rate volatility on Malaysian natural rubber price. The objectives of the study were to identify the impact of exchange rate volatility on both natural rubber (NR) prices of Standard Malaysia Rubber Grade 20 (SMR20 and Ribbed Smoke Sheet Rubber Grade 4 (RSS4), and forecast a short-term exchange rate price (ERP) in Malaysian Ringgit (RM per USD). Both NR prices served as a strong representative of the Malaysian NR market. With the utilization of the VECM model and Granger causal relationship, the result showed that the RSS4 price Granger-cause changed the SMR20 and ERP with unidirectional causality relationship. Therefore, their study had evidenced the impact of exchange rate volatility on Malaysian natural rubber price.

[Melba and Shivakumar \(2016\)](#) on the other hand investigated more about the cause for price formation and supply response of natural rubber. Regression analysis was conducted with spot price as the dependent variable and future price, international rubber price, synthetic rubber price, exchange rate and crude oil price served as independent variables. Their result indicated that the synthetic rubber price, futures price, and international price were statistically significant with the price of natural rubber, whereas the exchange rate and crude oil price were not significant. In line with the previous study, [Melba and Shivakumar \(2016\)](#) had evidenced the factors that influencing the price of natural rubber.

Research on NR production had been conducted by [Nyantakyi et al. \(2015\)](#) and similarly, [Kannan \(2013\)](#) had studied the determinants of production and export of natural rubber in India. The authors investigated the production of natural rubber (NR) of some Asian countries and world prices by modeling at various quantiles. Conditional quantile regression analysis was used in their study. Their results were comprehensively showed that increased production by most of these countries namely China, India, Indonesia, Malaysia, Sri Lanka, and Thailand have the negative effect on the world prices at various quantiles which lead to the reduction in world rubber price. Quantile regression, in this case, had given a more comprehensive picture of the effects of NR production of Asian countries on the world NR prices.

## METHODOLOGY

The conceptual equation is written by log function (ln) as below:

$$\text{LNSMR20}_t = \beta_0 + \beta_1 \text{LNTPNR}_t + \beta_2 \text{LNTCNR}_t + \beta_3 \text{LNEXR}_t + \beta_4 \text{LNCOP}_t + \beta_5 \text{LNSH}_t + \varepsilon_t$$

LNSMR20= The SMR20 NR price (SMR20) (USD/ton)

LNTPNR = The total world production of natural rubber (000' tonnes)

LNTCNR = The total world consumption of natural rubber (000' tonnes)

LNEXR = Real exchange rate (MYR/USD)

LNCOP = Crude oil price (USD/barrel)

LNSH = The Shanghai NR price (USD/ton)

T = Time trend (2008 Jan: to 2016 Dec: monthly time series data)

$\varepsilon$  = Error term

### Hypothesis Development

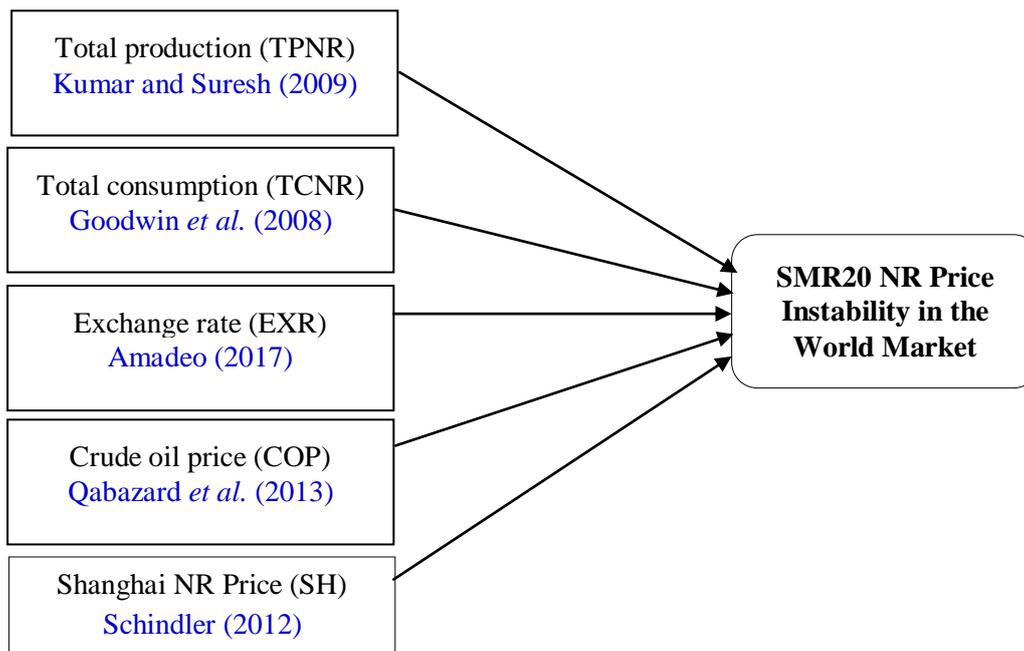
H<sub>A1</sub>: There is a positive relationship between total world production and SMR20 NR Price.

