Can Stakeholders in Natural Rubber Hedge in Crude Oil?

An ex-ante analysis

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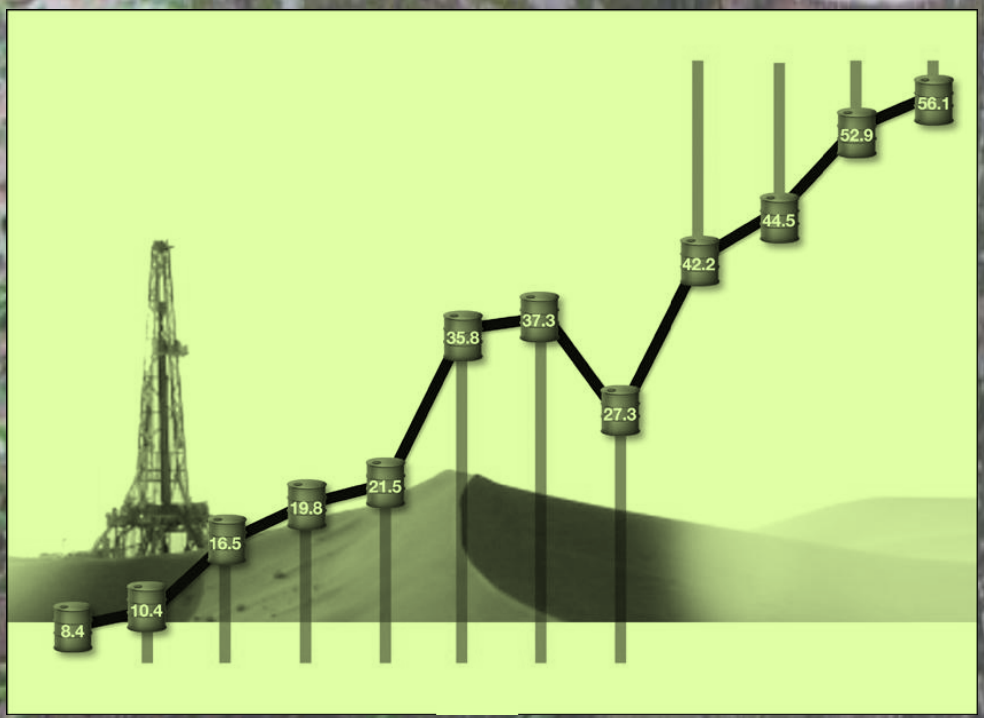

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Abstract

Natural Rubber futures trading has received flak from various corners on grounds that futures trading led to price rise. In fact, futures trading in natural rubber was also abandoned for some time last year, though the ban was subsequently removed in October 2008. This paper argues that in cases of ban on futures trading in natural rubber, the stakeholders can hedge effectively in crude oil, as the prices of the two commodities not only have a high degree of correlation, but elasticity too has increased after December 2005. This was due to a sudden spurt in growth of imports of synthetic rubber, where crude oil is an important factor of production. This phenomenon of increasing elasticity has been argued with a simple mathematical exercise, and basic econometric frameworks.

1. Introduction

Trading of rubber in commodity futures exchanges in India was banned in May 2008, under the allegation that futures trading led to an increase in price for the commodity. There was a mixed reaction among the various functionaries and industry groups, when the ban was slammed. While tyre manufacturers welcomed the move, the farm community criticized it severely, on the ground that the farmers would be deprived of an institutional mechanism of better price discovery and price risk management. Though the ban was subsequently removed in October 2008, yet, there has always been an apprehension of the regulator on whether to allow the resumption of futures trading to resume in rubber.

