Abstract

Agriculture sector in India underwent unprecedented policy changes in 1990’s. These policy measures were expected to have significant impact, among others, on integrating domestic commodity markets with world market. This paper undertakes an empirical verification of above hypothesis with respect to select plantation crops in Kerala (India), known historically for plantation agriculture by estimating Engle and Granger Error-Correction model. Period wise analysis reveals that markets were integrated even before liberalization except in cardamom, and the extent of integration got accentuated in post reform period in all the crops. Moreover, the estimated short run and long run elasticity coefficient implies that increased extent of integration or transmission of world price to domestic market was mainly on account of short-run rather than long –run.

I would like to express our immense gratitude to K.J Joseph for his valuable suggestions and comments during the preparation of this paper.
Trade liberalization and Primary Commodity Prices
Empirical Evidence from Select Tropical Crops in Kerala, India

Introduction

During the last decade India witnessed unprecedented policy changes in almost all the sectors of economy. This essentially involved a move away from import-substitution to outward orientation, which had its beginning in the early years of 1990s, got accentuated with India joining the WTO in 1995. As a result, the highly restricted agriculture trade was replaced by an unprotected bound tariff determined free trade regime. Later, India signed a bilateral free trade agreement with Sri Lanka in December 1998, which had its additional bearing on the agricultural sector more specifically on tropical products for which Sri Lanka also has comparative advantage. Analytically, removal of these trade barriers is likely to have the effect of integrating domestic agricultural commodity market with the world market. This in turn facilitates the transmission of world prices to the domestic market to a greater extent than the pre-reform period thus making the producers more exposed to the ups and downs of world commodity markets.

Given the fact that the cultivation of tropical products in India is concentrated in few regions the effect of liberalized policies on tropical crops are to be borne mostly by these regions. Kerala is historically known for the cultivation of export oriented tropical crops. Its agriculture is characterized by the domination of a number of major plantation crops coffee, tea, rubber, cardamom, coconut, pepper etc and these crops that account for more than 80 percent of total cultivated area. Moreover, the state accounts for 45 per cent of the plantation crops in the country and nearly 20 per cent of its population depends on plantation crops for their livelihood. Thus, Kerala stands apart in respect of its sensitivity to changes in the national and international trade environment and most of the agriculture products are dependent on domestic and international market. Obviously commodity price trends affect the incidence of poverty through their impact on employment opportunities and earnings of producers. At the farm household level, the impact of price change depends on whether global and border price trends are passed through to the producer at local level and whether improvements in productivity and production are able to compensate in a context of falling prices. Hence, the importance of the present study lies in the fact that, the domestic price trends and its movements with world market price of the tropical crops are likely to have profound influence on the levels of living of millions of people (both workers and farmers) who depend either directly or indirectly on the cultivation of these crops.

1 See for more details UN (2002)
The central focus of the present paper is to address two interrelated issues of select primary commodities - the extent of co-movement of primary commodity prices in the domestic and world markets and the bearing of reform measures on the extent of transmission of world prices to the domestic markets. This paper is organized in seven sections including this introduction. The second section presents the analytical framework followed by an overview of literatures in section 3. Section 4 introduces the model for the empirical verification of the hypotheses proposed. Section 5 delineates the data used and it is followed by results of the empirical analysis in section 6. Last section sums up the discussion and presents certain concluding observations and further issues for research.


In the literature, the transmission of world price to the domestic market has been analyzed in the framework of market integration or the law of one price. The theoretical concept of law of one price suggests that, if the markets are allowed to operate freely, price of an internationally traded product in spatially separated markets tend to converge to the same level. Thus the concept of law of one price leads to market integration terminology of internationally traded agricultural commodities (Baffes 1991, Mohanty et al 1999) wherein one could intuitively infer on the co-movement (price linkage) of prices in spatially separated markets. This concept of convergence of prices of several markets to the exact same level of price in one market would holds good under condition of perfect market information. But, under imperfect market conditions, convergence could take place, but the prices in all the markets may not exactly converge to the same level.