H<sub>A2</sub>: There is a negative relationship between total world consumption and SMR20 NR Price.

H<sub>A3</sub>: There is a negative relationship between exchange rate and SMR20 NR Price.

H<sub>A4</sub>: There is a positive relationship between crude oil price and SMR20 NR Price.

H<sub>A5</sub>: There is a positive relationship between Shanghai NR Price and SMR20 NR Price.



**Figure 5: Conceptual Framework of the Factors Affecting the Natural Rubber (NR) Price Instability in the World Market**

Source: Developed for the research

### Unit root test

According to Gujarati and Porter (2009), the level data (Original data) is symbolized as I (0) – level data form, and such time series data is non-stationary. First difference form, I (I), it is symbolized as  $\Delta$ , while second difference form, I (II), it is also symbolized as  $\Delta^2$ . Unit root test determines the data stationary. The ADF test hypotheses are: H<sub>0</sub> - The time series data possess a unit root (non-stationary) and; H<sub>A</sub> - The time series data do not possess a unit root (stationary). According to Table 1: ADF unit root test, all variables including SMR20, TPNR, TCNR, EXR, COP, and SH are significant at 0.01 level at first difference form I (I) because all p- values are smaller than  $\alpha$  0.05 level based on the ADF unit root test result. Hence, the decision is to accept H<sub>A</sub> while rejecting H<sub>0</sub>.

**Table 1: ADF unit root test for NR price model**

| Variables | Level       |         | 1 <sup>st</sup> different |         | 2 <sup>nd</sup> different |         |
|-----------|-------------|---------|---------------------------|---------|---------------------------|---------|
|           | t-statistic | p-value | t-statistic               | p-value | t-statistic               | p-value |
| LNSMR20   | -1.6748     | 0.4432  | -13.3730***               | 0.00    | -20.2925***               | 0.00    |
| LNTPNR    | -1.2424     | 0.6568  | -19.5881***               | 0.00    | -19.8362***               | 0.00    |
| LNTCNR    | -1.1156     | 0.7105  | -19.6181***               | 0.00    | -27.3591***               | 0.00    |
| LNEXR     | -1.8140     | 0.3734  | -17.0767***               | 0.00    | -22.5867***               | 0.00    |
| LNCOP     | -1.8580     | 0.3521  | -10.3408***               | 0.00    | -16.0180***               | 0.00    |
| LNSH      | -1.7142     | 0.4212  | -7.8315***                | 0.00    | -10.8652***               | 0.00    |

Source: Developed for the research

### Vector Error Correction Method (VECM) & Cointegration Equation

According to [Studenmund \(2014\)](#), the vector autoregressive (VAR) model is a general framework used to describe the dynamic interrelationship among stationary variables. If the time series data are not stationary then the VAR framework needs to be modified to allow consistent estimation of the relationships among the series. According to [Engle and Granger \(1991\)](#), a linear combination of two or more non-stationary data series might be stationary (see it in above Unit Root test). If such a stationary linear existed, the non-stationary time series is said to be co-integrated. The Vector Error Correction method (VECM) model is just a special case of the VAR for variables that are stationary in their differences, and the variables are co-integrated ([Gilbert, 1986](#); [Hendry and Ericsson, 2001](#)). Moreover, the VECM model does include a co-integration equation and also VECM equations. The VECM equations model of SMR20 NR price is as follow:

$$\Delta SMR20_t = \beta_1 + \beta_2 \Delta TPNR_{t-1} + \beta_3 \Delta TCNR_{t-1} + \beta_4 \Delta EXR_{t-1} + \beta_5 \Delta COP_{t-1} + \beta_6 \Delta SH_{t-1} + \varepsilon_t$$

