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NATURAL RUBBER PRICES FORECASTING USING SIMULTANEOUS SUPPLY-DEMAND AND PRICE SYSTEM EQUATION AND VECM MODEL: BETWEEN THEORY AND REALITY

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Abstract

Malaysia is the third largest producer of natural rubber (NR) in the world. NR price fluctuations become the world debt crisis and global economic slowdown with rubber price-related factors. Meanwhile, most of buyers in China were unwilling to commit themselves due to falling prices and uncertainties of market. In these situations, NR price forecasts are necessary to help in decision-making. The objectives of the study were conducted to investigate the inter-relationships between production, consumption and prices in the Malaysian NR market, to explore a simultaneous supply-demand and price system equation model compared with Vector Error Correction Method (VECM) model between theory and reality of the current market situation, to forecast a short term (ex-post forecast) and long term NR future price (ex-ante forecast) and to make recommendation this study is more efficient and wider applicability in the future. The price forecasting models will be utilized using quarterly data from 1990 Q1 to 2013 Q with providing a total of 96 observations and will be carried out for the period of 2013 Q1 to 2013 Q4 on the short-term and until to 2020 Q1 to 2020 Q4 on the long-term investment decisions. As such, an accurate estimation method of NR price forecasting is vital, to help in the decision-making process of economic planning for the NR sustainable production and the world market economy as well. .

Keywords: Natural Rubber, Forecasting, Supply-Demand and Price, VECM, Malaysia

Introduction

Rubber (Hevea brasiliensis) can only be grown in areas of Amazon rain forests, which effectively restricts production to regions 15 to 20 degrees latitude north or south of the equator. It takes 5 to 8 years for a rubber tree to mature to the girth at which it can be tapped and its economic life will then be 20 to 30 years. At the end of its life rubberwood provides a valuable end product as a medium density tropical hardwood. Actually, rubber is a polymer with the property of elasticity which, is known as a 'thermoset elastomer'. There are two main types of rubber, natural and synthetic. The natural rubber (NR) is made from the latex derived 'naturally' from the rubber tree, while the synthetic rubber (SR) is synthesized from chemicals sourced from petroleum refining (IRSG, 2014). Almost 60% of global consumption is by the world's tyre manufacturing industry, with the remainder going into the 'general rubber different goods and products' are manufactured by this sector, serving many industries, including transport, construction, health, mining etc.

Malaysia is the third largest producer of NR in the world and the NR price depends on the world debt

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crisis, global economic slowdown and rubber-related factors. In the last decade, the world NR industry has undergone very rapid and fundamental changes with the appearance of many new players, in particular the growth of some traditional suppliers and the emergence of new ones. Much of the changes and consequent challenges, both internally and externally, have impacted on Malaysia's comparative and competitive advantage in NR production. Moreover, the Malaysian rubber industry has produced positive net trade flows and consistent earnings for the government. Malaysian rubber planted area from the estate sector accounted for only 7 percent (77 thousand hectares) while planted area from the smallholder sector accounted for 93 percent (980 thousand hectares) of total rubber planted area (1057 thousand hectares) in 2013 and other NR producing countries total planted area in Figure 1 (MRB, 2014).

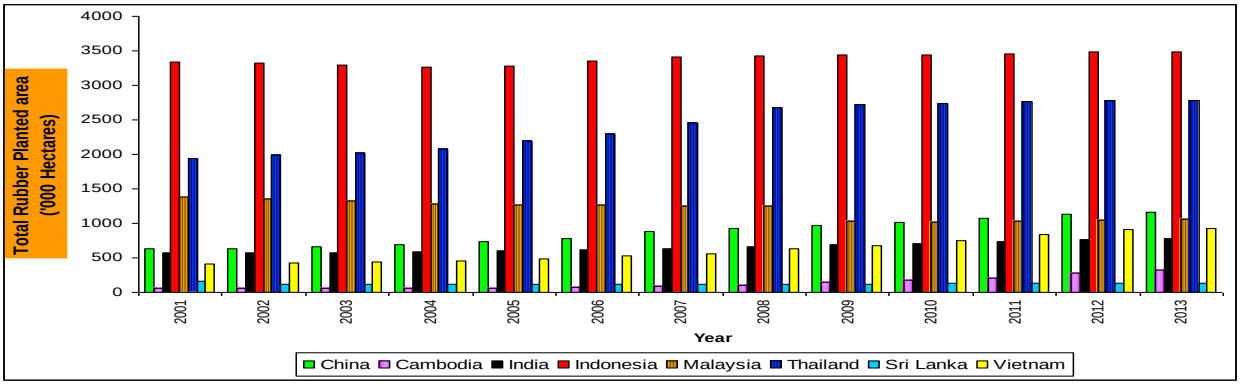


Figure 1. NR producing countries total planted area from 2001-2013 (MRB, 2014).

