An Analysis of Role of Agriculture in Economic Development in Sri Lanka (1970 – 2003)

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ABSTRACT

The study examines empirically the impact of a number of prominent aspects related to the agricultural sector in Sri Lanka on its overall national development since 1970. The theoretical framework of the analysis used basically the hypotheses made by Myint (1977), i.e. agriculture sector of a country can promote its economic development by five distinct ways: (1) increasing the supply of food available for domestic consumption; (2) releasing its labour for industrial development; (3) enlarging the size of the domestic market for the industrial sector; (4) increasing the supply of domestic savings from agriculture, and (5) providing the foreign exchange earned by agricultural exports.

Using the secondary data related to these aspects for the period of 1970 to 2003, a multiple regression analysis was carried out with appropriate variables to express these phenomena. The results suggest that various actions taken and policies implemented by respective governments on the agriculture sector in Sri Lanka have significant and long-term impact on overall economic development, especially with respect to household food production and food security, labor mobility, capital formulation, and marketing and trade of agricultural products.

KEY WORDS: Agriculture Sector in Sri Lanka, Economic Development, Structural Change, Agricultural Policies

INTRODUCTION

Agriculture has been the most important pursuit of the people in Sri Lanka from time immemorial. It has greatly conditioned the socio-economic environment of the country and continued to dominate every sphere of economic. It contributes approximately 19 percent to the total Gross Domestic Production (GDP). More than 70 percent of the 19.2 million populations in the island have made their livelihood primarily based on agriculture. In other words, the sector has provided source of employment to about 35 percent of the total labour force (Annual Report, 2003).

Total land area in the island is about 6.5 million hectares and 28 percent of it (1.8 million hectares) has already being used for agriculture. More than 60 percent of agricultural lands have being utilized for plantations (tea, rubber, and coconut), paddy and other field crops.

Government has identified the boom of agricultural sector as a key for the economic development. Therefore, they have tried to develop it from time to time. Government has given their fullest effort to develop agriculture following the closed economy in the period of 1970 – 1977.

Import substitution was found as their main economic strategy, which attempted to manufacture a wide range of consumer items, did not have a significant impact in changing the economic structure. Nevertheless, this strategy was fail. Because, Sri Lanka is small country with few raw materials, inadequate capital and technology and very small domestic market, cannot produce quality industrial products at competitive prices. In this time Sri Lanka's economy remained substantially an agricultural one with nearly 30 percent of GDP being from agriculture and only 14 percent from industry. Agricultural exports dominated the exports accounted 79 percent of exports and industrial exports were only 14 percent. In 1978, open economy was introduced with economic reforms including the liberalization of trade and exchange controls and the introduction of an economic strategy dependent on private investment and market forces. The role of agriculture in the development process alters during these periods. Contribution of agriculture to GDP declined to 23.3 percent by 1990, 19.7 percent by 2000 and only 17.9 percent by 2004 (Sanderatne, 2005).

This is an evident that Sri Lankan economy faced the structural transformation. Definition of structure transformation is a process by which increasing proportions of employment and output of the economy are accounted for by sectors other than agriculture. The economy becomes less agriculturally oriented in a relative sense, although agriculture and, more broadly, the food system continue to grow absolutely and generate important growth linkages to the rest of the economy. Structural transformation thus involves a net resource transfer from agriculture to other sectors of the economy over the long term.

This transformation made significant impact on Sri Lankan economy. Due to certain policies that are being implemented within the framework of both types of economies, agriculture in the island has faced internal as well as external problems.

Economists suggest that the development of agriculture can promote economic development by increasing the supply of domestic food consumption, releasing the labour needs for the industrial employment, enlarging the size of the domestic market for industrial sector, increasing the supply of savings from agricultural sector and providing exchange earned by the agricultural exports (Myint, 1977).

This theory is valid with respect to developing countries. Hence, the objective of the study is the analysis of five major policies stated from 1970 to 2003,under the closed and the open economic settings in terms of the development of agricultural sector and to find out the ways of improving the so-called policies in order to maintain sector in higher position.