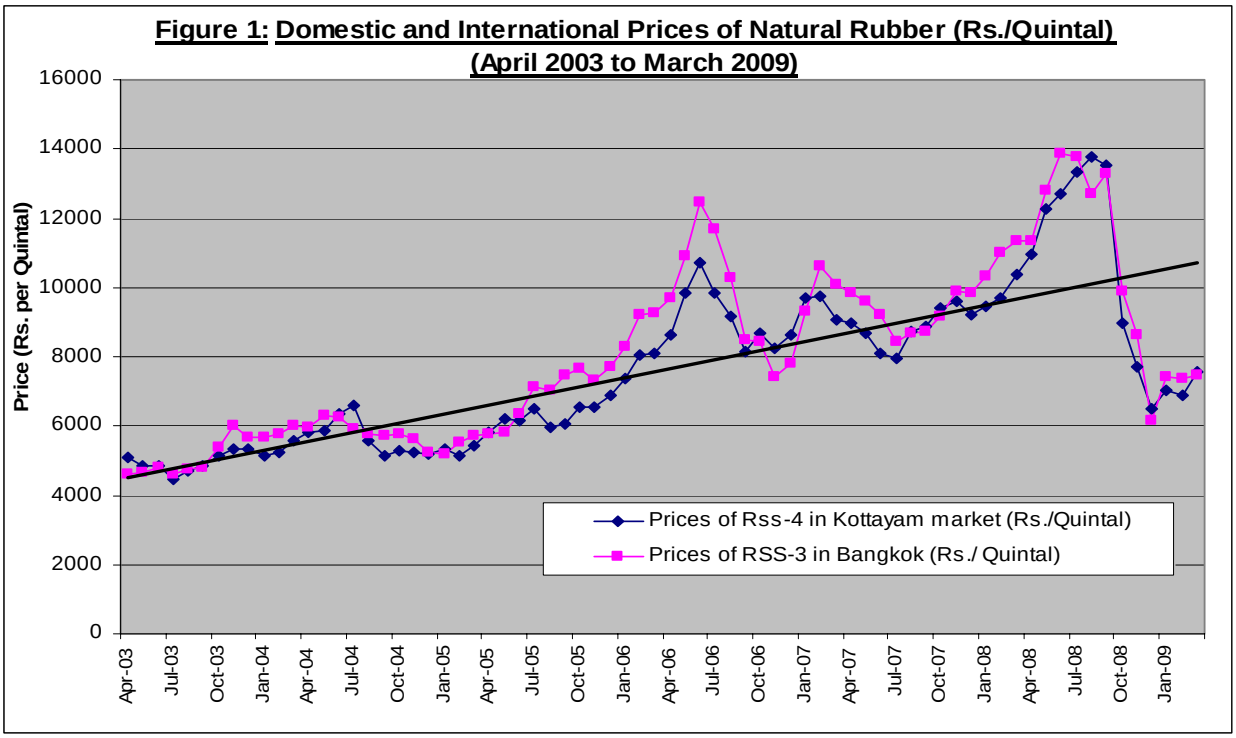
Interestingly, despite such apprehensions in allowing futures trading, India holds quite a prominent place in the world for its rubber production and consumption. The country stands as the fourth largest producer of natural rubber after Thailand, Indonesia and Malaysia; and the third largest consumer after China, and the U.S. Interestingly, as of 2007–08, more than 97% of the natural rubber production in India is concentrated in Kerala (92%), Tamil Nadu (3.2%), and Karnataka (2.1%). With Kerala being the prime producer, the prices prevailing in the Kottayam physical market for different grades of natural rubber are taken as reference prices in the country. About 90% of the natural rubber plantation holdings in India are fragmented and are held by small and marginal cultivators, while the remaining are held by co-operatives and private companies like AV Thomas Group and Harrison Malayalam. The main sales route is through a well-established network of dealers, though the small growers sell through rubber marketing co-operatives. The domestic rubber physical market witnesses the maximum arrivals of natural rubber between September and January. The various grades of natural rubber produced in India include RSS-4 (ribbed smoked sheet of fourth grade), RSS-5, latex, and ISNR 20 (Indian standard natural rubber). Internationally, however, RSS-4 is treated as equivalent to RSS-3, whose Bangkok market prices are taken as price setters for international markets.

