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Forecasting Analysis of Price Behavior: A Case of Malaysian Natural Rubber Market

[1]Aye Aye Khin and [2]Seethaletchumy Thambiah

[1]Faculty of Business Management and Professional Studies (FBMP),
Management and Science University (MSU), Shah Alam, Selangor DE, Malaysia
[2]Faculty of Management (FOM),
Multimedia University (MMU), Cyberjaya, Selangor DE, Malaysia

Abstract: In this article it is advocated 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 univariate model of the Autoregressive-Integrated Moving Average (ARIMA) of Malaysian natural rubber prices (SMR20). Both models utilized quarterly data from 1990 Q1 to 2013 Q4 as estimation period and data from 2013 Q1 to 2013 Q4 was estimated as an ex-post and followed by ex-ante short term price forecast was to 2014 Q1 to 2014 Q4. The data was tested the residual correction method for Heteroscedasticity-White test. A comparison of forecasting accuracy for both models was based on RMSE, MAE, U-Theil, AIC and SIC criteria. An illustration for real-time forecasts for natural rubber prices (SMR20) in the Malaysians shows its ease of use.

Key words: Simultaneous Supply-Demand and Price System Equation · Univariate · Forecasting accuracy · Malaysian Natural Rubber Prices

INTRODUCTION

Rubber is a vital commodity used in the manufacture of a wide range of rubber-based products in many developing countries. Rubber is a native of the Amazon basin in South America and has spread to other countries of South-East and South Asia such as Malaysia, Indonesia, Thailand, Sri Lanka and India during late 19th century. Natural rubber (NR) consumption is dominated by its use in the manufacture of tyres, ranging from bicycle to aeroplane tyres and in numerous general and industrial rubber products such as belts, hoses, automotive parts, medical gloves and tubes. The response of producers and consumers selling and buying depends on their expectation of future movements in the prices. If their anticipation are incorrect and future prices fluctuate, then such price behavior can lead to substantial losses [1]. In these situations of considerable uncertainty and high risk, natural rubber price forecasts are necessary to help in decision-making.

Fig. 1 shows that world natural rubber (NR) production increased from 10.4 million tonnes in 2010 to 12 million tonnes in 2013. Likewise, world NR consumption increased from 10.8 million tonnes in 2010 to reach 11.4 million tonnes in 2013. At that time of writing, the latest available data from [2] indicated that global rubber stock increased from 1.5 million tonnes in 2010 to 2.9 million tonnes in 2013. Additionally, world synthetic rubber (SR) production increased from 14.1 million tonnes in 2010 to 15.5 million tonnes in 2013. Similarly, world SR consumption increased from 13.9 million tonnes in 2010 to reach 15.5 million tonnes in 2013. At the same time, global SR stock increased from 4.2 million tonnes in 2010 to 4.7 million tonnes in 2013 (Fig. 2) [2].

In fact, variations in a NR price series of Bangkok STR20, KL SMR20, Indonesia SIR20 and USA, Germany and Japan of SR prices can arise from long-term trends or short-term fluctuations (instability) or both together in (Fig. 3). In 2008-2009, the extremely low prices for all due to the outbreak of the global recession. It experienced

Correspondent Author: Dr. Aye Aye Khin, Faculty of Business Management and Professional Studies (FBMP), Management and Science University (MSU), Shah Alam, Selangor DE, Malaysia.

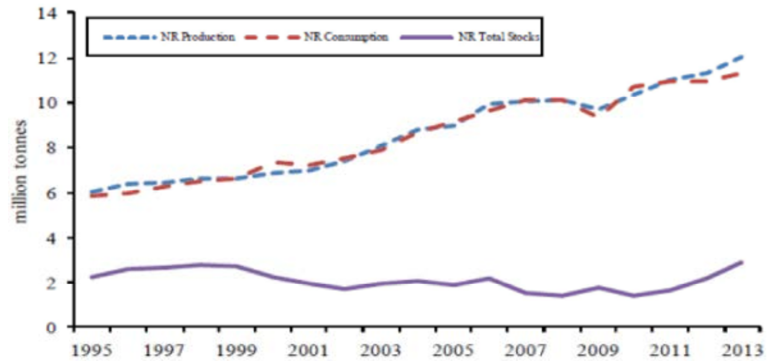


Fig. 1: World NR production, consumption and stocks [2].

