

# Price formation and supply response of natural rubber

Y. Melba\* and K.M. Shivakumar

*Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore, India*

## ABSTRACT

Natural rubber is a major economic plant in the plantation sector in terms of providing income to the growers for a long-time and also it serves as raw materials for various industrial products. Over 20 million families are dependent on rubber cultivation for their livelihood in the world natural rubber market. Natural rubber price is influenced by many factors such as weather, currency exchange rates, oil prices, policy changes in major rubber producing and consuming countries. The specific objective of the study was to identify the factor responsible for price formation and supply response of natural rubber. The result shows that the price formation of natural rubber revealed that the futures price, international price, and synthetic rubber price were statistically significant where as crude oil price and exchange rate were non-significant. From supply response analysis, it was inferred that price was a significant factor explaining output growth. The analysis confirmed that lagged price exerted a positive influence on natural rubber area.

**Keywords:** Natural rubber, price formation and supply response

Natural rubber is a vital commodity used in the manufacture of a wide range of rubber based products, like black rubber, preserved latex, crepes and sheets from which auto tyres, auto tubes, automobile parts, footwear, belts, cables, wires, and battery boxes are produced. According to International Rubber Study

Group (IRSG), world production and consumption of natural rubber was 114.1 and 109.5 lakh tonnes respectively with a surplus of 46 lakh tonnes during 2012 (IRSG, 2013). Thailand is the largest producer of natural rubber in the world, followed by Indonesia, Malaysia, India, Vietnam and China. Globally, China is the largest consumer of natural rubber and occupied 34 per cent of the world's total consumption in 2011-12. India is the second largest consumer of natural rubber in the world after China. India consumed 0.78 lakh tonnes every year with the growth rate of 1.8 per cent per annum (Rubber Statistic News, 2013).

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## Address for correspondence

Y. Melba: Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore, India

E-mail: [agrimelba@gmail.com](mailto:agrimelba@gmail.com)

Natural rubber imports from Indonesia have increased gradually, followed by Vietnam and Thailand. In 2012-13, India imported 0.99 lakh tonnes of natural rubber from Indonesia followed by 0.51 lakh tonnes from Vietnam. Malaysia has led export markets for Indian natural rubber followed by China, Sri Lanka, Iran, Italy and Germany. In 2011-12, export of natural rubber to Malaysia has increased from 0.04 lakh tonnes to 0.09 lakh tonnes in 2012-13 (Rubber Board of India, 2013). Therefore, the study was taken up to analyze the price formation and supply response of natural rubber.

## METHODOLOGY

The price data for natural rubber comprised of time series data for both spot and futures price of natural rubber. The Rubber Board of India data base was helpful in getting the spot and international prices of natural rubber selected for this study. Futures price data were collected from National Multi Commodity Exchange (NMCE), Ahmadabad. Other related information collected were exchange rate from RBI website and crude oil prices from (www.eia.gov). The present study aimed to analyze the price formation and supply response of natural rubber. Daily time series data for the price of natural rubber for years (2003-12) for domestic and international markets were collected and monthly price series of exchange rate, crude oil price and synthetic rubber price were collected.

### Price Formation in Natural Rubber

Regression was a statistical measure that attempts to determine the strength of the relationship between one independent variable and a series of dependent variables. It helped to determine the contribution of each independent variable towards explaining the variation in the dependent variable (Jennrich, 1995).

The study had used regression analysis to identify the factors responsible for price formation in natural rubber, assuming a model as follows

$$S_t = b_1 F_t + b_2 I_t + b_3 SR_t + b_4 E_t + b_5 CP_t + u_t$$

Where,  $S_t$ : spot price for natural rubber,  $F_t$ : Rubber futures price,  $I_t$ : international rubber price quoted at time  $t$  for delivery date,  $SR_t$ : synthetic rubber price,  $E_t$ : exchange rate at time  $t$ ,  $CP_t$ : crude oil price at time  $t$ ,  $b_1$  to  $b_5$ : regression coefficient,  $u_t$ : error term.