METHOD

Analytical framework

This study was undergone to test the five hypotheses made by Myint (1977) in relevant to Sri Lankan situation.

Five hypotheses were developed to find out the ways of affecting agriculture development in overall economic development of Sri Lanka. They are (1) Per capita consumption of foods that can be used domestically (Kg/year) (2) Percentage of economically active population in agriculture to total midyear population (3) Percentage of revenue earned by industrial sector to total revenue earned by same sector (4) Domestic savings from agricultural sector (Million rupees / year) (5) Percentage of agricultural exports earnings to total exports earnings.

Some assumptions were made to increase the accuracy and efficiency of the study. They are;

1) Only paddy and subsidiary food crops were considered as domestically available food crops.
2) Domestic revenue from industrial sector was calculated by deducting value of industrial exports from industrial production
3) Domestic savings from agriculture were calculated by using domestic saving ratio and GDP share in agriculture
4) Percentage of agricultural labour force roughly estimated as 36% for this study
5) Tea, rubber, coconut and export agricultural crops were considered as major export crops

Data collection

This study was carried out with using secondary data. Data related to GDP, GNP, paddy sector and industrial sector were collected by using various publications of central bank while labour force data were collected from department of senses and statistics. Following table was use to calculate variables (Table 1). According to study, variables were constructed as follows (Table 1). The model used for the study consisted of a dependent variable (percentage of per capita GNP to total GNP) and five independent variables (PFC, ALF, RIS, DSA and AET). It was assumed that dependent variable is a linear function of PFC, ALF, RIS, DSA and AET.

Multiple linear regression model was used to find out the relationships between the two kinds of variables.Multiple linear regression model contains two or more independent variables in addition to the constant error team. It can be illustrated as follows;

$$Y = \beta_1 + \beta_2 * X_2 + \beta_3 * X + \beta_3 * X_3 + \ldots . \beta_n * X_n + E_i$$

Where,

Y_i = the dependent variable.

β_i = constant or intercept of the equation. (i = 1, 2, 3....n)

X_i = Independent or explanatory variable. (i = 1, 2, 3...n)

ε_i = error term.

(Greene, 2000)

Table 1: Variable description and method of calculation:

Symbol	Variable Description	Method of Calculation
PAG	Per capita Agricultural GNP	1970 factor prices were used. Total GNP was divided by the mid year population in the same year. Then using below equation, percentage value was estimated. $PAG = \frac{\text{Per capita GNP in agriculture}}{\text{Total GNP}} * 100$
PFC	Per capita Food Consumption	Paddy and subsidiary food production (Kg) was divided by relevant mid year Population.
ALF	Agricultural Labour Force	Agricultural labour force was taken in each year. It was divided by total mid year population in relevant year.
RIS	Revenue earned from Industrial Sector	Value of industrial production and industrial exports were taken in million rupees. Revenue was calculated by deducting value of industrial exports from industrial Production. Percentage between revenue and industrial production was estimated in each year.
DSA	Domestic Savings From Agricultural sector	GDP in agriculture was calculated using agricultural share in GDP as a percentage in same year. Domestic saving ratio was taken in each year. Domestic savings from agriculture was estimated by multiplying GDP share in agriculture and domestic saving ratio.
AET	Agricultural exports	Only tea, rubber, coconut and export agricultural crops were considered. Then agricultural exports as percentage of total exports in each year were calculated.

According to this context, multiple linear regression model can be constructed as follows;

$$PAG = \beta_1 + \beta_2*PFC + \beta_3*ALF + \beta_4*RIS + \beta_5*DSA + \beta_6*AET + \varepsilon$$

Where,

PAG = Percentage of per capita GNP from agricultural sector to total GNP.

PFC = Per capita food consumption (Kg/year).

ALF = Percentage of agricultural labour force to total midyear population.

RIS = Percentage of revenue earned by industrial sector in domestic market to total revenue

DSA = Domestic savings from agricultural sector (Million rupees / year).