Domestic total NR production (dry and latex) recorded a decrease from 2010 (939 thousand tonnes) to 2013 (826 thousand tonnes; i.e. 6.8 percent of world NR production). Domestic total NR consumption (dry and latex) decreased from 2010 (458 thousand tonnes) by 79 percent to 2013 (434 thousand tonnes; i.e. 3.8 percent of world NR consumption). Global rubber production (both NR and Synthetic Rubber (SR)) was 28.5 million tonnes and global rubber consumption (both NR and Synthetic Rubber (SR)) was 28.6 million tonnes in 2014 (Figure 2). The latest available data from IRSG (2014) indicated that with a relatively strong recovery in the world economy, world rubber consumption (both NR and Synthetic Rubber SR) is forecasted to reach 30.4 million tonnes by 2019, with world NR production of 34.0 million tonnes. NR Standard Malaysia Rubber Grade 20 (SMR20) price in Kuala Lumpur market was declined considerable to USD 2300 per ton in 2013 December and also remained low again at USD 1400 per ton in 2014 December. However, the price was high at USD 1600 per ton in 2015 June (MRB, 2015).

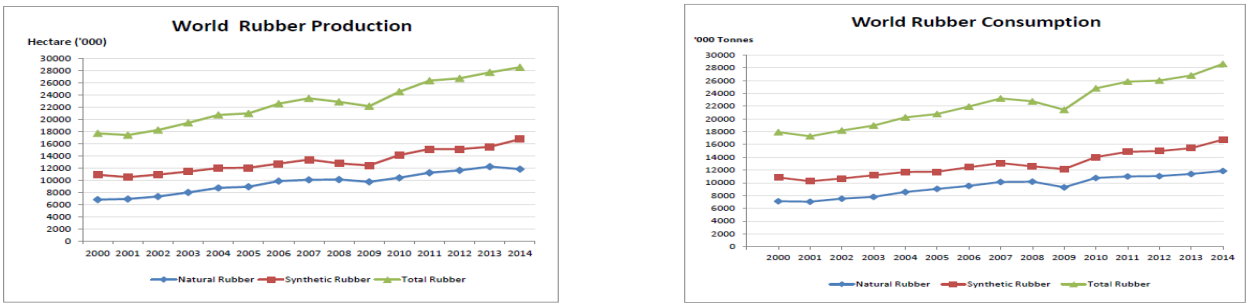


Figure 2. World rubber production and consumption from 2000-2014 (IRSG, 2014).

Moreover, Thailand, Indonesia, Vietnam, Malaysia, Myanmar and Cambodia accounted for 76 % of the world's production of NR in 2013. Malaysia is also the world's third NR producer of latex gloves, catheters and latex thread after Thailand and Indonesia in 2012 and now the seventh largest consumer of NR in the world after China, India, the USA and Japan in 2014. Since then South East Asia namely Thailand, Indonesia and Malaysia have become the world's largest producer of NR and Thailand has become the world's largest producer at 4.2 million tonnes (35 percent of World's NR production), followed by Indonesia at 3.1 million tonnes (26 percent) and Malaysia at 0.8 million tonnes (7 percent) in 2013 (MRB, 2014).

In 2014, the Malaysia exported about 45.9 percent, 13.9 percent and 5.6 percent to China, Germany and Iran of total NR exports volume 721 thousand tonnes, respectively. In comparison, the Malaysia imported about 48.7 percent, 25.4 percent and 6.5 percent from Thailand, Vietnam and Philippines of total NR imports volume 905 thousand tonnes, respectively. Rubber industry's contribution to national exports earnings was 30.94 billion in Figure 3. However, trade balance of export and import was increased to 10.3 RM Million in 2014 from 9.9 RM Million in 2013 (MRB, 2014).