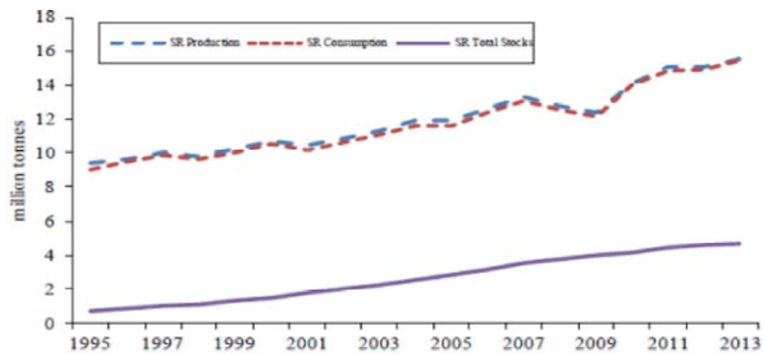


Fig. 2: World SR production, consumption and stocks [2].

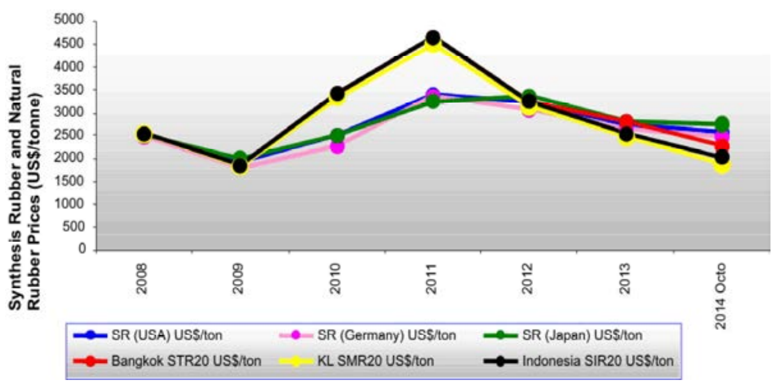


Fig. 3: Natural rubber and synthetic rubber prices (US$/ton) 2008-2013 [2]

during these years contributed to price volatility and instability in many countries, especially rubber smallholders in South East Asia. Noticeably, the prices dropped again in 2009 following the decline in the international NR prices were caused by lower crude oil prices [3]. The prices bounced back in 2010 and 2011 to reach a ten years peak level. The pattern of price movement of SMR20 price in Kuala Lumpur market (yellow trend) increased from US$ 2532 per ton in 2008 to US$ 4497 per ton in 2011. Conversely, SMR20 price was decreased to US$ 2485 per ton and US$ 1900 per ton in 2013 and 2014 October, respectively.

In addition to the above mentioned factors affecting the price of NR, the fundamentals of demand and supply and other factors may have direct and indirect effects on the price of NR. Several attempts have been made to forecast the long-term and short-term natural rubber market [4]. The essential elements of NR long-term supply model are: planted area, new planting, replanting and uprooting, the age of the area and the yield profiles, technical progress, other factors influencing normal production and prices. The variables used for demand model are the NR share in total world rubber consumption, the ratio of the Singapore RSS1 price of NR (in US$) and the US export unit value of SBR (Styrene-Butadiene Rubber) (in US$) and also the short-term price model included world natural rubber average production, world total rubber consumption, exchange rate, private world stocks, RSS1 price in Singapore (US$/tonne) and a dummy (taking in time trend). It included the economies of key players in the natural rubber market both on the demand side, on the supply side and price fluctuations.

[5] studied the heterogeneous panel data stationarity test including four models with different patterns of breaks under the null hypothesis were specified. The four models were derived in closed form via characteristic functions. [6] assumed that VAR and VEC model procedures to determine the linkages among several commodities oil and exchange rates. This study suggested that the agricultural commodity markets depend more on the exchange rate and to a lesser extent on oil prices, but both would be utilized in this study.