AET = Percentage of agricultural exports to total exports

ε = Error term

RESULTS AND DISCUSSION

This section attempted to discuss how to affect above five factors to agricultural development process in Sri Lanka. Significance of model and significance of parameter estimation was described using Table 2.

Associations between five contributions to agricultural development are stated in Table 2. R^2 value describes how much degree of fitness of variables is associated to the model. If R^2 is high, that indicates the variables are fit to the model or vise versa. It was 0.9040 (90.49%) in this analysis. That means, five contributions considered in the study were highly related with the agricultural development process in Sri Lanka.

Parameter estimation describes the significant relationship between dependent variable PAG and independent variables (PFC, ALF, RIS, DSA, and AET). If the probability level is less than 0.05, there is significant relationship between agricultural development and per capita food consumption, agricultural labour force, industrial revenue, domestic savings and agricultural exports. If not vise versa. It is shown in Table 2.

Table 2- Parameter estimation of five contributions:

Variable	Parameter Estimate	Significance
PFC	0.00829 (0.00957)	0.3941
ALF	-0.20274 (0.14179)	0.1642
RIS	0.06562 (0.04431)	0.1508
DSA	-0.00020 (0.00103)	0.8474
AET	0.06206 (0.03423)	0.0809

*Significance at 0.05 $R^2 = 0.9040$

According to the parameter estimate it was identified that five contributions were not significantly related with agriculture development (probability of all variables were greater than 0.05). However, probability level of variable AET was 0.0809, which was closer to 0.05, compared to other contributions. That means, Percentage of agricultural exports to total exports were significantly related with agricultural development than other variables. Hence, development of export agricultural sector is the easiest way to increase GNP of agriculture.

This analysis revealed that there is no significant relationship between per capita food consumption and agricultural development though most of them believed that Per capita food consumption relate to agricultural growth.

Agricultural labour force was more or less remained unchanged during the observed period. Labour mobility from agricultural sector to other sectors like industrial, services were not observed.

Though industrial production was increased, revenue earned by industrial sector in domestic market was gradually decreased. That is due to export oriented industrial production, which performs diluting the domestic market for industrial production.

Domestic savings from agricultural sector was not contributed the development of agricultural sector. Indeed, it is very difficult with the low levels of domestic savings and decreasing contribution of agricultural sector.

Foreign exchange from agricultural export more related with the agricultural development than others. Plantation exports and export agricultural crops were main source of foreign earnings in agricultural sector. Decreasing of agricultural exports resulted decreasing of GDP in agricultural sector which reflecting dependency of agricultural exports on plantation crops and export agricultural crops.

It was also revealed that, per capita food consumption, industrial revenue and agric exports are positively related while agricultural labour force and domestic savings is negatively related with the agricultural development.

According to that, some predictions could be made on the future way and direction of Sri Lankan agriculture. Revenue earned by industrial sector will be increased further, while contribution of agricultural exports to total exports will be decreased. Domestic savings from agricultural sector will be decreasing continuously with the decreasing earnings in agricultural sector. Combination of agricultural sector with industrial sector will play a prominent role in near future (Figure 1).

The decline proportion of agriculture in GDP and a rising share in industry and services is an observed phenomenon of economic development. Agriculture contributes only a small fraction of GDP even in large agricultural producers like United States and Canada. In the United States, agriculture contributes less than 5% of GDP. However, this reduced importance in the economy has not been due lesser production in agriculture, but much higher production in the other sectors of the economy.