Yet, given the apprehension among the various market functionaries and stakeholders, as well as the uncertainty prevailing about futures trading, there is a critical need to analyse whether market functionaries can find an appropriate substitute commodity for hedging, in case natural rubber futures suffer from ban in the face of continuous demand for the abandonment of rubber futures by the automobile lobby. This paper, practically, hinges upon this concern. In section 2, this paper discusses the price dynamics of natural rubber in India, and traces its relation with the Bangkok market, and raises a critical question on its price variability relation with crude oil. In section 3, a simple theoretical framework on how input price of imported substitute goods can affect the price of a commodity has been explained. In section 4, the paper presents the crux of the analysis, in which it shows that the price of natural rubber has, over time, become increasingly dependent on crude oil. In this section, the paper analyses the factors behind natural rubber price movements. Section 5 consists of concluding remarks.

2. Dynamics of Price Movements of Natural Rubber

Domestic price of natural rubber depends on the price trends of international rubber that further depends on demand from China, Thailand, India, Japan and the U.S. Domestic price is also influenced by rubber production from Thailand, Indonesia, and Malaysia—the three accounting for over 72% of global natural rubber production. Figure 1 shows the monthly movements of the domestic rubber smoked sheet type 4 (RSS-4) prices in the Kottayam physical market, as against the RSS-3 prices in the Bangkok market.

Figure 1: Domestic and International Prices of Natural Rubber (Rs./Quintal) (April 2003 to March 2009)



Source: CMIE

There are three stories that emerge from Figure 1. First, there is an increasing trend in the price movements of natural rubber, as revealed by the trend line (which is true even for real prices). Second, the domestic and the international prices of natural rubber have moved in conjunction with each other, to the extent of revealing a correlation coefficient of 0.97. This indicates the operation of identical types of demand and supply forces in both markets. Third, interestingly, post-December 2005, there were violent fluctuations in the prices of natural rubber. This is revealed by a higher coefficient of

variation from January 2006 to March 2009, as compared with April 2003 to December 2005 [Table 1], primarily because of higher imports of synthetic rubber in which crude oil is an important input of production.

On the other hand, high volatility of natural rubber never allowed market participants to judge the direction of rubber price movements even though the information of prices and the stocks in the markets were being published every month in major rubber journals. Here, we put forward the hypothesis that crude oil price fluctuations have caused rising volatility in natural rubber prices. Apparently, this hypothesis might not stand (Figure 1). In fact, it is interesting to note that the coefficient of variation of crude oil prices (considering WTI) has increased marginally from 27.05 to 32.4—a marginal increase of 19%, when we consider the New York Mercantile Exchange (NYMEX) futures market prices. On the other hand, the coefficient of variation for domestic natural rubber price has increased by 70%. The obvious question that arises is: how can we, at all, think of international prices of crude causing fluctuations in domestic prices of natural rubber, despite the evidences showing something else? Yet, we posit that the influence of crude oil prices on the prices of natural rubber has increased over time due to higher substitution effects caused by synthetic rubber imports. This hypothesis will be tested in later parts of the article.

Table 1: Coefficient of variation in two periods

Period	**Coefficient of Variation (CV) in domestic natural rubber prices**	**Coefficient of Variation (CV) in crude oil prices (NYMEX)**
April 2003 to December 2005	11. 29	27.05
January 2006 to April 2009	19.12	32.40

Source: Estimated by Authors

3. A simple framework of dependence on input of substitute goods

Let us conceive of a framework where we assume that there are two competing commodities whose demands are given by, Q and q (each signifying quantity), which act as substitutes for each other. Let P be the price of Q. We assume that Q is produced entirely within the country. However, a part of q, say, $\bar{q}$ is produced within the country,

while the remaining is imported, and denoted by q^M. We further assume that imported quantity is produced with the input of crude oil, *c*, whose price is given by p^C. Eventually, we pose the following equations:

$P = \phi(Q)$ …(1) ---------- Excess demand function for Q (say, natural rubber)

$Q = e - f.q$ … (2) ---------- Substitutability of Q and q (say, q is synthetic rubber)

$q = \bar{q} + q^M$ … (3) ---------- Supply identity for q

$q^M = \theta.c^\alpha.\varepsilon$ … (4) -------- Production of q^M (imported synthetic rubber[&]), $0<\alpha<1$.