As elucidated by [Gujarati and Porter \(2009\)](#) if there is a stable long-run relationship between the two variables, the time series is said to be co-integrated. The VECM model has co-integration equation includes in such a way so that it restricts the long-term behavior of the endogenous variables to converge to their co-integrating relationship while allowing for short-term adjustment dynamics. The co-integration 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. The co-integration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments ([Engle and Granger, 1991](#)). The co-integration equation of SMR20 NR price is as follow:

$$\beta_1 \Delta SMR20_{t-1} + \beta_2 \Delta TPNR_{t-1} + \beta_3 \Delta TCNR_{t-1} + \beta_4 \Delta EXR_{t-1} + \beta_5 \Delta COP_{t-1} + \beta_6 \Delta SH_{t-1} = 0$$

### RESULT AND DISCUSSION

#### Vector Error Correction Model (VECM) Equations of NR Price Model

According to [Studenmund \(2014\)](#), the VECM model does include a co-integration equation and VECM equations. The VECM equations model of SMR20 NR price is as follow:

$$\begin{aligned} \Delta SMR20_t = & -5.8746 + 0.4716 \Delta TPNR_{t-1} - 0.6638 \Delta TCNR_{t-1} + 0.2251 \Delta COP_{t-1} \\ & \quad [1.4705*] \quad \quad \quad [-1.9244*] \quad \quad \quad [1.8701*] \\ & - 0.9363 \Delta EXR_{t-1} + 0.3756 \Delta SH_{t-1} + 0.1135 \Delta SMR_{t-1} - 1.5789 \varepsilon_t \\ & \quad [-0.2835] \quad \quad [2.5022**] \quad \quad [0.6789] \quad \quad (1) \end{aligned}$$

R squared=0.2419

Adjusted R squared= 0.1877

Based on the VECM model of SMR20 results, the model can be explained by 24.19% in the SMR20 equation. The result shows that the TPNR, TCNR, COP, and SH were the significant variables of the model at  $\alpha$  0.10 and 0.05 levels, respectively.

$$\begin{aligned} \Delta \text{TPNR}_t = & 2.5081 + 0.0185 \Delta \text{SMR20}_{t-1} - 0.2250 \Delta \text{TCNR}_{t-1} + 0.1053 \Delta \text{COP}_{t-1} \\ & [0.40861] \quad [-2.4129^*] \quad [1.05851] \\ & + 0.0121 \Delta \text{EXR}_{t-1} - 0.0324 \Delta \text{SH}_{t-1} + 0.2933 \Delta \text{TPNR}_{t-1} - 1.8321 \varepsilon_t \\ & [0.8352] \quad [-0.79760] \quad [-0.6789] \end{aligned} \quad (2)$$

R squared=0.3026

Adjusted R squared= 0.2527

Next, based on the VECM model of TPNR results, the model can be explained by 30.26% in the TPNR equation. The result shows that the TCNR was the significant variable of the model at  $\alpha$  0.10 level.

$$\begin{aligned} \Delta \text{TCNR}_t = & 5.0170 - 0.0023 \Delta \text{SMR20}_{t-1} - 0.0299 \Delta \text{TPNR}_{t-1} + 0.4202 \Delta \text{COP}_{t-1} \\ & [-0.0453] \quad [-0.3125] \quad [2.9643^*] \\ & - 0.9212 \Delta \text{EXR}_{t-1} - 0.0172 \Delta \text{SH}_{t-1} - 0.4329 \Delta \text{TCNR}_{t-1} - 1.4441 \varepsilon_t \\ & [-0.4588] \quad [-0.3827] \quad [-4.20262^{**}] \end{aligned} \quad (3)$$

R squared=0.2679

Adjusted R squared= 0.2156

On the other hand, based on the VECM model of TCNR results, the model can be explained by 26.79 % in the TCNR equation. The result shows that COP and lagged TCNR were the significant variables of the model at  $\alpha$  0.10 and 0.05 levels, respectively.