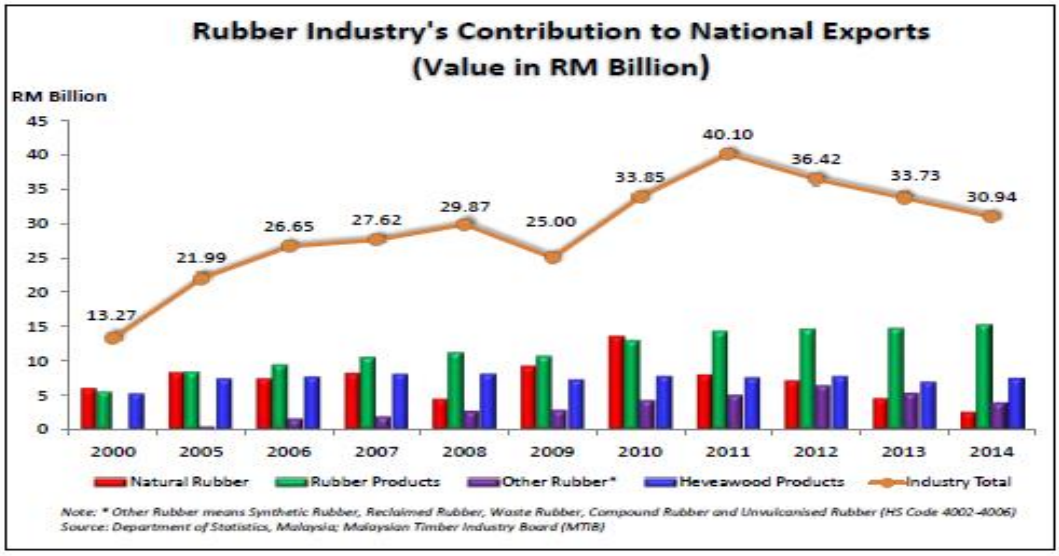


Figure 3. Rubber industry's contribution to national exports earnings in Malaysia (MRB, 2014).

In fact, if the producers' and buyers' expect price to continue to increase or decrease, they might be attracted to produce or buy when NR price is high or low. The response of producers and consumers in the NR market depends on their expectation of future movements in the prices. If their anticipation are incorrect and future prices fluctuate, then such behavior can lead to substantial losses. In these situations of considerable uncertainty and high risk, NR price forecasts are necessary to help in decision-making (Burger and Smit, 2000). Generally, NR prices were strong fundamentally influenced by external factors of ongoing Euro Zone debt crisis, global economic slowdown and rubber-related factors, including crude petroleum oil prices, exchange rates, time-lag, stock, demand and supply situation and slowing growth in agricultural productivity, as well as government policies (MRB, 2014). Accordingly, on December 2011, prices started to drift down due to persistent rains and flood in Thailand and uncertainties over the effectiveness of the steps taken by European leaders to settle the region's debt crisis, coupled with global economic slowdown. Meanwhile, most of buyers in China were unwilling to commit themselves due to falling prices and uncertainties of market. Despite the steady crude oil prices, market players (producers and buyers) remained cautious about prospects for economic growth in both Europe and China.

Moreover, ASEAN Rubber Business Council (ARBC) reported that rubber producers were rejected requests to renegotiate contracts with buyers and a number of buyers had cancelled contracts due to remain low again prices of NR in 2011. Therefore, International Rubber Consortium (IRC) would help to producers' trade with more transparent and reliable prices to take "specific measures", to forecast and support future prices after a meeting of representatives from the three governments (Thailand, Indonesia and Malaysia) (ARBC, 2011). Malaysian Rubber Board (MRB) expects that some RM 275 million will be invested under the rubber National Key Economic Area (NKEA), mainly involving replanting and new planting of rubber trees nationwide, i.e. active replanting activities would cover about 38,000 hectares per year focusing mainly on Peninsular Malaysia while new planting would cover about 5,000 hectares each in Sarawak and Sabah in 2012. Under the rubber NKEA, the rubber industry is targeted to contribute about RM 90 billion of gross national income by 2020. Furthermore, rubber's performance in 2012 is expected to stay robust with growth coming from the Asia-Pacific, mainly from China and India. These two economies with their huge domestic markets, low cost and abundant domestic labour, offer vast market opportunities for NR (MRB, 2011).

Krichene (2005) has argued that a relationship exist between crude oil prices, changes in the nominal effective exchange rate of the US$, and the U.S. interest rates. The study used the simultaneous equations model for world crude oil and natural gas markets and found that both interest rates and the nominal effective exchange rate were shown to influence crude prices inversely. The result explained that demand and supply for both crude oil and natural gas were highly price inelastic in the short run, leading to excessive volatility in crude oil and natural gas market. From the study, a simultaneous equations model estimation methodology could provide realistic and relevant information for this paper.

Abdul Rahim et al. (2010) also 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. Romprasert, S (2011) studied the forecasting of NR future price and the market efficiency by using the time series data of the spot price of Thailand. The results indicated that, the daily futures prices served as unbiased estimators of future spot prices and there was independence on daily price changes. This result showed that Thailand's rubber futures market was efficient and aided the process of price. The analytical model was shown to be applicable and would be facilitated and related studies in forecasting the futures prices of other commodities.