### Estimation of Supply Response for Natural Rubber

To determine the responsiveness of natural rubber area in India to price and non-price factors with the help of supply response functions, Nerlovian Acreage Response Model was used. The basic model used for studying the supply response in agriculture was that of Nerlovian lagged adjustment model (Nerlove, 1958). The description of data and variables were presented below for better understanding. The structure of supply response model stated that current area under natural rubber was a function of lagged area and lagged price of natural rubber.

Algebraically, the functional model was given below:

$$\Delta A_t = f(A_{t-1} + P_{t-1} + u_t)$$

Where,  $\Delta A_t$ : change in area under natural rubber at time  $t$ ,  $A_{t-1}$ : Lagged area,  $P_{t-1}$ : Lagged price,  $u_t$ : error term.

The logarithmic form of the Nerlovian model was estimated in EViews using Ordinary Least Squares.

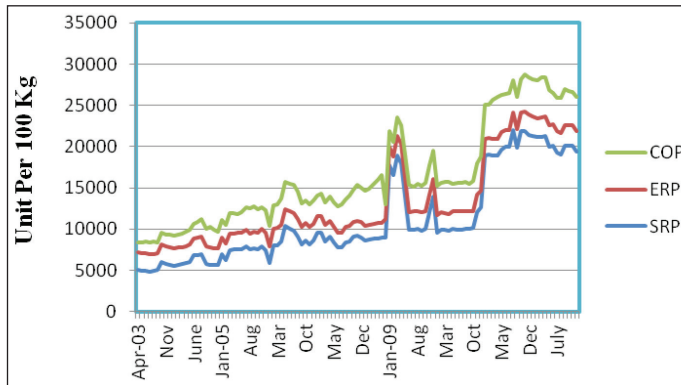
$$\text{Short run Elasticity} = A_1$$

$$\text{Long run Elasticity} = A_1 / (1 - A_2)$$

Where,  $A_1$ : coefficient of natural rubber price;  $A_2$ : Lagged area coefficient

### Results and Findings

In order to ascertain the factors responsible for price formation in natural rubber, regression analysis was conducted with spot price as dependent variable and future price, international rubber price, synthetic rubber price, exchange rate and crude oil price as independent variables and the results are presented in Table 1. The price movements of the variables taken for analysis are also indicated in Figure 1.



**Fig. 1: Price Movement of Synthetic Rubber Price, Exchange Rate and Crude Oil Price**

**Note:** COP: Crude Oil Price, ERP: Exchange Rate Price and SRP: Synthetic Rubber Price.

The exogenous variables like, finding of crude oil prices, synthetic rubber prices and exchange rate during the study period exhibited the similar movements as exhibited by the domestic rubber prices. Higher crude oil prices increased the cost of natural rubber price and also increased the inflation rate. Like Hasbrouck and Schwartz (1988) Hasbrouck (1995) and Gresse (2010), consistent with literature, the included variables had the same relationships with that of the spot price of natural rubber. Romprasert (2010) studied the RSS 3 futures price in Agricultural Futures Exchange of Thailand (AFET) at time  $t'$  had positive relationship with crude oil price and TOCOM future price and accordingly, increase in one unit in crude oil price affected the RSS 3 futures price by 0.022 unit and one unit increase in TOCOM price resulted in increase in RSS 3 futures price by 0.230 unit.

**Table 1: Results of Price Formation in Natural Rubber**

S. No.	Variables	Coefficient	Standard Error
1.	Intercept	-282.40 (-0.22)	1268.65
2.	Futures price	0.25** (9.13)	0.03
3.	International price	0.57** (16.90)	0.03
4.	Synthetic rubber price	0.20** (5.56)	0.04
5.	Exchange rate	0.01 (0.01)	0.61
6.	Crude oil price	-0.11 (-1.15)	0.09

**Note:** Figures in parentheses indicate  $t$ -value of respective coefficients.

$R^2$  Value = 0.784968

Adjusted  $R^2$  = 0.784252

\*\* indicates significance at five percent level.