$$\begin{aligned} \Delta \text{EXR}_t = & 0.0083 + 0.0011 \Delta \text{SMR20}_{t-1} + 0.0032 \Delta \text{TPNR}_{t-1} - 0.0035 \Delta \text{TCNR}_{t-1} \\ & [0.6351] \quad [3.1887^{**}] \quad [-3.1520^{**}] \\ & - 0.0017 \Delta \text{COP}_{t-1} - 0.0023 \Delta \text{SH}_{t-1} + 0.2903 \Delta \text{EXR}_{t-1} - 0.0062 \varepsilon_t \\ & [-1.5811^*] \quad [-0.4762] \quad [3.1087^{**}] \end{aligned} \quad (4)$$

R squared=0.2859

Adjusted R squared= 0.2349

In addition, based on the VECM model of EXR results, the model can be explained by 28.59% of the EXR equation. The result shows that TPNR, TCNR, COP and lagged EXR were the significant variables of the model at  $\alpha$  0.10 and 0.05 levels, respectively.

$$\begin{aligned} \Delta \text{COP}_t = & -0.1388 + 0.0032 \Delta \text{SMR20}_{t-1} - 0.0126 \Delta \text{TPNR}_{t-1} + 0.0102 \Delta \text{TCNR}_{t-1} \\ & [0.7841] \quad [-1.58153^*] \quad [1.1903^*] \\ & - 0.1604 \Delta \text{EXR}_{t-1} - 0.0032 \Delta \text{SH}_{t-1} + 0.5883 \Delta \text{COP}_{t-1} - 0.5364 \varepsilon_t \\ & [-0.0197] \quad [-0.8762] \quad [6.1258^{***}] \end{aligned} \quad (5)$$

R squared=0.3685

Adjusted R squared= 0.3234

Furthermore, based on the VECM model of COP results, the model can be explained by 36.85% of in the COP equation. The result shows that TPNR, TCNR, and lagged COP were the significant variables of the model at  $\alpha$  0.10 and 0.01 levels, respectively.

$$\begin{aligned} \Delta \text{SH}_t = & -4.5337 - 0.0025 \Delta \text{SMR20}_{t-1} + 0.7314 \Delta \text{TPNR}_{t-1} + 0.7939 \Delta \text{TCNR}_{t-1} \\ & [-0.0126] \quad [1.9416^*] \quad [1.96003^*] \\ & + 0.7750 \Delta \text{COP}_{t-1} - 0.2947 \Delta \text{EXR}_{t-1} + 0.2046 \Delta \text{SH}_{t-1} - 1.3405 \varepsilon_t \\ & [1.4932^*] \quad [-0.1982] \quad [1.16063] \end{aligned} \quad (6)$$

R squared=0.1708

Adjusted R squared= 0.1115

Moreover, based on the VECM model of SH results, the model can be explained by 17.08% of the SH equation. The result shows that TPNR, TCNR, and COP were the significant variables of the model at  $\alpha$  0.01 level.

### Co-integration Equation

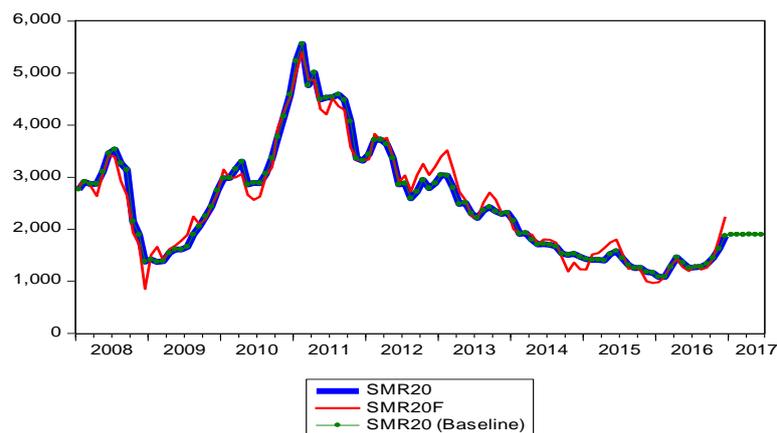
As elucidated by [Gujarati and Porter \(2009\)](#) if there is a stable long-run relationship between the two variables, the time series is said to be co-integrated. The co-integration equation of SMR20 NR price is as follow:

$$\begin{aligned}
 &0.0372 \Delta\text{SMR20}_{t-1} - 0.0742\Delta\text{TPNR}_{t-1} + 0.0149\Delta\text{TCNR}_{t-1} - 0.0029\Delta\text{COP}_{t-1} \\
 &\quad [0.7592] \quad [-5.5912***] \quad [1.0168] \quad [2.3462*] \\
 &+ 0.0011 \Delta\text{EXR}_{t-1} - 0.0743\Delta\text{SH}_{t-1} = 0 \\
 &\quad [-2.8285**] \quad [1.2877]
 \end{aligned} \tag{7}$$