Khin et al. (2011) developed a short-term econometric model of world NR price. This study used the Vector Error Correction Method (VECM) with cointegration

characteristics and was utilized using monthly data from 1990 to 2008. The results indicated that the price of NR is highly and positively dependent on total production of NR and highly and negatively dependent on total consumption of NR. The cointegration approach was used directly to test long-term variables and indirectly to know imbalance in short-term by using parameter estimate from long-term relationship variables. Estimations revealed that the explanatory variables, namely total production of NR and the total consumption of NR and synthetic rubber, were the most important explanatory variables in the cointegration equation of price forecasting VECM model with significance at 0.01 level.

Therefore, in these situations, NR price forecasts are necessary to help in decision-making. Besides, the objectives of the study were conducted to investigate the inter-relationships between production, consumption and prices in the Malaysian NR market, to explore a simultaneous supply-demand and price system equation model compared with Vector Error Correction Method (VECM) model between theory and reality of the current market situation, to forecast a short term (ex-post forecast) and long term NR future price (ex-ante forecast) and to make recommendation this study is more efficient and wider applicability in the future. The price forecasting models will be utilized using quarterly data from 1990 Q1 to 2013 Q with providing a total of 96 observations and will be carried out for the period of 2013 Q1 to 2013 Q4 on the short-term and until to 2020 Q1 to 2020 Q4 on the long-term investment decisions.

Materials and Methods

NR Supply Forecasting Model

The research earlier examined and reviewed the supply, demand and price relationship based on models developed by (Tan, 1984), (Barlow et al., 1994), (Arshad and Zainalabdin, 1994), (Goodwin, 1994), (Ferris, 1998), (Burger and Smit, 2000), (Enders, 2004), and (Khin et al., 2011). A quarterly model of the Malaysia NR market is formulated comprising of three behavioral single-equations and identified first the supply of NR (TPNR) as a function of related factors (in logs) as follow:

$$TPNR_t = a0 + a1\ NRP20_{t-1} + a2\ TPNR_{t-1} + et \quad (1)$$

NR Demand Forecasting Model

The demand of NR (TCNR) as a function of related factors (in logs) can be specified as follow:

$$TCNR_t = b0 - b1\ NRP20_t + b2\ TCNR_{t-1} - b3\ RSS1_t + et \quad (2)$$

NR Price Forecasting Model

The NR price (NRP20) equation, which was derived, based on related factors (in logs) and however, the study will only be tested to forecast the NR price forecasting model which can be stated as follows:

$$NRP20_t = c1 + d1\ TPNR_{t-1} - d2\ TCNR_{t-1} - d3\ STONR_{t-1} - d4\ RSS1_{t-1} + d5\ COP_{t-1} + d6\ REER_{t-1} + d7\ NRP20_{t-1} + \varepsilon 6\ t \quad (3)$$

Model Specification for NR Price Forecasting Models

(1) Simultaneous Supply-Demand and Price Equation Model

The simultaneous equation model is a two-equation model based on the market demand and supply where price and quantity are both endogenous variables (Ferris, 1998), (Pindyck and Rubinfeld, 1998) and (Gujarati, 2003). The model deals with directly to the interaction of supply and demand in establishing prices without separately using the single-equations of supply, demand and price. Price and supply are endogenous also; jointly determined price and demand are endogenous variables. Others are exogenous variables. Therefore, the simultaneous equations model will be substantially compared to the single-equation of VECM price forecasting model are considered in this study. Following is the model (in logs) with price dependent supply and demand illustrating the dynamics of such models.

Assuming the sign on as follow a1 and a2 are positive, b1 and b2 are negative and a0 and b0 are intercepting. Therefore, we can write for the price dependent equation for supply based on supply equation (1) as.

$$NRP20t\text{-}1 = a0 + (a1 + a2)\,(TPNRt\text{-}1) + et \quad (4)$$

Moreover, the model with price dependent equation for demand based on demand equation (2) and then we can write as follows:

$$NRP20t = b0 - (b1 + b2)\,(TCNRt\text{-}1) - b3\,RSS1t + et \quad (5)$$

If exports and imports are negligible, Supply = Demand. Therefore, supply equation (1) and demand equation (2) will be

$$a0 + a1\,NRP20t\text{-}1 + a2\,TPNRt\text{-}1 + et = b0 - b1\,NRP20t\text{-}1 - b2\,TCNRt\text{-}1 - b3\,RSS1t + et$$

Therefore, we can write the price simultaneous equation (in logs) on equation (6) as follows:

$$NRP20t = (a0 + b0)/(a1 + b1) + a2\,TPNRt\text{-}1 - b2\,TCNRt\text{-}1 - b3\,RSS1t \quad (6)$$

(2) Vector Error Correction Model (VECM)