[7] developed a short-term econometric models of world natural rubber price Standard Malaysia Rubber Grade 20 (SMR20). Both single and simultaneous equations were utilized using monthly data from January 1990-December 2008. The models specifications were developed in order to discover the inter-relationships between NR production, consumption and prices of SMR20 and to determine forecast price of SMR20. Comparative analysis between the single-equation and simultaneous supply-demand and price equation were made in terms of their estimation accuracy based on RMSE, MAE and (U-Thile) criteria. The results revealed that the simultaneous equation of supply-demand and price model was more accurate and efficient measure in terms of its statistical criteria than the single-equation model in predicting the price of SMR20 in the next 6 months.

[8] conducted the univariate and multivariate econometric models to forecast the short-run average monthly price of Standard Malaysia Rubber 20 (SMR20), using monthly data from January 2000 to September 2011. The autoregressive integrated moving average (ARIMA) and vector autoregressive (VAR) or vector error correction (VEC) models were employed in the analysis for forecasting. The study also generated an out-of-sample forecast to analyze and compare the statistical results from all the models in order to determine the accuracy of which methods were more accurate in terms of statistical criteria and visual proximity with the actual prices. The results found that multivariate time series models outperform univariate time series models in term of forecasting accuracy.

This paper therefore, advocates selecting 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 univariate model of the Autoregressive-Integrated Moving Average (ARIMA) of Malaysian natural rubber prices (SMR20). Both models will be utilized quarterly data from 1990 Q1 to 2013 Q4 as estimation period and data from 2013 Q1 to 2013 Q4 will be estimated as an ex-post and followed by ex-ante short term price forecast will be to 2014 Q1 to 2014 Q4. The models will be tested the residual correction method for Heteroscedasticity-White test. It is checking for the price forecasting models are linear, correctly specified and has an additive error term, the error term has a zero population mean and all explanatory variables are uncorrelated with the error term. A comparison of forecasting accuracy for both models is based on RMSE, MAE, U-Theil, AIC and SIC criteria.

MATERIALS AND METHODS

Simultaneous Supply-demand and Price System Equation Model: The simultaneous supply-demand and price system equation model is a two-equation model of demand and supply where price and quantity are both endogenous variables [9-15]. 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. Jointly determined price, supply and demand are endogenous. Others are exogenous variables. Following is the model (in logs) with simultaneous supply-demand and price system equation illustrating the dynamics of such models.

Model Specification:

$$\text{Supply} ; PNR_t = a_0 + a_1 P20_{t-1} + a_2 PNR_{t-1} + e_t \quad (1)$$

$$\text{Demand} ; CNR_t = b_0 - b_1 P20_t + b_2 CNR_{t-1} - b_3 RSS1_t + e_t \quad (2)$$

Assuming the sign on a_1, a_2 and b_2 are positive and on b_1, b_3 are negative. Therefore, we can write the price simultaneous equation (3) (in logs) as follows:

$$(a_1 + b_1) P20_t = (-a_0 + b_0) - a_2 PNR_{t-1} + b_2 CNR_{t-1} - b_3 RSS1_t$$

$$\text{Price} ; P20_t = -(a_0 - b_0)/(a_1 + b_1) + a_2 PNR_{t-1} - b_2 CNR_{t-1} + b_3 RSS1_t \quad (3)$$

Univariate Model (ARIMA Model): The autoregressive-integrated-moving average (ARIMA) model is discussed in detail in [16-20]. Briefly, this technique is a univariate approach, which is built on the premise that knowledge of past values of a time series is sufficient to make forecasts of the variable in question.

Model Specification: The short-term price forecasting models based on the Box-Jeckins procedure, univariate time-series model of the autoregressive-integrated moving average ARIMA (*p,d,q*) can be specified follows:

$$P20_t = C + (\Phi_1\ P20_{t-1} + \dots \Phi_p\ P20_{t-p}) - (\theta_1\ \varepsilon_{t-1} + \dots \theta_q\ \varepsilon_{t-q}) + \varepsilon_t \quad (4)$$

where,

PNR = Total production of natural rubber (000 tonnes) (000, Ton)
CNR = Total consumption of natural rubber and synthetic rubber (Total Demand) (000, Ton)
P20 = Real price of SMR20 in Kuala Lumpur market (US$/Ton) deflated by the CPI.
RSS1 = Real price of RSS1 in New York market (US$/Ton) deflated by the CPI.