The variables of TPNR, COP, and EXR are cointegrated between the variables. In addition, a long-term relationship exhibit among TPNR, COP and EXR variables are statistically significant at  $\alpha$  0.01, 0.10 and 0.05 levels, respectively.

### Ex-post and Ex-ante Forecast of NR price from 2016 to 2017

The forecasting techniques conducted based on model simulation, generally over the time horizon in which the simulation is performed and depending on the objective of the simulation. As stated by [Pindyck and Rubinfeld \(2005\)](#) the estimation period in order to produce the data from 2008 January to 2015 December is called historical simulation or ex-post simulation.



**Figure 6: Ex-post and Ex-ante forecast of the NR Price in the World Market**

Source: Developed for the research

The ex-post forecast is also simulated forward throughout the estimation period (from 2016 January to 2016 December). The ex-ante forecast is simulated forward throughout the time beyond the estimation period (from 2017 January to 2017 March). Figure 6 and Table 2 shows that the ex-post forecast values (estimated values, red color line) and ex-ante forecast values (SMR20 Baseline, green color line), which is consistent with actual values trend (blue color line). From July to December 2016, it shows that the NR price presents a decreasing trend, and from January to February 2017, it shows an increasing trend. However, March 2017 shows that the price decreases again. This forecasting study resembles the same trend as the actual price trend in the Malaysian Rubber Board ([Malaysia Rubber Board, 2017](#)).

**Table 2: Ex-post and Ex-ante forecast of NR Price from 2016 July to 2017 March**

| Observations | Actual Values | Ex-post Forecast | Ex-ante Forecast |
|--------------|---------------|------------------|------------------|
| 2016.07      | 1269.0489     | 1269.0500        | 1269.0500        |
| 2016.08      | 1279.1517     | 1299.3966        | 1279.1517        |
| 2016.09      | 1332.9054     | 1293.3346        | 1332.9054        |

|         |           |           |           |
|---------|-----------|-----------|-----------|
| 2016.10 | 1448.5452 | 1416.3096 | 1448.5452 |
| 2016.11 | 1624.1387 | 1554.3354 | 1624.1387 |
| 2016.12 | 1869.3119 | 1777.3402 | 1869.3119 |
| 2017.01 |           |           | 2059.2393 |
| 2017.02 |           |           | 2121.9278 |
| 2017.03 |           |           | 2085.2519 |

Source: Developed for the research

### Hypothesis Testing

**Table 3: Hypothesis Testing**

| Hypothesis      | Description   | Support/ Reject |
|-----------------|---|-----------------|
| H1 <sub>A</sub> | There is a positive relationship between total production and SMR20 NR Price.   | Supported       |
| H2 <sub>A</sub> | There is a negative relationship between total consumption and SMR20 NR Price.  | Supported       |
| H3 <sub>A</sub> | There is a negative relationship between exchange rate and SMR20 NR Price.      | Rejected        |
| H4 <sub>A</sub> | There is a positive relationship between crude oil price and SMR20 NR Price.    | Supported       |
| H5 <sub>A</sub> | There is a positive relationship between the Shanghai price and SMR20 NR Price. | Supported       |