Co-integration is a statistical concept within the regression theory framework that explains the long run equilibrium in economic theories. Engle and Granger (1987) pointed out that the residual has a pattern and if residual are stationary, the two variables are co-integrated and there is a long run relationship between the two variables. It is called the error correction model (ECM). If residuals are random walk, the two variables are not co-integrated and there is not a long run relationship between the two variables. In the ECM model, the only right-hand side variable is the error correction term and this term is zero. And also co-integrating equation is no lagged difference terms. Besides, ECM models have no vector of intercept terms (αi) and the disturbance terms (εi). The co-integration equations for Malaysian NR price long-term forecast based on equation (3) is:

$$CointEq: NRP20t + TPNRt - TCNRt - STONRt - RSS1t + COPt + REERt = 0 \quad (7)$$

Vector error correction method (VECM) is developed in two stages. First, a general autoregressive distribute lag equation is specified, which explains an endogenous variable by its current and own lagged exogenous variables. Second, this equation is manipulated to reformulate it in terms that are more easily interpreted, producing a term representing the extent to whether the long-term equilibrium is met. The last term, is called an error-correction term since it reflects the current "error" in achieving long-run equilibrium. According to Engle and Granger (1991) a linear combination of two or more non stationary series might be stationary. Therefore, the Malaysian NR price forecasting model for short-term forecast the VECM model based on equation (3) is:

$$\Delta\,NRP20t = c1 + d1\,TPNRt\text{-}1 - d2\,TCNRt\text{-}1 - d3\,STONRt\text{-}1 - d4\,RSS1t\text{-}1 + d5\,COPt\text{-}1 + d6\,REERt\text{-}1 + d7\,NRP20t\text{-}1 + \varepsilon 6\,t \quad (8)$$

where

NRP20 = Standard Malaysia Rubber Grade20 NR Export FOB price (USD/ton)

RSS1 = RSS1 NR Export FOB price (USD/ton)

TPNR = Malaysian Total Production of NR (Total Supply) (‘000 tonnes)

TCNR = Malaysian Total Consumption of Rubber (Total Demand) (‘000 tonnes)

STONR = World NR stocks (‘000 tonnes)

COP = Crude petroleum oil yearly price (USD/barrel)

REER = Real effective exchange rate in foreign currency per RM (USD/RM)

T = Time trend 1990 to 2013 quarterly data

t and eti = Time period and error terms respectively

Model Simulation and Model Evaluation

Significantly, the models are needed to do for the error checking with the classical assumptions for ordinary least squares (OLS) estimators. The classical assumptions must be met in order for OLS estimators to be the best available (Studenmund, 2011). For instance, heteroskedasticity takes account of correcting the standard errors and it has a constant variance (White, 1980). Therefore, H0: residual are not heteroskedasticity (the error term has a constant variance) and HA: residual are heteroskedasticity (the error term has not a constant variance). If in the White test, sig p-value > α 0.05, then fail to reject H0. There is no heteroskedasticity. Therefore, the forecasting model is satisfactory and no need to revise.

The model simulation time horizon is based on (Pindyck and Rubinfeld, 1998) and as short term and long term price forecast. If the study will be based on the quarterly data from 1990 to 2013, the ex-post forecast (short term price forecast) would be from 2013 Q1 to 2014 Q4 and followed by ex-ante forecast (long term price forecast) would be from 2010 Q1 to 2020 Q4. Accuracy is generally being accepted as the most important factor in evaluating a forecasting technique, but there is no consensus as to how accuracy should be measured. Indeed, one of the difficulties in dealing with the criterion of accuracy in forecasting situations is that there is no one single universally accepted measure of accuracy (Makridakis et al., 1998) and (Pindyck and Rubinfeld, 1998).

The simultaneous supply-demand and price system equation model and VECM model of the NR price would be in terms of their modelling accuracy based on Root Mean Square Error (RMSE), Mean Absolute Error (MAE), and Mean Absolute Percent Error (MAPE) and (U-Theil) criteria. The values of RMSE and MAE are all small, the values of the Theil's inequality coefficient (U-Theil) are all nearly zero which is that the forecasting performance and accuracy of the forecasting model is satisfactory and the model is no need to revise.

Results & Discussions

This research is conducted in stages. In each stage, a set of analysis is applied, and the findings in the respective stage determine the next stage. Upon collection of data, which is extracted during 1990 Q1 to 2013 Q4 quarterly, stationary analyses are to be tested. Hence, Augmented Dickey Fuller Test (ADF) and Phillip-Perron Test (PP) are to be conducted on data to test for existence of unit root in Table 1. If data are non-stationary, they are to be treated to become stationary. This is done by means of differencing from data. After that (Khin et al., 2011) suggested that cointegration test should be done before conducting VECM Model.