Among the five independent variables included in the model, the values of futures price, international price, and synthetic rubber price were statistically significant at five per cent level. It could be interpreted that one unit increase in the futures price would increase the spot price by 0.25 units when keeping the other things constant. Likewise one unit increase in the international rubber price increased spot price by 0.57 unit and one unit increase in the synthetic rubber price increased spot price by 0.20 unit. Whereas the other factors like exchange rate did not show any impact on the natural rubber price and where as crude oil price was non-significant.

The Coefficient of Multiple Determination ( $R^2$ ) indicated that 78.4 per cent of the variation in the response variable was explained by the three independent variables included in the model. Similarly, the adjusted  $R^2$  also indicated the higher proportion of variation in the dependent variable by taking care of degrees of freedom. Table 1 which represented the price determination relationships and they were of greater interest for the current study. The price formation model inferred that futures, international and synthetic rubber price were significant at five per cent and the crude oil price and exchange rate were non significant. From the above analysis, it could be inferred that spot price is influenced by futures price, international price and synthetic rubber price.

From the Table 1 it could be inferred that the coefficient of multiple determination ( $R^2$ ) was 0.632 which indicated that 63.2 per cent of the variation in the dependent variable was explained by the independent variables included in the model.

A Nerlovian supply response model was used in the present study to know the response of current area under cultivation to the area and price of natural rubber in the lagged year. The regression results for the period from 1997 to 2012 are presented in Table 2.

**Table 2:** Results of Acreage Response for Natural Rubber

S.No.	Variables	Parameters	t value	Probability	Short run price elasticity	Long run price elasticity
1.	Lagged area	0.74	3.29	0.01		
2.	Lagged Price	0.04	1.47	0.16		
3.	Constant	2.90	1.07	0.30	0.042***	0.167
	R square	0.75				

(\*\*\* significant at 1 per cent level)

These variables together explained 75 per cent of the variation in Indian natural rubber area, which would decide the actual supply. The sign revealed that lagged price of rubber in the current year exerted a positive influence on natural rubber area in India. The estimated coefficient of adjustment was significantly different from unity, implying immediate adjustment of supply to price changes and suggesting that the inclusion of a lagged dependent variable in the models was appropriate.

In the model, the price elasticity of supply response for natural rubber was estimated to be low, as expected. The estimated elasticities from OLS estimators showed that one per cent increase in lagged price of natural rubber increased supply by 0.042 and 0.167 unit under short-run and long-run respectively, which was consistent with standard production theory: a positive supply response to own price. If agricultural supply was highly responsive to price changes, it would reflect farmer's behavior to produce more. This showed that natural rubber farmers' decision on area to be shown was largely dependent on the price prevailed in the current previous season.

It was indispensable to study the acreage response of natural rubber farmers to the change in price. The movement of price and the decision of farmers regarding the area to be cultivated in order to minimize the loss or maximize their profit could be studied. Interpretation of the resulting elasticities was slightly undefined, since they shared some long-run as well as some short-run characteristics. The long-run characteristics arose from the fact that the elasticity measures moved between two static equilibrium positions, while the short-run characteristics arose from the fact that there were fixed

inputs. From this analysis, it was inferred that price was a significant factor explaining output growth. The analysis confirmed lagged price exerted a positive influence on natural rubber area.

## CONCLUSION

The objective of the study was to analyze the factors responsible for price formation and supply response of natural rubber. While estimating the price formation model, it was inferred that spot natural rubber price is influenced by futures price, international price and synthetic rubber. The supply response analysis revealed that price was a significant factor explaining output growth. The analysis confirmed lagged price exerted a positive influence on natural rubber area.

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