Source: Developed for the research

According to Table 3 hypothesis testing, it is based on the NR price (SMR20) equation. The result showed that SMR20 is positively related to TPNR and negatively related to TCNR with statistically significant at  $\alpha$  0.10 level. In line with [Khin et al. \(2017\)](#) who researched on “Short-term and long-term price forecasting models for the future exchange of Malaysian natural rubber market”, their VECM results, showed that the NR price is positively affecting TPNR production significantly at the 0.05 acceptance level. Moreover, TCNR is also negatively and statistically significant at the 0.05 acceptance level. The findings from [Khin et al. \(2017\)](#) are consistent with the result showed in Table 4. H1<sub>A</sub> and H2<sub>A</sub> are supported, and hence there is a relationship between total production, total consumption, and SMR20 NR price. Moreover, this outcome is in line with [Khin et al. \(2016\)](#) who researched on “Impact of Exchange Rate Volatility on Malaysian Natural Rubber Price” also mentioned to H3<sub>A</sub>. According to [Khin et al. \(2016\)](#), the price of natural rubber RSS4 in India had Granger cause changed the exchange rate and however, SMR20 NR price did not Granger cause changed the exchange rate. India is also one of the major natural rubber producing countries in this case. Therefore, H3<sub>A</sub> is rejected, and there is not a significant relationship between exchange rate and SMR20 NR Price.

Based on the Table 4 hypothesis testing, SMR20 has a positive relationship to COP that is statistically significant at  $\alpha$  0.10 level. This result is consistent with the results evidenced by another study “Determinants of the volatility of natural rubber price”, conducted by [Sadali \(2013\)](#). According to [Sadali \(2013\)](#) crude oil (Petroleum) has given a positive impact towards volatility of the natural rubber price and the relationship does exist at all times. With the fact that when COP increases, the cost of producing synthetic rubber increases simultaneously. Simply put, the demand for natural rubber will boost, and cause the SMR 20 price to rise simply because natural rubber is a substitute product of synthetic rubber. Hence, H4<sub>A</sub> is also supported. Lastly, based on Table 4 hypothesis testing, hypothesis H5<sub>A</sub>, SH is expected to have a positive impact on SMR20 that is statistically significant at  $\alpha$  0.05 level. SMR20 is said to be influenced by SH as Shang Hai NR price appears to be a large natural rubber price market which creates an extensive amount of demand. According to [Jacob \(2017\)](#), major future exchanges in the natural rubber market include Bangkok, Singapore, Tokyo and also

Shanghai future exchange. Shanghai natural rubber price will be one of the important factors influencing the SMR 20 NR price too. In fact, there are very few researches that actually investigate such relationship between Shanghai rubber price and the SMR20 NR price.

## CONCLUSION

Based on the VECM model of SMR20 results, TPNR, TCNR, COP, and SH served as the significant variables of the model at  $\alpha$  0.10 and 0.05 levels, respectively. There was 4 hypothesis accepted on TPNR, TCNR, COP, and SHANGHAI. There is no relationship between the EXR and SMR20. For theoretical contribution, NR price increases were driven by several factors that include the recovery in the crude oil market, supply concerns and renewed expectation of a US-led global economic recovery (Association of Natural Rubber Producing Countries, 2017). According to the Malaysian Rubber Board (2017) the prolonged rainy season in Malaysia and the floods in the world's largest NR producer, Thailand, would cause NR shortage. When there is NR shortage, the NR prices will eventually increase as the supply of NR is unable to satisfy the demand of the market. The outcomes of this study will benefit future researchers in finding a balance between supply-side and demand-side considerations in order to stabilize the NR price in the world market. For the practical implication of the study, the currency exchange rate generally affects in the NR producing countries because most commodities especially NR products are traded in US dollar (US\$). It encourages an increase in exports and concomitant output from these producing countries and hence a rise in world natural rubber supply. However, the exchange rate of a nation's currency is regarded as the value of one country's currency in terms of another currency. Therefore, the exchange rate has two components, namely; the domestic currency (Malaysia Ringgit, RM) and foreign currency (US\$), and can be quoted either directly or indirectly. In an indirect quotation, the price of a unit of domestic currency is expressed in terms of the foreign currency whereas, in a direct quotation, the converse holds. Therefore, the exchange rate is not only determined by the NR price but also the foreign exchange market, which is opened to a wide range of different types of buyers and sellers where currency trading is continuous (Goldberg and Charles, 2005).

For future research, Autoregressive Integrated Moving Average method which is also known as the univariate model can be applied instead of the multivariate model. Besides, the univariate analysis does not deal with causes or the relationship between a variable with another variable. It is a concern about data collection, summarizing the findings and patterns, and data forecasting.

## ACKNOWLEDGMENT

The authors are remarkably thankful to the Universiti Tunku Abdul Rahman (UTAR)'s Internal Research Fund (UTARRF) that has provided funding for this research.