Table 1 The Results of Unit Root test of NRP20, TPNR, TCNR, STONR, RSS1, COP and REER

Variables	Augmented Dickey Fuller Test			Phillip-Perron Test		
	Level	1st Difference	2nd Difference	Level	1st Difference	2nd Difference
NRP20	-1.372	-7.242***	-7.824***	-1.401	-7.903***	-54.024***
TPNR	0.301	-16.000***	-9.069***	-2.788*	-25.093***	-43.306***
TCNR	-0.428	-5.300***	-19.088***	-0.631	-38.751***	-91.197***
STONR	-0.987	-3.874***	-7.150***	-0.859	-9.769***	-28.676***
RSS1	-1.282	-8.065***	-8.049***	-1.025	-7.999***	-56.249***

COP	-0.386	-9.258***	-7.313***	-0.690	-11.126***	-44.694***
REER	-1.672	-7.278***	-6.741***	-1.523	-7.281***	-40.371***

Note: *, **, ***: statistically significant at respectively 0.10, 0.05, and 0.01 acceptance levels

Results of unit root tests presented in Table 1 which indicates NR price and variables with TPNR, TCNR, STONR, RSS1, COP and REER are stationary only after the 1st difference and 2nd difference. Results of ADF and PP tests confirm each other.

Simultaneous Supply-Demand and Price Equation Model: In order to test the model, long-term relationship between NR price with other variables TPNR, TCNR, and RSS1 are identified and showed by price simultaneous equation (9).

NRP20t = 1.031 + 0.118 TPNRt-1 – 0.174 TCNRt-1 – 0.514 RSS1t + 0.352 et (9)

t statistic = [2.175**] [-2.927**] [-45.028***]

R^2 = 0.514 Adjusted R^2 = 0.501

Heteroskedasticity Test: White

F-statistic 1.0075 Prob. F(3,92) 0.3931

In Equation (9), it based on the results of simultaneous supply-demand and price equation (6) about NR price model. The result reveals that the relationship between NR price and production, consumption and RSS1 price. In other words, it shows the forecasting power of NR price with other variables' lag selection is on one period (lag) ahead in time. Results are significant at 0.05 and 0.01 acceptance levels with R-Square value of 0.514, indicates that up to 51.4 percent of variation in short term changes of NR price of Malaysia are explained by variation in the lagged variables as well as TPNR, TCNR, and RSS1. Therefore, this is a concrete model in predicting and explaining long term movement of NR price of Malaysia. Moreover, existence of such relationship is statistically supported. T-statistic of 2.175 indicates that the NR price is positively affecting TPNR production significantly at 0.05 acceptance level. Moreover, t-statistics of 2.927 and 45.028 suggest that NR price is negatively affecting the TCNR, and RSS1 are statistically significant at 0.05 and 0.01 acceptance level. Moreover, in the White test, sig p-value 0.3931 > α 0.01, then fail to reject H0. There is no heteroskedasticity of residuals. Therefore, the forecasting model is satisfactory and no need to revise.

Vector Error Correction Model (VECM): In order to test the model, long-term relationship between NR price with other variables TPNR, TCNR, STONR, RSS1, COP, and REER are identified by means of co-integration tests based on the equation (7). Results of Johansson co-integration test on the model (co-integration rank) is presented in Table 2. It provides Johansson co-integration results obtained from both methods of Trace and Maximum Eigenvalues. Results of trace method suggest existence of two co-integration equations; similarly, maximum Eigenvalue suggests there are also two co-integration equations. In other words, both methods confirm each others that there are two long-run equilibrium equations between NR price and other variables TPNR, TCNR, STONR, RSS1, COP, and REER exists within a multivariate framework.

Table 2 Results of Johansson Co-integration Test on NR Price Forecasting VECM Model

Hypothesized No. of CE (s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prof. **
None *	0.664543	204.9670	125.6154	0.0000
At most 1 *	0.399541	102.2945	95.75366	0.0164
At most 2	0.251596	54.34871	69.81889	0.4466
At most 3	0.129996	27.10638	47.85613	0.8502
At most 4	0.099696	14.01615	29.79707	0.8397
At most 5	0.042821	4.144047	15.49471	0.8916
At most 6	0.000321	0.030177	3.841466	0.8620
Hypothesized No. of CE (s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prof. **
None *	0.664543	102.6725	46.23142	0.0000
At most 1 *	0.399541	47.94579	40.07757	0.0053
At most 2	0.251596	27.24233	33.87687	0.2506
At most 3	0.129996	13.09024	27.58434	0.8799
At most 4	0.099696	9.872102	21.13162	0.7566
At most 5	0.042821	4.113870	14.26460	0.8471
At most 6	0.000321	0.030177	3.841466	0.8620
Trace and Max-Eigen statistics indicate 2 cointegrating equations at the 0.05 level.				
* denotes rejection of the hypothesis at the 0.05 level.				
** Mackinnon-Haung-Michelis (1999) p-values				