Authors have defined the term market integration differently. But, Roehner (1995a, 1995b) has reduced these into two alternative definitions. The first definition of market integration has been based on the assumption of perfect information. Accordingly, two markets are said to be integrated if enough arbitrages are present in these markets and they are acting efficiently. Under this definition a market is integrated or not but there is no provision for the estimation of extent of integration. Second concept of market integration delineates that; the degree of market integration is identified with the level of inter market price differentials (or some other variable). If the price differentials are very large, then the market is poorly integrated and if they are small the market is strongly integrated.

Thus the concept of market integration in economic theory suggests equal price of a commodity in different locations subject to transfer costs and under certain condition and this is considered as a necessary condition for the allocation of resources in the right direction (Baffès 1988). However, price convergence or market integration need not necessarily imply efficient allocation of resources unless the setting in which trade takes place is competitive (Faminow and Benson, 1990, Baulch 1997b). For example let us consider the market integration of products which are traded internationally in the domestic market of a producer
country and the in the world market (main market in which most of the transaction takes place). This means that in a competitive trading environment market integration of domestic market with that of world market would facilitate the efficient allocation of resources and influence the production decision of a farmer in the producer country. Analytically, one could differentiate two aspects of price movements the long run co-movement, which is influenced by the supply conditions and the short – run transmission of prices, which is influenced mainly by demand conditions. Using this conceptual framework, the present paper explores the co-movement of prices of select plantation crops in one of the main market of Kerala and its major counterpart in the world.

3. Review of literature

The impact of structural adjustment programs and the globalisation on the agriculture sector in India is well documented\(^2\). The expected immediate impact of the removal of protection as manifested in the tariff reduction \textit{inter alia} includes the transmission of world prices of various agricultural commodities to the domestic markets. The intensity of this transmission, however, is likely to vary across different crops\(^3\). The studies have shown that the prices of various agricultural commodities in India were well below the international prices (Gulati and Sharma 1994), and domestic prices were growing faster than that of international prices (Bhatia 1994). A recent study on trade liberalization concluded that liberalization would lead to a rise in prices of those commodities with prices below the world markets prices and fall in prices if they were above the international prices (Chand 1997) indicating the possibility of price parity between domestic and world markets. Another recent study on major cereals, pulses and oil seeds (Chand 2001) suggested that domestic price of rice increased by 2.42 percent at FOB prices, wheat by about one-tenth of international prices. Conversely for the crops facing import substitution namely soybean oil and seed, the domestic prices declined by 18.5 percent and 7.03 percent respectively. Further, the price elasticity estimated\(^4\) using linear regression for the period 1976/77 to 1996/97 were reported statistically significant confirming the evidence of transmission of central wholesale price to the farm level. Studies have also analyzed the impact of reforms on the integration of domestic market prices in different markets in India in particular in the case of a number of cereals and oil seeds (Pramod and Sharma 2004 Acharya, 2001, Wilson, 2001).\(^5\)


\(^3\) Chand (2001) welfare analysis on a number of food crops according different states has shown that welfare gain vary vastly across regions depending on the nature of crops grown in that region.

\(^4\) Chand (2001), The price elasticity were estimated by using \(Y=a+bX\), wherein, the farm harvest price was considered as the dependent variable and price of the same crop in the central market was taken as the independent variable.
It may be noted that most of the studies in India have focused on either food crops or oil seeds and the regional dimension has not been given due attention. In a vast country like ours, which is known for its regional diversity, much could be learned and significant input for policy making could be gathered by analyzing these issues in a regional perspective. Secondly, our understanding of the price movements of plantation crops, which are having a longer history of integration with the world market, under globalization remains rudimentary. Hence the point of departure of the present study from that of existing literature is that the major focus is on a particular region (Kerala) wherein the agricultural economy is dominated by a number of non-food crops, most of them (coffee, cardamom and pepper) are either facing high competition in the world market or facing import substitution (rubber) in producer country.