$c = \eta - \lambda.p^C$ … (5) ----- Input demand function for crude oil

From the theoretical viewpoint, let us assume that all the functions are derived from well-behaved production, cost, and utility functions, with the only exception that for the sake of simplicity, several functions have been considered linear. With (1) being the excess demand function, a rise in demand will increase the prices, and hence, $\phi'(Q) > 0$. Even in the production function (5), the assumption of $0<\alpha<1$, has been placed to assert on the diminishing marginal productivity of input. All other associated parameters, namely, *a, b, e, f,* θ, η, α and λ are positive.

Here for simplicity's sake, we have not considered any demand function for *q*, and assume that an increase in demand will automatically exert a rise in q^M. This is also to assert the assumption that $\bar{q}$ is the maximum capacity of synthetic rubber that can be produced domestically, and the remaining $(q - \bar{q})$ has to be imported. Since we are not looking at the supply response due to price change of crude, for natural rubber we have not taken a supply function. Our aim is simply to find how a rise in crude prices can affect the demand for natural rubber, and eventually its price dependence on external factors. Thus, in a thoroughly partial system, there is hardly much need to consider the impact on supply, which, as we are aware, is an important determinant of price. In case the supply would have been perfectly inelastic, the price would have been demand-determined entirely. Hence, this case is similar to assuming that supply does not determine prices.

[&] ε indicates a vector of other factors in the production process.

In any case, what we need to find is the impact of a change in price of natural rubber due to a change in the price of crude oil. This translates to finding $\frac{dP}{dp^C}$, which can be defined as follows:

$$\frac{dP}{dp^C} = \frac{dP}{dQ}.\frac{dQ}{dq}.\frac{dq}{dq^M}.\frac{\partial q^M}{\partial c}.\frac{dc}{dp^C} \quad \ldots (6)$$

After relevant deductions from (6), we obtain the following:

$$\frac{dP}{dp^C} = \frac{\phi'.f.\lambda.q^M}{b.c} \geq 0 \ldots (7), \text{ as we assume that } q^M \geq 0.$$

It is clear from (7) that a rise in crude prices will increase the price of natural rubber. This will happen precisely because a rise in crude prices will bring about a fall in crude demand, which will have a tendency to depress synthetic rubber production, and eventually result in a lower ability to satisfy the import demand for synthetic rubber. The void creates more demand pressure on natural rubber, whose effective demand rises, thereby causing a rise in the price of natural rubber.

The other interesting aspect of (7) is that it reveals that higher the level of import of synthetic rubber, higher the sensitivity of natural rubber prices to crude oil prices. Hence, if we denote the elasticity of natural rubber price to crude oil price by σ, which will be defined by $\sigma = \frac{dP}{dp^C}.\frac{p^C}{P}$, then there is no doubt that all other things remaining constant, σ is directly proportional to q^M. This implies that if imports are high, a rise in crude oil prices will bring about a large change in natural rubber prices.