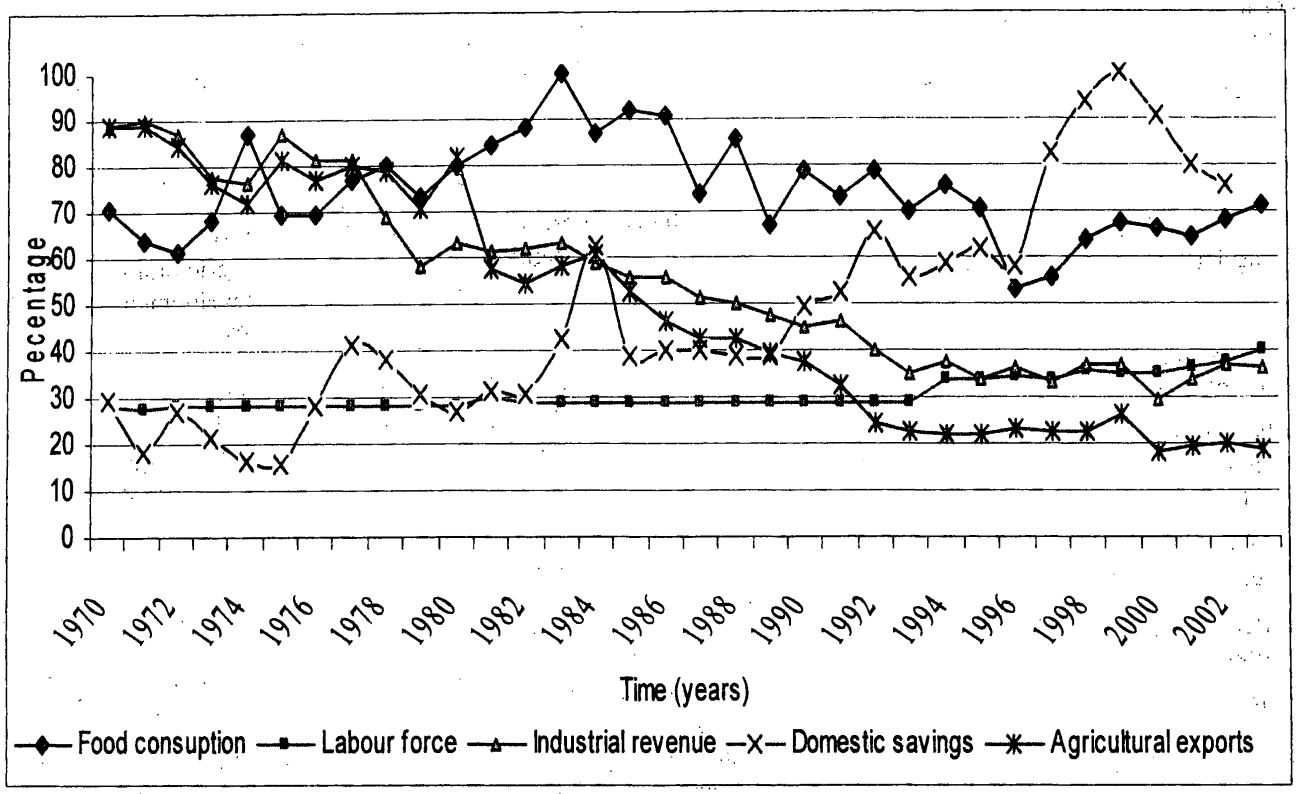

Figure 1- Behavior of five contributions from 1970 to 2003:

Unfortunately this is not entirely so in Sri Lanka (Nimal Sanderatne, 2005).

CONCLUSION

Results suggested that performances of the agricultural sector was continued to decline while the performances of other sectors were improved. Quality and diversification are the key factors with respect to development of Sri Lankan agriculture. Therefore, policy makers focus their attention on these key factors.

Governments should understand the importance of other field crops (Chilies, Pulses, Corn...etc) and policies should be imposed to give subsidies and incentives to this sector.

Relevant authorities should find out the ways of diversifying the agricultural sector in to agribusiness sector and agro-industry sector, instead of engaging raw agriculture. They will help to absorb more labour force from other sectors. Quality of labours should increase through training programs, workshops. Technical knowledge is the one of main area that should be improved. Ultimately, quality labour force will result quality production to compete in domestic market as well as in foreign market.

Policies may be imposed to create guaranteed and well-secured domestic market. State sector should play prominent role through co-operatives and regaining the CWC (Corporative Wholesale Corporation) from private sector.