Φ_1 ….. Φ_p = Autoregressive (AR) parameter (The Φ_1 SMR20_{t-1} represented the fit to the series value SMR20_t) and θ_1 ….. θ_p = oving Average (MA) parameter (The term $\theta_1\ \varepsilon_{t-1}$ and ε_t represented the assumed random error in the data at period t-1 and period t)

a_0 = Intercept
a_1, a_2, b_1, b_2, b_3 = Coefficients of the parameters
T = Time trend, 1990 Q1 to 2013 Q4
t and e_i = time period and error terms respectively

$P20_t$ is related to both past series values and past random errors and it was the stationary series. There are two types of basic Box-Jenkins models: autoregressive (AR) models and moving-average (MA) models. In terms of the original series such models are called integrated models and the AR and MA models may also be combined to form by Auto Regressive, Integrated, Moving-Average (ARIMA) models.

The ARIMA model of order ARIMA (1,1,1) was found to be the most appropriate model and generate the best forecast with minimum error. The numbers inside the parentheses of ARIMA (1,1,1) model of order (p,d,q) refer to the order of the autoregressive process, the degree of differencing required to induce stationary and the order of the moving average process, respectively. In equation (4), ε_t is a random disturbance assumed to be distributed as N (0, σ^2). The Φ_is are called autoregressive (AR) parameters and θ_is are also called moving-average (MA) parameters. The subscripts on the Φ's and θ's are called the orders of the parameters. In an AR model p is the order of the model and in an MA model q is the order of the model. The order of an ARIMA model is expressed in terms of both p and q. The stationary conditions for this model are: $/\Phi_1/ < 1$and $/\theta_1/ < 1$.

The $\Phi_1 P20_{t-1}$ represented the fit to the series value $P20_t$ and Φ_1 was also called an AR parameter of order 1. The term $\theta_1\ \varepsilon_{t-1}$ and ε_t represented the assumed random error in the data at period t-1 and period t and θ_1 was also called a MA parameter of order 1. The parameter diagnostics showed that any given value in price of $P20_t$ was directly proportional to the previous value $P20_{t-1}$ plus some random error ε_t and ε_{t-1}. That was, what happens this period was only dependent on what happened last period, plus some current random error. The term ($-\ \theta_1\ \varepsilon_{t-1}$) was the use of the minus sign in front of θ_1 was conventional only and had no other significance.

Model Identification (Unit Root Test): Moreover, it is also needed to develop the time series into a stationary one by using the unit root test for the selected variables of short-term quarterly NR price forecasting model in a series. [14, 21, 22] explained that most of the time series variables are non-stationary, with mean and variance non-constant (unit root). If the data contained unit root, the data are called non-stationary, which lead to spurious regression result. The selected variables of short-term quarterly NR price forecasting model have been tested for stationary, using Augmented Dickey Fuller (ADF) and Phillips-Peron's tests (PP) for unit root. The results of the unit root test, which are presented in Table 1, showed that most of the selected variables are significant stationary at the first difference form at the 0.01 level using Augmented Dickey Fuller (ADF) and Phillips-Peron's tests (PP) for unit root.

Model Estimation (Heteroskedasticity-white Test): Both models of the short-term quarterly NR prices will also be developed to test with the residual correction method of Heteroskedasticity-White test. Heteroskedasticity-corrected (HC) errors take account of heteroskedasticity, correcting the standard errors without changing the estimated coefficients [23]. The (HC) standard error arises in the context of linear regression

Table 1: Unit root tests' result of quarterly time series variables for NR price forecasting model

	Unit Root Test			
	Level		1st difference	
Variables	ADF t-value	P-P t-value	ADF t-value	P-P t-value
PNR	-1.69	-2.79	-14.49***	-25.09***
CNR	-0.32	-0.63	-17.75***	-38.75***
P20	-1.58	-1.40	-7.24***	-7.90***
RSS1	-1.28	-1.03	-8.06***	-7.99***

Note: *: Statistically significant at the 0.10 level; **: Statistically significant at the 0.05 level; ***: Statistically significant at the 0.01 level. ADF: Augmented Dickey-Fuller test statistic; P-P: Phillips-Perron test statistic

and also time series analysis. The logic behind HC standard errors is power. If heteroskedasticity does not cause bias in the estimated coefficients but does impact the standard errors, then it makes sense to adjust the estimated equation in a way that changes the standard errors but not the coefficients. The estimating model obtains the residual as below:

$$Y_i = B_1 + B_2X_{2i} + B_3X_{3i} + \mu_i \tag{5}$$

The Estimate Auxiliary Regression Is:

$$\mu_i^2 = A_1 + A_2X_{2i} + A_3X_{3i} + A_4X_{2i}^2 + A_5X_{3i}^2 + A_6X_{2i}X_{3i} + v_i \tag{6}$$