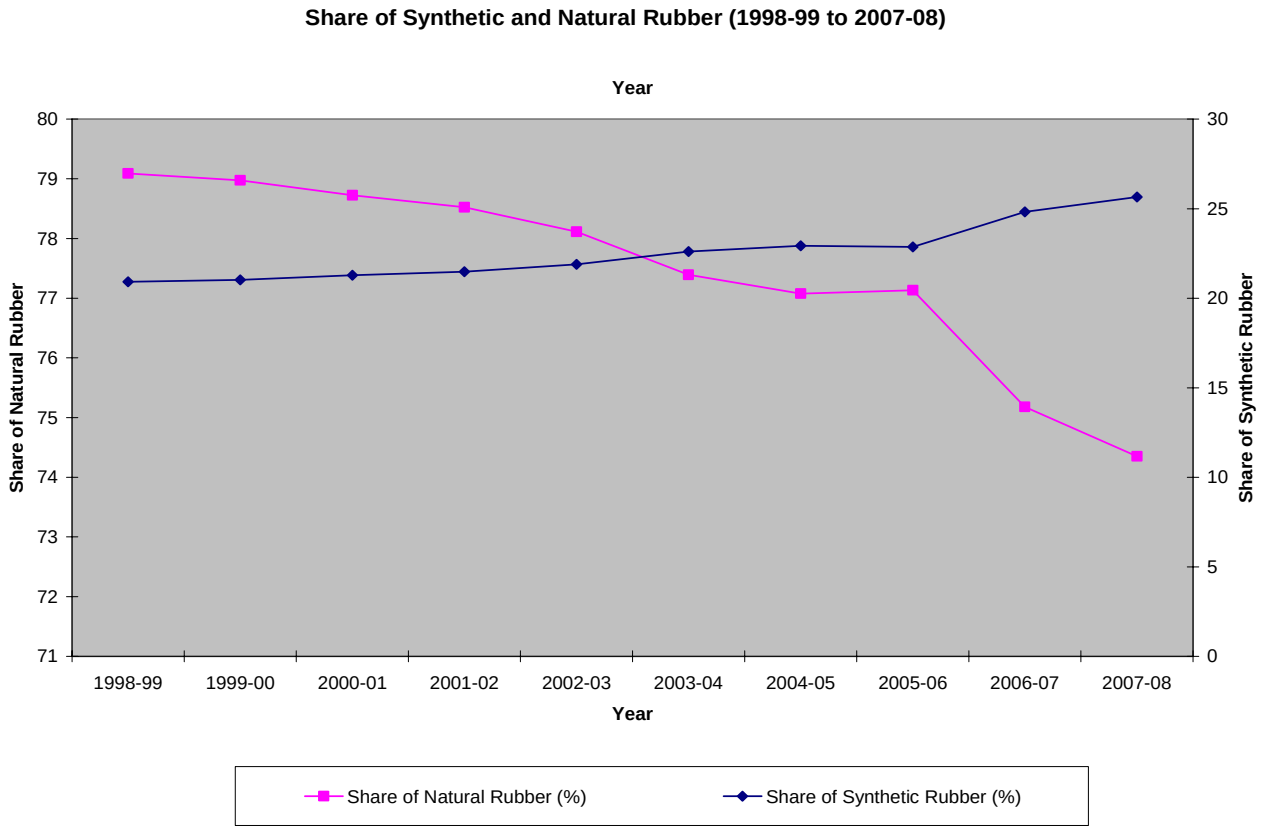
4. The Empirical Framework

Substitutability of natural and synthetic rubber: increasing imports of synthetic rubber

Natural rubber and synthetic rubber are almost perfect substitutes of each other. The phenomenon is getting more and more reinforced over time. Due to substitutability, a

rise in relative price of synthetic rubber as against natural rubber will shift relative demand toward natural rubber and raise the price of the latter. Of late, the share of synthetic rubber has been increasing, slowly displacing the share of natural rubber. (Figure 2).