Increment of agricultural earnings cause to increase agricultural savings. Hence necessity steps should be taken improve agricultural earnings through guaranteed price scheme, crop insurance policies and creating market at correct time, at correct place. Especially for other field crops like chilies, onion, potatoes.

Dependency of agricultural exports on plantation crops and other export agricultural crops should be minimized since it has a risk. Policies should be implemented diversify and substitute the agricultural exports. Exportation of fertilizer is good option since having rock phosphate in Eppawala. In addition to that, agro chemicals and value added foods are good option

Understanding the situation and adopting to implement new policies and constitutions is essential in this regard. "National Policy of Agriculture" is being identified as a long lasting for sustainable development in agriculture.

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Development of a Leading Indicator for Natural Rubber Prices in Sri Lanka

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ABSTRACT

The price is a relatively important driving force in the production and manufacturing industry of Rubber. It varies within the year (seasonal) and also between years (cyclical). Although advanced time series methods *viz.* ARIMA, ARMA *etc* are available, the prediction of cyclical behavior of the prices is found to be hard to predict.

In this study an attempt was made to identify cyclical nature of Sri Lankan rubber prices and the possible leading indicators to predict the cycle. A Composite Leading Indicator (CLI) was developed using 14 identified leading indicators. The CLI developed, closely predict the trend-cycle component. However, the CLI developed in this study needs to be further developed using at least 50 to100 years' data and possibly by involving more leading indicators.

KEYWORDS: Price Cycle, Trend-cycle component, CLI, Cross-correlation

INTRODUCTION

Rubber industry in Sri Lanka has been in existent for over 100 years since Sir Henry Wickham introduced rubber to Sri Lanka in 1876. Sri Lanka is the 6th largest exporter of rubber in the world (IRSG, Monthly bulletin, 2004).

Rubber accounts 0.7 percent of the total GDP in the country (Anon, 2004). It occupies seven to eight percent of total agricultural lands in the country. Total area under the rubber has gradually declined over past few years (Anon, 2004).

Also export of raw rubber has decreased from 99 million Kg in 1988 to 40.5 million Kg in 2004 while domestic rubber consumption has shown a remarkable increase from 16 million Kg in 1988 to 68 million Kg in 2004 (Anon, 2004). Therefore the sector has been recognized as a priority sector in the country's development programmes.

Rubber prices which have remained at a low level since the East Asia crises in year 1997, has begun to improve in 2002. The auction prices at Colombo Auction of all grades of rubber increased to the highest rupee recorded prices, ever in 2003 (Anon, 2003). As well as rubber production grew by 3 percent (95 million Kg) in 2004 in response to higher prices. The increase in crude oil price resulted in high synthetic rubber prices in the international market with a corresponding increase in natural rubber prices. (Anon, 2004).

As a primary commodity, the price variation of rubber has been a common phenomenon observed in the long history of rubber cultivation. The fluctuating price makes it difficult for investors to invest and producers to plan. The behavior of natural rubber prices of different grades have been discussed by Wijesuriya *et.al.* (1995).

The cyclical movement of prices is important but hard to predict. Thus, a technique to predict this movement is of great importance to producers and consumers of natural rubber alike. The composite leading indicator (CLI) which is an important statistical tool can be used to give an early indication of turning points in a time series.

The study analyses long-term price behaviour especially in terms of its cyclical variation. Thus, this study attempts to develop suitable composite leading indicator, which have strong correlation with rubber price that greatly influence the identification of movements in price cycles. This will enable policy makers to correctly predict the declining or increasing trend in prices and take suitable policy actions.

METHODOLOGY

Collection and organizing data

Study used secondary data on natural rubber for the period of 1980 to 2002. Data were obtained from published sources such as International Rubber Study Group (IRSG), Association of Natural Rubber Producing Countries (ANRPC), Ministry of Plantation Industries, Department of census and statistics, Central Bank, Internet *etc.*

Statistical Analysis

a) Price cycles

In developing price cycles, data were assumed to be made up as

$$Y = T.S.C.I$$

Where, T = Trend
S = Season
C = Cycle
I = Irregular component

The trend-cycles of Grade RSS1 and F.O.B was obtained using the statistical package SPSS and the cycles were derived.

b) Construction of CLI

First, the candidate series were identified and each variable was standardized using the formula (1).

$$xi = \frac{Xi - \overline{X}}{S} \qquad \text{--------- (1)}$$

Where, xi = Data standardized
X_i = Original data
$\overline{X}$ = Mean S = Standard deviation

Data were standardized to leave out differences in units.