The residual are squared (μ_i^2) and regress against the original independent variables (X_2 and X_3), their square values (X_2^2 and X_3^2) and their cross product ($X_2 \times X_3$). The residual correction method of Heteroskedasticity-White test includes the parameter diagnostics and the residual diagnostics. The parameter diagnostics shows that any given value in price of $P20_t$ was directly proportional to the previous value $P20_{t-1}$ plus some random error ε_t and ε_{t-1}. Meaning that, what happens this period was only dependent on what happened last period, plus some current random error. The term ($-\theta_1 \varepsilon_{t-1}$) with the minus sign in front of θ_1 was conventional only and had no other significance. In Box-Jenkins models, the random error component plays a dominant role in determining the structure of the model. Therefore, H_0: residual are no heteroskedasticity and H_A: residual are heteroskedasticity. If the residual diagnostics' test statistics X^2 > Critical Value $X^2_{d.f}$, then reject H_0. There is heteroscedasticity. If test statistics X^2 < Critical Value $X^2_{d.f}$, then fail to reject H_0. There is no heteroscedasticity. Otherwise, if sig-value > α 0.05, then accept H_0. There is no heteroscedasticity. If sig-value < α 0.05, then reject H_0. There is heteroscedasticity.

As mentioned when discussing the specification of ARIMA model as spelled out in the previous sections, it is only a univariate approach, which is built on the premise that knowledge of past values of a time series is sufficient to make forecasts of the variable in question. Here, it is required to justify possibly some comparisons with other model specifications, which is the simultaneous supply-demand and price system equation model. If the forecasting performance is satisfactory, the forecasting model is clearer to explain for the interrelationships within a set of variables and how the problem of endogeneity occurs. It means that whether the independent variable is correlated with the error term in the model or not.

Model Simulation: The comparison of the forecast accuracy of the NR price forecasting models will be evaluated to generate and firstly, the data used from 1990 Q1 to 2009 Q4 for *historical simulation* and secondly, the data used from 1990 Q1 to 2013 Q4 for *ex-post forecast* (from 2013 Q1 to 2013 Q4). Similarly, the data will be subsequently employed for *ex-ante forecast* (from 2014 Q1 to 2014 Q4). The data observations are totally 96 observations.

Model Evaluation: Performance of the model is measured by the validity of its estimate on the basis of its forecasting power [11], [12] and [24]. Comparative analysis between univariate model and simultaneous supply-demand and price system equation model of NR prices (P20) will be made in terms of their estimation accuracy based on the Root Mean Squared Error (RMSE), the Mean Absolute Error (MAE), Theil's Inequality Coefficients (U-STAT), Akaike's Information Criterion (AIC) and Schwarz's Information Criterion (SIC). Performance of the model is measured by the validity of its estimate on the basis of its forecasting power. In the *ex-ante* simulation, the RMSE of all the endogenous variables are less than one percent and the values of MAE are all small. The values of the Theil's inequality coefficient (U-STAT) are all nearly zero, which is that the forecasting performance of the estimated model is satisfactory. Both the AIC and SIC lower values are better.

RESULTS AND DISCUSSIONS

Univariate Model (ARIMA): Equation (7) shows the results of the univariate model of ARIMA of the *ex-ante forecast* of short-term quarterly NR prices of P20. The term $\Phi_1 P20_{t-1}$ (Φ_1 is an AR parameter of order 1) and the coefficient value is 0.64. The term $\theta_1 \varepsilon_{t-1}$ (θ_1 is a MA parameter of order 1) and ε_t coefficients' value are 0.36 and 0.77, respectively. The parameter diagnostics shows that the coefficient values of $\Phi_1 P20_{t-1}$ (Φ_1 is an AR parameter of order 1), $\theta_1 \varepsilon_{t-1}$ (θ_1 is a MA parameter of order 1) and ε_t are statistically significant at α 0.01 level. Meaning that, the model has included the correct parameters. Besides, the residual diagnostics (Heteroskedasticity White test) shows that residuals are significance at α 0.05 level that sig-value (0.0721) > α 0.05, then accept H_0. Therefore, there is no heteroscedasticity. Parameter diagnostics and residual diagnostics comprised the tools available for determining whether a selected model was valid. The AR and MA parameters can be explained about 64 percent of the variation in the quarterly NR price univariate model (ARIMA).