Given the importance of primary commodities in the world trade on the one hand and its predominant role in the export earning of a number of developing countries on the other, the issue has attracted the attention of a large number of researchers outside India resulting in a growing body of literature. In general these studies have mixed result to offer. Hanzell et al (1990) using data from 22 developing countries over a period (1961-87) found that world prices have been almost entirely transmitted to the developing countries in the dollar value of their export unit values but it has not been transmitted to average producer (farm gate) prices. The limited transmission of prices to the farm gate level has been attributed to the plausible imperfections in the domestic market. The study, however, refers to the period prior to globalisation. Mundlak and Larson (1992) in a study covering 58 countries concluded that most of the variations in world prices were transmitted to domestic price and it constitutes the dominant component of variation of domestic prices. Morriset (1997) by analyzing the price movements of commodities (coffee, sugar wheat and beef), during 1970-1994 has shown that upward movements of world prices were perfectly transmitted but downward movements were not and the spread between world and domestic prices would increase continuously over time. Baffes and Ajwad (1998) have carried out a study on the price linkage of cotton in the markets of US, Greece, Central Asia and Africa on one side and an index which was considered as a measure for world price on the other side with special emphasize on the improvement of price linkage in last decade. The period of analysis from 1985 to 1997 was divided into two and the results of cointegration analysis found promising in the sense the improvement in price linkages appears to be mostly the result of short-run price transmission and to a very limited extent the result of long-run co-movement. Baffes and Gardner (2003) analysed the extent of

5 These studies have analyzed the impact of trade liberalization on extent of integration of whole sale prices of wheat jowar, rice, rapeseed and mustard seed in different market within North India such as Hapur, Karnal, Amristar, Delhi, Rajkot, Kanpur and Indore and Patna. Acharya analyzed the market integration using correlation while the recent developed cointegration method was used in the second study. However, Pramod and Sharma have given due attention to the regional dimension but it was limited with the internal market integration.
transmission of world commodity prices to the domestic market prices of 8 countries (Chile, Ghana, Madagaskar, Indonesia, Egypt, Mexico, Argentina Columbia) for 10 crops (Maize, Wheat, Cocoa, Rice, Coffee, Palm Oil, Sugar, Soyabeans, Sorgum,) has shown that domestic market prices of Chilee, Mexico, and Argentina were integrated with that of world prices. However, in terms of effects of policy reforms, some of the countries have rejected the hypothesis of increased market integration while some countries have reported that reform had significant impact on the extent of integration.

The existing literature on the study of co-movement and impact of policy reforms provide sufficient theoretical base for the empirical verification to the hypothesis that we proposed. But as already noted, understanding of co-movement and the extent of integration of crops in Kerala wherein domestic market prices are mostly influenced by the world price because of its export orientated nature under the liberalization regime remain rudimentary. An interesting study in this direction was by Varma (2001), using correlation analysis, on coconut and rubber facing a different trading environment as compared to coffee, cardamom and pepper. The results of correlation suggest that the extent of integration has increased in the case of rubber while decreased in the case of coconut oil in the post reform period. However the scope of the study has been limited and did not analyze the process of transmission of world prices to the domestic market.

4. The Empirical Model

The existing studies on market integration suggest three different methodologies to approach the problem. They are a) correlation method b) regression method and c) cointegration method. However, it is well known that most of the price series of agricultural commodity are non-stationary and the use of correlation analysis might result spurious result. Similarly the estimation of price linkage using regression of the following form

---

6 Baffes and Gardner (2003) analysis has shown that policy reforms have significant impact on extent of market integration of some of the crops in several developing countries namely, cocoa in Ghana, coffee in Madagascar, rice in Ghana, and Madagascar, maize in Egypt, Colombia, and Mexico, soybeans and Palm oil in Mexico and Indonesia, wheat in Colombia and Argentina. In this analysis the pre –liberalization period was from 1985 to 1987 and post liberalization period was from 1995-97.

7 The estimated correlation coefficient for rubber in the pre-reform period (from 1980 to 1992) and post reform period (1993 to 2000) were found to be high and statistically significant (Varma, 2001).