## REFERENCES

- Amadeo, K., 2017. What are exchange rates? The balance. Available from <https://www.thebalance.com/what-are-exchange-rates-3306083> [Accessed August 14, 2017].
- Association of Natural Rubber Producing Countries, 2017. Natural rubber trends and statistics by association of natural rubber producing countries. Available from <http://www.anrpc.org/html/default.aspx?ID=4&PID=5> [Accessed November 07, 2017].
- Burger, K., H. Smit and B. Vogelvang, 2002. Exchange rates and natural rubber prices, the effect of the Asian crisis. Zaragoza (Spain), 28: 31.
- Engle, R.F. and C.W.J. Granger, 1991. Long-run economic relationships: Readings in cointegration. Oxford: Oxford University Press.
- Gilbert, C.L., 1986. Professor Hendry's econometric methodology. Oxford Bull Economic Statistic, 48: 283-307.
- Goldberg, L. and K. Charles, 2005. Foreign direct investment, exchange rate variability and demand uncertainty. International Economic Review, 36(4): 855-873.
- Goodwin, N., J.A. Nelson, F. Ackerman and T. Weisskopf, 2008. Consumption and the consumer society. Global Development and Environment Institute. pp: 1-26.
- Gujarati, D.N. and D.C. Porter, 2009. Basic econometrics. 5th Edn., USA: McGraw-Hill.
- Hendry, F.D. and N.R. Ericsson, 2001. Understanding economic forecasts. Cambridge, Massachusetts: MIT Press.
- Jacob, J., 2017. Global rubber market: What's in store for 2017? Retrieved from Rubber Asia. Available from <https://www.rubberasia.com/2017/01/23/global-rubber-market-whats-store-2017/>.
- Kannan, M., 2013. The determinants of production and export of natural rubber in India. IOSR Journal of Economics and Finance, 1(5): 41-45.



- Khin, A.A., S. Thambiah and K.L.L. Teng, 2017. Short-term and long-term price forecasting models for the future exchange of Malaysian natural rubber market. *International Journal of Agricultural Resources, Governance and Ecology*, 13(1): 21-42.
- Khin, A.A., H.C. Wong and L.Y. Ung, 2016. Impact of exchange rate volatility on Malaysian natural rubber price. Paper Presented at the 3rd International Conference of Accounting Studies (ICAS 2016), Malaysia.
- Kumar, S.A. and N. Suresh, 2009. *Operations management*. New Age International.
- Malaysia Rubber Board, 2017. Natural rubber report. Malaysian Rubber Board, Malaysia. Available from <http://www3.lgm.gov.my/mre/YearlyAvg.aspx>.
- Malaysian Rubber Board, 2017. Towards sustaining the viability of the Malaysian rubber industry. (n.d.). Available from <http://www.lgm.gov.my/> [Accessed November 04, 2017].
- Melba, Y. and K.M. Shivakumar, 2016. Price formation and supply response of natural rubber. *Economic Affairs*, 61(1): 173.
- Mustafa, G., I. Latif and H. Egwuma, 2016. An empirical analysis of supply response of rubber in Malaysia. *American Journal of Agricultural and Biological Sciences*, 12: 148-156.
- Nyantakyi, K.A., B.L. Peiris and L.H.P. Gunaratne, 2015. Quantile regression analysis of the effect of production of natural rubber by Asian countries on world rubber price, 4(5): 492-504.
- Pindyck, R.S. and D.L. Rubinfeld, 2005. *Microeconomics*. 6th Edn., New Jersey: Auflage.
- Qabazard, H.M., M. Fantini and M. Haderer, 2013. *I need to know: An introduction to the oil industry & OPEC*. 2nd Edn., Vienna: OPEC Secretariat, Public Relations & Information Department.
- Sadali, N.H., 2013. Determinant of volatility natural rubber price. Available from <http://dx.doi.org/10.2139/ssrn.2276767>.
- Schindler, R.M., 2012. *Pricing strategies: A marketing approach*. Thousand Oaks, California: Sage.
- Studenmund, A.H., 2014. *Using econometrics: A practical guide*. 6th Edn.: Pearson, Prentice Hall.
- Venkatachalam, P., N. Geetha, P. Sangeetha and A. Thulaseedharan, 2013. Natural rubber producing plants: An overview. *African Journal of Biotechnology*, 12(12).