Fig. 2:



Source: *CMIE*

Table 2: Production to Consumption Ratios

Year	Natural rubber	Synthetic rubber
2001-02	0.99	0.39
2002-03	0.93	0.41
2003-04	0.99	0.42
2004-05	0.99	0.42
2005-06	1.00	0.41
2006-07	1.04	0.37
2007-08	0.96	0.36

Source: *CMIE*

On the other hand, as revealed in Table 2, while the total domestic production to total consumption ratio for rubber ranged between 0.8 and 0.9 from 2001–02 to 2007–08, the ratio has always been prominent (from 0.93 in 2002–03 to 1.04 in 2006–07) for natural rubber. This implies a low import dependence of natural rubber, while a low production to consumption ratio of synthetic rubber is indicative of its high import dependence.

Table 3: India's annual export and import of natural rubber and synthetic rubber (in metric tonnes) with price difference between domestic and international price, April 2002–December 2008

Year	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09 (up to December '08)
Import of natural rubber	26,217	44,199	72,835	45,285	89,699	86,394	62, 547
Import of synthetic rubber	129,902	104,733	113,095	132,118	171,998	195,705	184,757

Source: Rubber Board up to 2007-08, and thereafter CMIE

Interestingly, there is a sudden rise in imports of synthetic rubber from 2006–07 onwards (Table 3). In fact, within the first three quarters of the financial year of 2008–09, imports have already surpassed the 2006–07 levels, and hence by the end of the financial year, imports are likely to surpass the 2007–08 levels. A rise in imports of synthetic rubber by almost 87.5% between 2003–04 and 2007–08 indicates that not only the domestic prices of synthetic rubber are exposed to international trade vagaries, but simultaneously the domestic prices of natural rubber are also exposed to the same due to the substitution opportunities between the two types of rubber.

Price movement of natural rubber: a demand-driven phenomenon

Domestic production of natural rubber has failed to keep pace with the rising demand. The production grew at *CAGR* of 4.6% and at *CAGR* of 7.5% of natural and synthetic rubber respectively. Although, domestic natural rubber production accelerated (since 2001–02) to meet the rising demand, 2007–08 witnessed a fall in natural rubber production (27,550 tonnes) from its previous year due to bad weather (excessive rainfall)

and the outbreak of chikangunya disease in Kerala, which reduced the number of tapping days.

There is a clear indication that the price increase in natural rubber has been a *demand-driven phenomenon*. Production has not even responded to increasing prices, even with lag effects. This is also reflected in the regression analysis, which has been conducted with domestic production and consumption of natural rubber as the explanatory variables, and the domestic price of natural rubber as the dependent variable. This has been run in a log-linear format, so that each slope coefficient reflects on the elsticity. Prior to that, the unit root test of stationarity was conducted, which revealed that all the data series were stationary over time. (The regression results obtained are given in Table 4.)

Table 4:
Regression Results (Y: Natural log of Domestic Price of NR, Ln (Prod): Natural log of Production of Natural Rubber and Ln (Cons): Natural Log of Consumption of Natural Rubber period: April 2003-January 2009)

				Y : Natural Log of domestic price of NR		
Regression Statistics						
Multiple R	0.826670289					
R Square	0.683383767					
Adjusted R Square	0.673932536					
Standard Error	0.171007788					
Observations	70					
ANOVA						
	D.f.	*SS*	*MS*	*F*	*Significance F*	
Regression	2	4.229004	2.114502	72.30632	1.85E-17	
Residual	67	1.959325	0.029244			
Total	69	6.188329				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-26.19761483	2.923916	-8.95977	0.00	-32.0338	-20.3615
Ln (Prod)	-0.111697984	0.072186	-1.54737	0.13	-0.25578	0.032385
Ln(Cons)	3.270468385	0.27745	11.78762	0.00	2.716677	3.82426