As illustrated by Equation (10), the long run relation based on co-integration equation (7), which is the horizontal equation in first row in VECM model, suggests that long-term relationship between NR price and TPNR, TCNR, RSS1, and REER are statistically significant. This is due to respective t-statistics of 7.347, 3.247, 2.016 and 2.242, which suggest a significant relationship between TPNR, TCNR, RSS1 and REER at 0.01, 0.05 and 0.10 acceptance level. On the other hand, t-statistic of 1.644 and 1.879 fails to support any form of relation between STONR and COP and NR price in Malaysia. The sign of coefficients of production, consumption and stock variables are right signs with NR price. Hence, one may infer a direct long-term relationship between NR price with other variables TPNR, TCNR, RSS1 and REER.

Co-integration Equation

$$-0.084\ \Delta NRP_{t-1} + 0.161\ \Delta TPNR_{t-1} - 0.037\ \Delta TCNR_{t-1} - 0.034\ \Delta STONR_{t-1} + 0.066\ \Delta RSS1_{t-1}$$

t statistic = [-2.326**] [7.347***] [-3.247**] [-1.644] [-2.016*]

$$+ 0.082\ \Delta COP_{t-1} + 0.019\ \Delta REER_{t-1} = 0 \quad (10)$$

t statistic = [1.879] [2.242**]

VECM Equations of PSMR20 Model

$$\Delta NRP_t = 0.015 + 0.325\ \Delta TPNR_{t-1} - 0.419\ \Delta TCNR_{t-1} - 0.563\ \Delta STONR_{t-1} - 0.149\ \Delta RSS1_{t-1} +$$

t statistic = [3.832**] [-3.053**] [-2.991**] [-0.628]

0.123 ΔCOPt-1 + 1.189 ΔREERt-1 + 0.156 ΔNRP20t-1 + 0.003 et (11)

t statistic = [1.215] [2.656**] [0.751]