Smoothing technique was used to leave out seasonal and irregular components and trend cycles were obtained. The software used in this step was SPSS Version 4.0 (Frude, 1993). A cross correlation was carried out with the FOB prices and the candidate series that lead the FOB price were identified.

The composite leading indicator was calculated using weighted average. applying Green Beckman method (1992).

$$Wi = \frac{1}{\overline{Xi} + \sigma i} \quad \text{--------- (2)}$$

$$\overline{Xi} = \frac{\Sigma(\log X_t - \log X_{(t-1)})}{T} \quad \text{--------- (3)}$$

$$\sigma i = \sigma(\log X_{it} - \log X_{i(t-1)}) \quad \text{----- (4)}$$

Where;
Wi = Weight for each leading component
X = Leading component
i = 1, 2...n
T = Number of observations
σ_i = Standards deviation
Thus, composite leading index was calculated using

$$CLI = \frac{W_1 * X_1 + W_2 * X_2 + \ldots + W_9 * X_9}{W} \quad \text{----- (5)}$$

$$W = W_1 + W_2 + \ldots + W_9 \quad \text{-------- (6)}$$

The CLI was regressed with trend cycle component of rubber price and the elasticity was obtained. Here, formula (7) was used.

$$LogP = \alpha + \beta LogCLI \quad \text{--------- (7)}$$

Where;
P= Auction price of rubber
CLI = Composite leading indicator
α = Constant term
β = Elasticity
The resultant elasticity was used to forecast the price cycle based on growth of CLI.

RESULTS AND DISCUSSION

a) Price cycles

Figure 1a and 2a shows how nominal price vary. It has been noted that there is high oscillation in prices. Nominal prices showed an increasing trend. This may be due to the effect of inflation. However, It is important to note the unpredictability of prices.

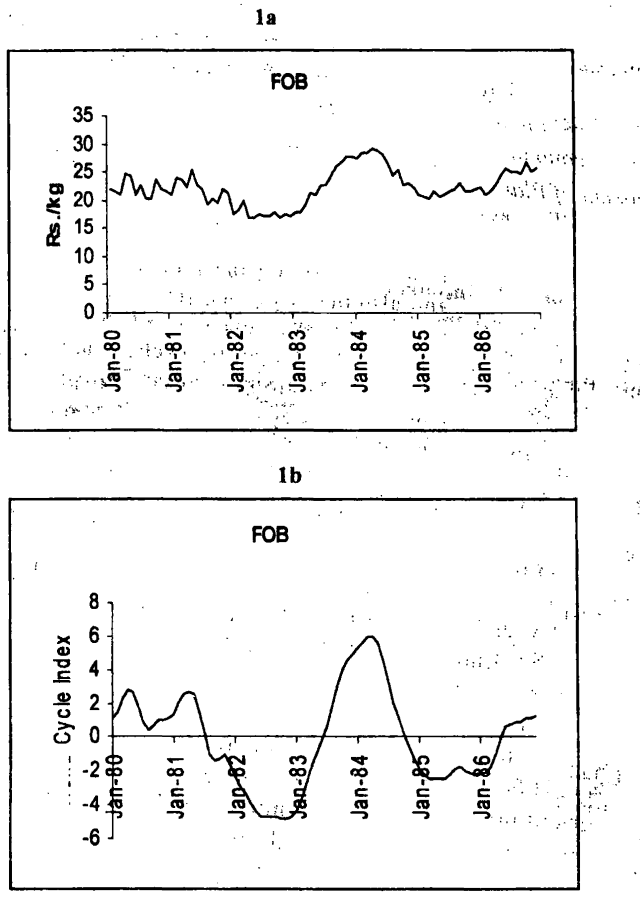

Figure1. Temporal variation of actual data (1a) and cyclical index (1b) of FOB price