Parameter Diagnostics:

$$P20_t = 1.53 + 0.64\, P20_{t-1} - 0.36\, \varepsilon_{t-1} + 0.77 \varepsilon_t \qquad (7)$$

[12.46***] [7.06***] [5.88***]

$R^2 = 0.64$ Adjusted $R^2 = 0.63$ Durbin-Watson = 1.67

Residual Diagnostics: Heteroskedasticity Test (White Test):

F-statistic	= 2.71Prob.	F(2,90)	= 0.0721**
Obs*R-squared	= 5.28Prob.	Chi-Square	= 0.0714**

Source: Own Data Analysis

Note: t-statistics in [ ]. *** Statistically significant at the 0.01 level, ** at the 0.05 level and * at the 0.10 level.

Simultaneous Supply-Demand and Price System Equation Model: Equation (8), (9), (10) and (11) show the results of the short-term natural rubber price SMR20 quarterly simultaneous supply-demand model of the *ex-ante forecast* and all the estimated coefficients in the equations show the expected signs. Firstly, in the Equation (8), the explanatory variables accounted for about 85 percent of the variation in the quarterly NR supply model. Estimations reveal that the explanatory variables, namely the total production of natural rubber (PNR) in the previous period and total consumption of natural rubber and synthetic rubber (CNR), were the most important explanatory variables with statistically significance at α 0.01 level in the supply model.

Supply : $PNR_t = 0.09 + 0.06\, P20_{t-1} + 0.62\, CNR_{t-1} + 0.07\, RSS1_{t-1} + 0.21\, PNR_{t-1} + 0.05\, e_t \qquad (8)$

[0.105] [9.81***] [1.11] [2.95***] [1.00]

$R^2 = 0.85$ Adjusted $R^2 = 0.84$ Durbin-Watson = 1.94

Demand : $CNR_t = 0.01 - 0.011\, P20_{t-1} + 0.15\, PNR_{t-1} - 0.07\, RSS1_{t-1} + 0.87\, CNR_{t-1} + 0.04\, e_t \qquad (9)$

[0.403] [4.64***] [-0.25] [30.38***] [2.25**]

$R^2 = 0.93$ Adjusted $R^2 = 0.92$ Durbin-Watson = 1.57

SMR20 NR Price : $P20_t = 0.01 + 0.07\, PNR_{t-1} - 0.05\, CNR_{t-1} + 0.43\, RSS1_{t-1} + 0.45\, P20_{t-1} + 0.02\, e_t \qquad (10)$

[0.89] [0.65] [6.06***] [6.37***] [0.64]

$R^2 = 0.93$ Adjusted $R^2 = 0.92$ Durbin-Watson = 1.91

Rss1 Price : $RSS1_t = 0.01 + 0.05\, PNR_{t-1} - 0.06\, CNR_{t-1} + 0.39\, P20_{t-1} + 0.52\, RSS1_{t-1} + 0.02\, e_t \qquad (11)$

[0.69] [0.84] [5.92***] [7.92***] [0.78]

$R^2 = 0.94$ Adjusted $R^2 = 0.93$ Durbin-Watson = 1.88

Residual Diagnostics: Heteroskedasticity Test (White Test):

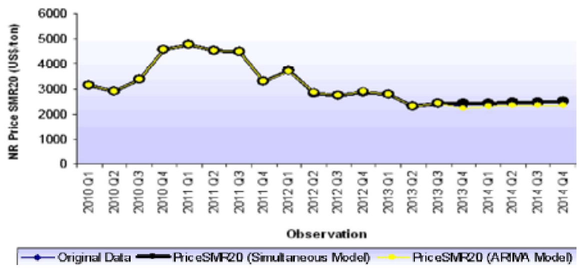
F-statistic = 1.0076Prob. F(3,92) = 0.3931***

Obs*R-squared = 3.0539Prob. Chi-Square = 0.3834***

Source: Own Data Analysis

Note: t-statistics in [ ]. *** Statistically significant at the 0.01 level, ** at the 0.05 level and * at the 0.10 level.