R2 = 0.818 Adjusted R2 = 0.810

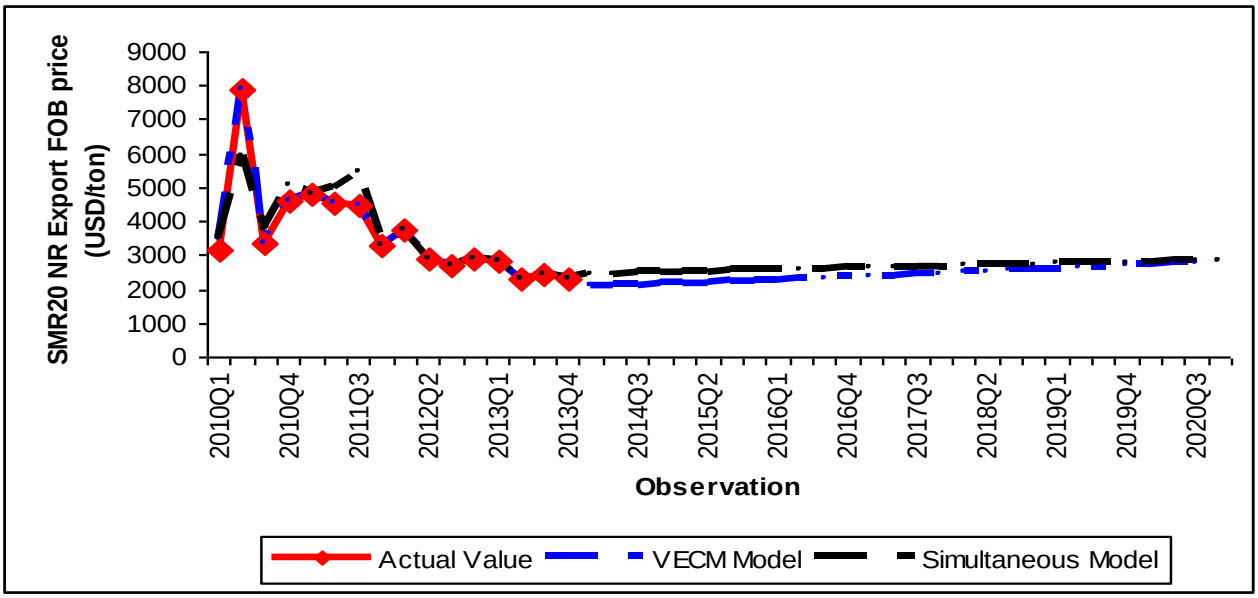
Heteroskedasticity Test: White

F-statistic 2.722 Prob. F(6,89) 0.0179

In Equation (11), it provides the results of VECM equation about NR price based on equation (8). The result reveals that the short run relationship between NR price with only production, consumption, stock and real exchange rate. In other words, it shows the forecasting power of NR price with other variables' lag selection is on one period (lag) ahead in time. Results are significant at 0.05 acceptance levels with R-Square value of 0.818, indicates that up to 81.8 percent of variation in short term changes of NR price of Malaysia are explained by variation in the lagged variables as well as TPNR, TCNR, STONR, RSS1, COP, and REER. Therefore, this is a concrete model in predicting and explaining short term movement of NR price of Malaysia. Moreover, existence of such relationship is statistically supported. T-statistic of 3.832 indicates that the NR price is positively affecting TPNR production significantly at 0.05 acceptance level. Moreover, t-statistics of 3.053, 2.991 and 2.656 suggest that the TCNR and STONR are negatively and REER is positively statistically significant at 0.05 acceptance level. Moreover, in the White test, sig p-value 0.0179 > α 0.01, then fail to reject H0. There is no heteroskedasticity of residuals. Therefore, the forecasting model is satisfactory and no need to revise.

Khin and Thambiah (2014) advocated selecting a forecasting model if it significantly contributed to the forecasting accuracy of a combined forecast using a simultaneous supply-demand and price system equation model and univariate model of the ARIMA of Malaysia NR price. Both models utilized data from 1990 Q1 to 2013 Q4 as estimation period and data were estimated as a short term price forecast was to 2014 Q1 to 2014 Q4. The result showed that the one lagged of NR price and RSS1 price were the most important explanatory variable with statistically significance at α 0.01 level in the NR price model.

In Equation (9) and (11), the results of both NR price forecasting models show that NR price is significantly both short-term and long-term relationship between TPNR production and TCNR consumption. In Figure 4, it is to select a forecasting model if it significantly contributes to the forecasting accuracy of a combined forecast using a simultaneous supply-demand and price system equation model and VECM model of NR prices. Both models used the quarterly data from 1990 Q1 to 2013 Q4 as estimation period, and data from 2010 Q1 to 2014 Q4 was estimated as an ex-post forecast short term price forecast and followed by ex-ante long term price forecast was to 2010 Q1 to 2020 Q4. The results showed that the comparative forecasting powers criteria' values of VECM model of cointegration equation for short term and long term price forecast were smaller than the values estimated by the simultaneous supply-demand and price system equation model. It meant that the forecasting performance of VECM model of cointegration equation model was satisfactory and thus, a revision of the model was not necessary. These statistics suggested that the forecasting performance of VECM model of cointegration equation model is more efficient than the simultaneous supply-demand and price system equation model.



Forecasting powers criteria' values	VECM Model	Simultaneous Model
RMSE	0.0736	0.0767
MAE	0.0579	0.0604
MAPE	0.8165	0.8502
U-Theil	0.0051	0.0053
Bias Proportion	0.0000	0.0000
Variance Proportion	0.0041	0.0045
Covariance Proportion	0.9959	0.9955

Figure 4. Short-term (Ex-post) forecast and Long-term (Ex-ante) forecast of NR price forecasting models from 2010 Q1 to 2020 Q4

The price trend of the Malaysian NR shows that NR price is predicted to increasing trend from 2016 Q1 until to 2020 Q4 long term price forecast and however, at the end of 2014 Q4, the prices of NR were down for short term price forecast in Fig 3. Therefore, it would be most effective for the long-term investment decisions which results in the greatest increase in demand. For short term, it may be weather, seasonal factors, currency movements, futures markets activities, market interventions and irregular demand ensured a brief interruption to the downward trend. If some of the major automobile manufacturers could be planned to boost their production in coming year as a result of low inventories, which would also aid price level stability (MRB, 2015).

Conclusion

World Bank (2015) also supported for this study and rubber prices are volatile and are influenced by many factors also. Over the past decade NR prices have increased from US$1 per kg to US$4.5 per kg. The elevated price volatility following the 2005 to 2008 commodity booms caused concern to both international organizations and policymakers. The volatility of NR prices, as a general rule, tends to be more volatile than other mainstream commodities. Following the news of an Ebola outbreak in West Africa at the beginning of the 2015, share prices of rubber gloves have risen by 5 to 10%. Any significant development in the situation or a full-scale Pandemic

would further boost worldwide healthcare awareness and could potentially spark a surge in demand for NR examination gloves, given that they remain as the most affordable and fundamental form of protection against diseases. The World Bank commodities price forecast in (nominal) US$ indicates that Malaysian rubber price will reach US$2.40 per kg in 2015 and US$2.44 per kg in 2016. As such, an accurate estimation method of NR price forecasting is vital, to help in the decision-making process of economic planning for the NR sustainable production and the world market economy as well.

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