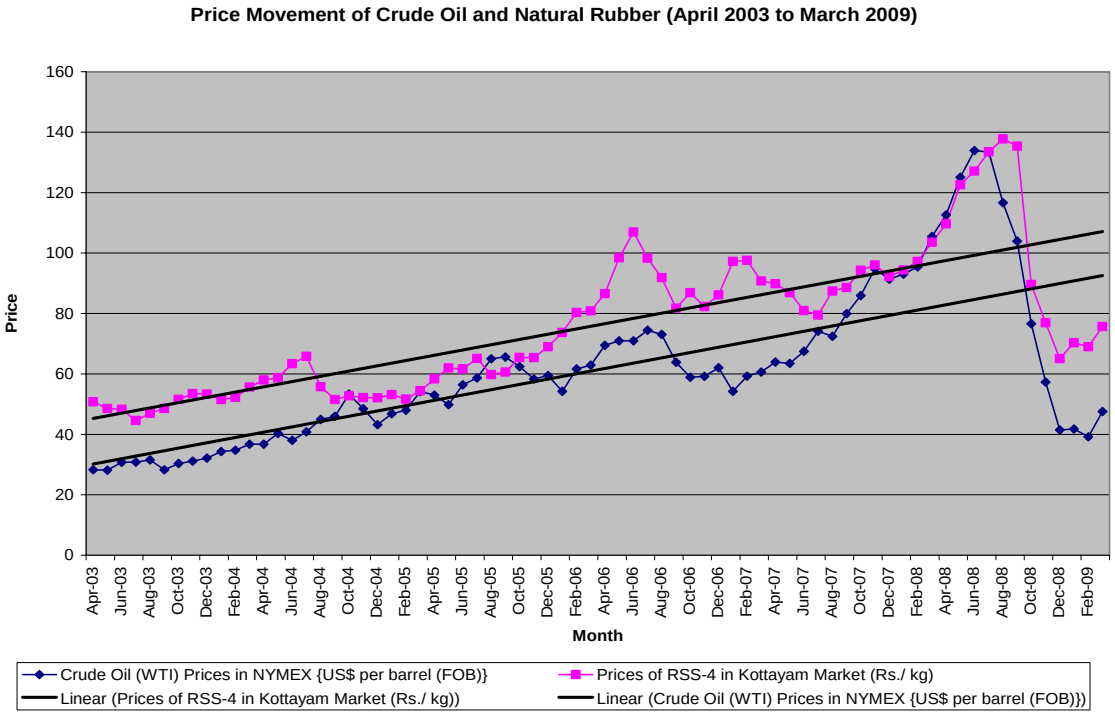
Source: Estimated by Authors

The regression equation shows that consumption is a significant variable at 1% level of significance affecting prices, while production is not a significant variable affecting prices. On the other hand, between April 2003 and January 2009, the price elasticity of demand (consumption) is as high as 3.27. Hence, this validates our assumption of inelasticity of supply, as assumed in the theoretical framework.

4.3. Crude oil prices and volatility of natural rubber prices

As stated in Table 1, the volatility in the price movements of natural rubber has increased after December 2005. We attribute the rationale for this volatility to higher exposure to international oil price movements. As stated earlier, synthetic rubber acts as a substitute for natural rubber in many cases. With a majority of the rubber produced in the world being synthetic (unlike the Indian case), which is a derivative of petroleum-based products, the price of natural rubber is highly influenced by the movement of the global price of crude oil. Figure3 shows that the domestic prices of natural rubber and crude oil have moved in conjunction with each other over time.

Fig.3:



Source: Compiled from CMIE, Bloomberg, and Rubber Board of India.

To check the increasing influence of crude on domestic price of natural rubber, we have fitted a regression equation of the following log-linear form.

$$\ln Y_t = \alpha_1 + \alpha_2 . D + \alpha_3 . \ln X_t + \alpha_4 . D . \ln X_t + u_t$$

where

Y_t is the price of natural rubber;

X_t is the price of crude at NYMEX;

D is the period dummy defined as

D = 0, for period before December 2005

D = 1, for period from January 2006 to March 2009.

α_i [i = 1, 2, 3, 4] denote the parameters, while u_t denotes the random disturbance term, and subscript t denotes the time variable.