Likewise, in the Equation (9), the explanatory variables accounted for about 93 percent of the variation in the quarterly NR demand model. Estimations reveal that the explanatory variables, namely the total production of natural rubber (PNR) and total consumption of natural rubber and synthetic rubber (CNR) in the previous period, were the most important explanatory variables with statistically significance at α 0.01 level in the demand model. Moreover, in the Equation (10), the explanatory



Model Evaluation Criteria	Simultaneous Supply-Demand and Price Model	ARIMA Model
R2	0.9269	0.6420
RMSE	0.0767	0.2065
MAE	0.0604	0.1353
U-STAT	0.0053	0.3317
AIC	- 8.1610	13.5630
SIC	-7.7309	13.6447

Fig. 4: Ex-ante forecasts of NR price forecasting models from 2014 Q1 to 2014 Q4 and model evaluations.

variables accounted for about 93 percent of the variation in the quarterly NR price (SMR20) model. Estimations reveal that the explanatory variable, namely the price of SMR20 ($P20_t$) in the previous period and RSS1 price were the most important explanatory variable with statistically significance at α 0.01 level in the SMR20 price model. Besides, in the Equation (11), the explanatory variables accounted for about 94 percent of the variation in the quarterly NR price (RSS1) model. Estimations reveal that the explanatory variable, namely the price of SMR20 and RSS1 in the previous period were the most important explanatory variable with statistically significance at α 0.01 level in the RSS1 price model. Moreover, the residual diagnostics (Heteroskedasticity White test) shows that residuals are significance at α 0.01 level that sig-value (0.3931) > α 0.05, then accept H_0. Therefore, there is no heteroscedasticity. Also, residual diagnostics comprised the tools available for determining whether a selected model was valid.

In Fig 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 univariate model of the Autoregressive-Integrated Moving Average (ARIMA) of Malaysian natural rubber prices (SMR20). Both models utilized quarterly data from 1990 Q1 to 2013 Q4 as estimation period and data from 2013 Q1 to 2013 Q4 was estimated as an *ex-post forecast* and followed by *ex-ante* short term price forecast was to 2014 Q1 to 2014 Q4. The results revealed that the comparative forecasting powers of RMSE, MAE, U-STAT, AIC and SIC criteria' values of supply-demand and price system equation model were comparatively smaller than the values generated by the univariate model of the ARIMA. It meant that the forecasting performance of supply-demand and price system equation model was satisfactory and thus, a revision of the model was not necessary. These statistics suggested that the forecasting performance of supply-demand and price system equation model is more efficient than the univariate model of ARIMA.

The price behaviors of the Malaysian NR market from 2010 to 2014 shows in Fig 5. Mostly actual price were decreasing trends after 2010 to until 2014. The overall downward trends were the result of an imbalance in the rubber industry, which towards the end of these years were made worse by the actions of the intervention scheme of Malaysia. However, 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 [25]. Furthermore, based on the supply-demand and price system equation model, NR price (SMR20) is predicted to slightly increasing trend from 2014 Q3 to 2014 Q4 in Fig 4. Therefore, it would be most effective at the beginning of an economic recovery for next year, which results in the greatest increase in demand.

[26] also conducted the empirical analysis of price behavior of NR latex of the central rubber market in Hat Yai, Songkhla, Thailand. The rubber industry had always been susceptible to the price volatility of rubber latex, particularly to small-holder producers. The paper studied that the best econometric model to capture price volatility of NR latex type RSS3 in Thailand for the period 2004-2011. The daily price of latex type RSS3 was modeled by adopting and comparing conditional volatility models, GARCH, GARCH-GJR and EGARCH. The price volatility of NR latex type RSS3 was strongly persistent and statistically valid.