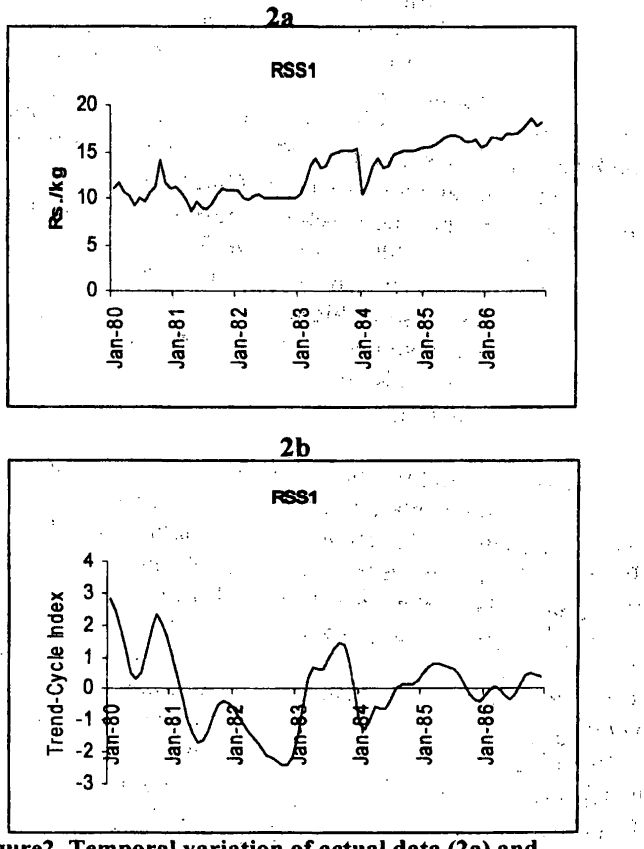

Figure2. Temporal variation of actual data (2a) and cyclical index of (2b) RSS1 price

Price variation showed seasonal as well as cyclical fluctuations. Figure 1b and 2b has isolated the cyclical component leaving out the trend, seasonal and irregular components. Both FOB and RSS1 showed almost a three year price cycle.

b) Construction of CLI

The analysis of cross correlation of trend cycles confirmed variables that are related to FOB price of rubber. The variables having minus lag value with the significant cross correlation value were identified as leading variables of F.O.B price (Table1). Only 14 variables could be identified from 30 variables tested. The minus lags value mean that variable lead the F.O.B price of rubber by those months (Table 1). Most of the international market prices were found to be leading the Sri Lanka F.O.B price by two months. This confirms finding by Wijesuriya *et al* (1995). In constructing the leading indicators, some variables had to be omitted as they did not have monthly observations. Then the weighted average was obtained for each leading component (Table 2).

Thus composite-leading index was calculated as formula (5). This was used to obtain a common index for all variables instead of each and every one. So that series of 274 values of CLI indices could be obtained.

For obtaining the elasticity the log value of trend cycle component of F.O.B price series was regressed with log value of CLI series (Table 3).

Table1. Significant leading variables as a result of Cross-correlation

Variables	Lag Period	Cross correlation value	Standard error
London RSS1 Price	-2	0.328	0.61
London RSS3 Price	-2	0.335	0.61
New York RSS1	-2	0.309	0.61
Sri Lanka RSS1	-1	0.389	0.60
Sri Lanka Latex Crepe	-2	0.381	0.61
S'Pore RSS1	-2	0.333	0.61
K' Pore RSS1	-2	0.363	0.61
K' Pore RSS3	-2	0.352	0.61
Exchange rates Thailand	-5	-0.145	0.61
Exchange rates Malaysia	-6	-0.202	0.61
Volume of Export Sri Lanka	-1	-0.112	0.6
Total Natural Rubber Consumption	-3	0.242	0.61
Total Synthetic rubber consumption	-2	0.220	0.61
Total synthetic rubber production	-1	0.215	0.60