To rule out the possibility of spurious relation between the dependent and the explanatory variables, we have tested for the stationarity of the time series data. The Augmented Dickey-Fuller (ADF) test for the unit root suggested the rejection of the non-stationarity hypothesis. (The results of the regression equation are stated in Table 5.)

Table 5: Regression Results explaining domestic price of natural rubber as a function of price of Crude Oil

		ln Y is natural log of Domestic price of NR				
Regression Statistics		ln X is natural log of Crude (WTI)				
Multiple R	0.957936727	D = 0 for April 2003 to December 2005				
R Square	0.917642772	D = 1 for January 2006 to March 2009				
Adjusted R Square	0.914009365					
Standard Error	0.086603928					
Observations	72					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	3	5.682717	1.894238989	252.557103	0.00	
Residual	68	0.510016	0.00750024			
Total	71	6.192733				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*

Intercept	7.5518	0.2106	35.8540	0.0000	7.1315	7.9720
D	-0.5740	0.2855	-2.0107	0.0483	-1.1437	-0.0043
ln(X)	0.2855	0.0561	5.0887	0.0000	0.1736	0.3975
D. ln (X)	0.2157	0.0718	3.0026	0.0037	0.0724	0.3591

Interestingly, the coefficients of both *ln X* and *D. ln X* are significant and positive. This indicates that increase in crude prices not only brings about a rise in natural rubber prices (Figure 3), but the intensity of influence of crude prices on natural rubber prices have increased after December 2005 due to a massive rise in synthetic rubber imports. This is evident from the regression results in Table 5 that suggests that the elasticity (given by the slope coefficient) of domestic price of natural rubber in the second sub-period has increased to 0.5012 from the first sub-period's elasticity of 0.2855. Hence, the sensitivity of domestic prices of natural rubber to crude prices has increased substantially.

Resultantly, the volatility of crude prices, which has remained almost the same in the two sub-periods (Table 1), has got further injected into the price dynamics of domestic rubber. This has resulted in a greater fluctuation of domestic rubber prices after December 2005, as compared with the period prior to that. The high level of dependence is also evidenced from the fact that 2008 marked historic highs in monthly natural rubber prices (Rs127–138 per kg) during June–August period, when the monthly crude oil prices soared to $140 a barrel during June 2008.

On the other hand, the recent decline, in domestic natural rubber prices, as evidenced till March 2009, is attributable to the decline in crude prices of late. The meltdown in natural rubber prices has hit rubber farmers in India hard, with domestic rubber prices (monthly average) came down drastically to Rs 6.90 a kg following the fall in the crude oil price to $47 per barrel during March 2009. There are now clear indications that the business cycle of natural rubber follows the business cycle of crude oil.

5. Concluding Remarks

Price volatilities in commodities affect all, and create uncertainties for various stakeholders in the market ecosystem. Natural rubber is no exception. The recent decline in natural rubber prices is not a zero-sum game. While it has hit the farmers hard, it has

not been beneficial to the rubber goods producers (especially tyre makers) either. This is because many of them have procured rubber and have built up their inventories at higher prices. Economic slump has affected overall demand, and eventually resulted in involuntary inventory accumulation. This uncertainty in demand is not a one-off story. This needs to be viewed as an integral component of the global business cycle, of which India represents a portion. With domestic prices in India getting globally aligned, as also being significantly and increasingly affected by global crude oil price fluctuations, rubber and rubber goods producers need effective mechanisms to hedge against price risks. This article, in that sense, has highlighted that futures trading in rubber might be helpful as a hedging mechanism. The utility of the futures market for hedging cannot be denied in any case. A higher dependence on crude prices in the post-December 2005 era has further indicated that in the absence of derivatives trading in rubber, cross-hedging with crude oil in the derivatives market might also be a good option. This, indeed, gives the stakeholders a wider opportunity to hedge, which is, indeed desirable from the market participants' viewpoint.