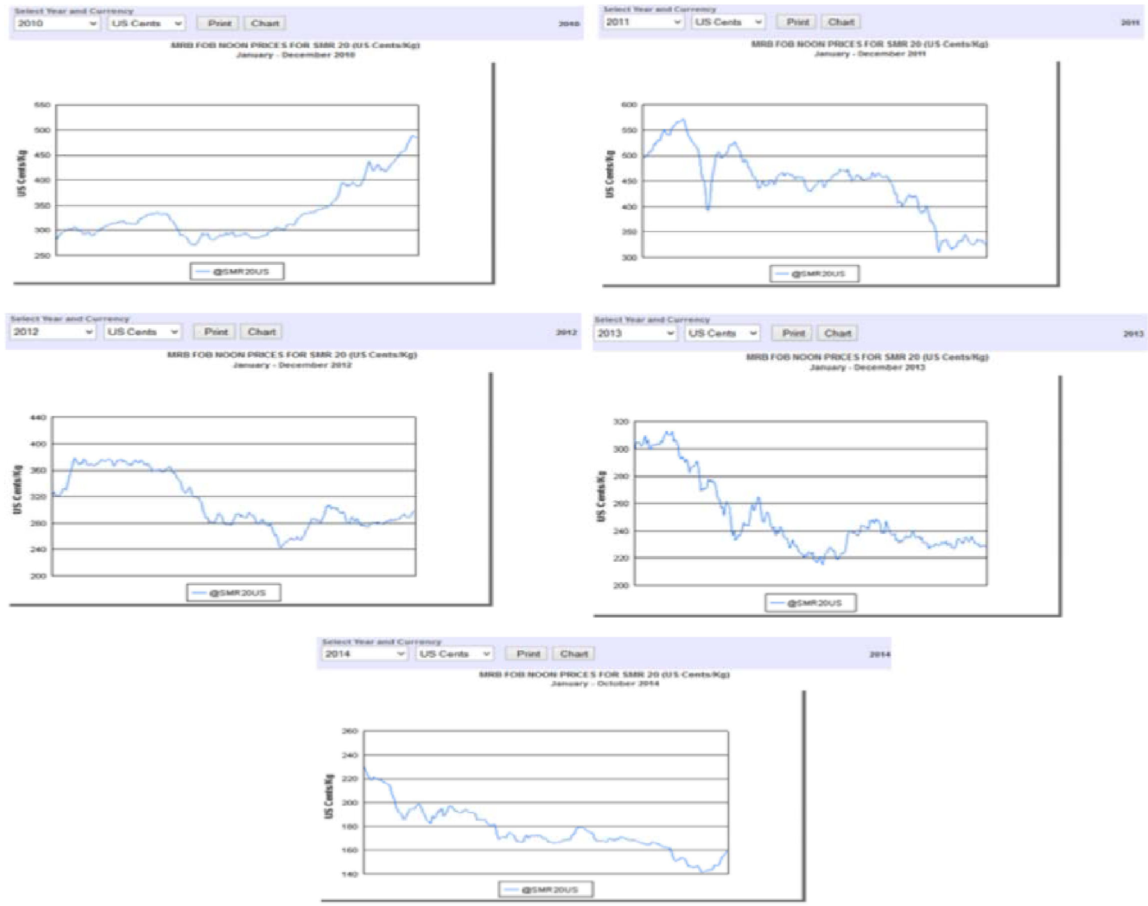


Fig. 5: Price behavior of the Malaysian natural rubber market from 2010 to 2014 [25].

CONCLUSIONS

Based on the above analysis, forecasting performance of supply-demand and price system equation model's *ex-ante forecast* is more efficient measured either in terms of its statistical criteria or even by visual proximity with the actual prices. The results revealed that NR price (SMR20) is predicted to slightly increasing trend by using *ex-ante* short term price forecast from 2014 Q3 to 2014 Q4 in the Malaysian NR market. It would likely lead to a shift in the comparative advantage of rubber production against other crops, in particular oil palm and attracted smallholders to revive rubber tapping in NR producing countries such as Thailand, Indonesia, Malaysia and so on. If global economic growth of the developed countries such as the Japan, the United States and large developing countries such as China and India could be sustained, it is expected that price would be strengthened. However, this would be limited in the long-term by the potential increase in supply via a more intensive tapping regime to increase yield in the major producing countries [27]. Therefore, the implementation with respect to economic, environmental and transportation policy could lead to benefits to NR small holders and to price stabilization mechanisms on national and export.

In conclusion, forecasts are frequently used as guides for public and private policy. This means that an accurate estimation method of NR forecasting is vital, to help in the decision-making process of economic planning, for NR producing countries and the world market as well.

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