Table2. Weighted value for each significant component

Variables	Weighted values
London RSS1 Price	65.6726
London RSS3 Price	63.9150
New York RSS1	90.2172
Sri Lanka RSS1	61.58
Sri Lanka Latex Crepe	44.3733
S'Pore RSS1	92.0924
K' Pore RSS1	81.220
K' Pore RSS3	79.3837
Exchange Rates Thailand	127.2227
Exchange Rates Malaysia	162.3714
Volume of Export Sri Lanka	29.0366
Total Natural Rubber Consumption	135.6242
Total Synthetic Rubber Consumption	221.2767
Total Synthetic Rubber Production	222.5383

Table3. Results of the regression with trend cycles of FOB and CLI

Variables	Estimate	P(t)**
Constant	-3.521275	0.0001
	(0.622646)	
Log CLI	1.772249	0.0001
	(0.215004)	

** = *Significant at 0.05* R^2 = *21.54 %*

(Figures within parentheses are Standard Errors)

The f value was significant at 5% probability level proving evidence that the model is significant. The R^2 value was rather low. Omission of some important data series due to non-availability of monthly data may have resulted low R^2 value. As data was not available for last 50 years data from 1980 to 2002 was used. The longer the period, higher will be the reliability of the results. However, it should be noted the t test showed that the CLI is highly significant in explaining trend cycle component of F.O.B price. Since this is a log-log function the estimated β gives the elasticity directly. The observed elasticity value was 1.772. The estimated elasticity was used to predict the trend cycles of F.O.B price. The estimation for known time periods (year 2002) was carried out.

Table4. CLI Growth from January to December 2002

MONTHS	GROWTH OF CLI
JAN	2.028626411
FEB	3.327376497
MAR	3.737719359
APR	4.3212527
MAY	4.603737
JUN	5.109917105
JUL	3.893497849
AUG	2.247206249
SEP	0.41221387
OCT	-0.760096638
NOV	-1.178259868
DEC	-0.473489701

To check the robustness of the model, the estimated values were compared with the actual values. First, the CLI growth rate was obtained (Table 4). Then, the elasticity was used to get the trend-cycle of the future time periods.

Table 5. Comparison with actual values of trend-cycle components

MONTHS	ESTIMATED VALUES	ACTUAL VALUES
JAN	66.0872195	61.565
FEB	65.19494083	59.757
MAR	63.71484875	59.666
APR	64.23478062	61.154
MAY	66.14283444	64.069
JUN	69.87030258	67.36
JUL	72.00735379	71.35
AUG	74.1911923	74.609
SEP	75.1539762	77.537
OCT	76.49266094	79.677
NOV	78.01344265	81.546
DEC	80.86180969	82.481

The estimated values were closed to actual values although there are some errors. This may be due to the shorter range in time period used in the analysis, due to non availability of data.

CONCLUSION

The F.O.B and price of RSS1 showed heavy cyclical fluctuation between years. These cyclical fluctuations are hard to predict using conventional time series analysis. Therefore, this study attempted to find suitable leading indicators for the cyclical fluctuation. Fourteen (14) such data series were found to lead F.O.B price in Colombo, out of tested 30 data series. The constructed composite leading indicator (CLI) could explain only 21.5 percent (R^2 = 21.5) of the cyclical variation in F.O.B prices. However, the estimation of known values of F.O.B prices showed that the estimates were closer to the actual values. Therefore, CLI developed in this study could further be improved to reflect a comprehensive CLI, provided availability of all necessary data. The limitations on good quality data has influenced the study and may have lowered the robustness of the model. For this kind of forecasting studies, availability of good, reliable national level long term data is highly important. Therefore, further research is required to strengthen the CLI whereas developed in this study. These findings are highly important to policy makers and decision makers involved with rubber cultivation *viz.* raw rubber producers and raw rubber product manufacturers.

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