8 Cashin et al. (1999) This analysis has shown that the co-movement of unrelated price series using correlation analysis was a myth if we apply proper statistical methods. They have analyzed the co-movement of the price series by the concordance statistics first suggested by Pagan (1999) and its distributional properties examined by Mcdermott and Scott (1999). In this method they have given due importance to the co-movement during different peaks and troughs. Let \( X_i \) and \( X_j \) are two time series. Define, \( \{S_{ij}\} \) be a dichotomous variable taking the value zero when it s in a slump phase and one when it is in a boom phase (expansionary). Similarly, define \( \{S_{ij}\} \) for the time series \( X_i \). The degree of concordance of in the cycles of the two series is then
\[ P^D_t = \alpha + \beta P^W_t + e_t \]  

(1)

where, \( P^D_t \) and \( P^W_t \) are the prices of a commodity at the domestic and international markets, without giving due importance to the non-stationary property of the individual price series would result in misleading interpretation of the results (Baffes, 1999, 2003).

In order to overcome the inconsistency in the parameter estimation of prices under non-stationary condition, there has been a growing body of literature using co-integration. The method of cointegration was developed in two different ways; first by Granger (1981) and Engle and Granger (1987 and secondly by Johansen (1988). The concept of cointegration has now a days become increasingly popular, both as an underpinning of the error correction representation, and as a way of separating the specification and estimation of the long-run properties of an economic relationship and short-run dynamic adjustment towards the long-run equilibrium. Further this would also be helpful in determining how the short-term movements of the variables will be affected by the lagged deviation from the long-run relationship between the variables. The present analysis intends to use the co-integration and error correction model developed by Engle and Ganger for the empirical verification of co-movement and extent of market integration of domestic prices with that of world prices of the selected agricultural commodities.

According to Granger (1981), a time series \( x_t \) which has a stationary, invertible, non-deterministic ARMA representation after differencing \( d \) times is integrated of order \( d \) and is denoted by \( \sim I(d) \). The components of the vector \( x_t(n \times 1) \) are said to be cointegrated of order \( d,b \), denoted \( CI(d,b) \), if i) all the components of \( x_t \) are \( I(d) \); ii) there exists a column vector \( \alpha (\alpha \neq 0) \) so that \( z_t = (\alpha' x_t) \) is \( I(d-b), b > 0 \). This implies that in order to establish cointegration, the price series has to satisfy certain economic properties. In general the necessary condition for cointegration is that the individual series are integrated of the same order. However, evidence suggests that non-stationary variables (integrated of different order) are to be cointegrated (Greene 1997), but if the slope coefficient is different from unity, the corresponding price differential would be growing and such growth would not be accounted for, although the price move in a synchronized manner (Baffes, 2003). Therefore, before establishing the cointegration relationship of a number time series variables (individual price series), we have to test for the stationary

\[ C_{ij} = T^{-1} \left\{ \sum(S_{i,t} S_{j,t}) + (1-S_{i,t})(1-S_{j,t}) \right\}, \]  

where \( T \) is the sample size and \( C_{ij} \) measures the proportion of the time series are in the same state.

property of the individual price series, which is same as that of determine the order of integration. The problem of detecting stationarity\textsuperscript{10} is again same as that of testing for unit roots. Therefore, the formal method to test the stationary of a series is to test for unit root. The first step therefore, in cointegration analysis is to test the stationarity of the time series, which is equivalent to test the null hypothesis \( \rho = 1 \) in the following regression.

\begin{equation}
    P_t = \rho P_{t-1} + u_t,
\end{equation}

where \( u_t \) is the stochastic error term with mean zero and constant variance and is non autocorrelated and \( P_t \) is any price series. If the null hypothesis \( \rho = 1 \) is rejected, the series is stationary, otherwise strong evidence of non-stationary. In general, if the original series is not stationary, further differencing may lead to stationarity and the number of times a series differenced will be the order of integration.

The Augmented Dickey-Fuller (ADF, 1979) test would be appropriate to test the unit root of the individual series. This test uses the following equations to identify the unit roots.

\begin{equation}
    \Delta P_t^D = \delta P_{t-1}^D + u_t \tag{2}
\end{equation}

\begin{equation}
    \Delta P_t^D = \gamma_0 + \gamma_1 t + \delta P_{t-1}^D + \sum_{i=2}^{\kappa} \theta_i \Delta P_{t-i}^D + u_t \tag{3}
\end{equation}

where \( u_t \) is white noise error term. If the error is an autoregressive process, equation (3) and (4) will be appropriate to test the unit roots with and without trends.

\begin{equation}
    P_t^D = \gamma + \delta P_{t-1}^D + \sum_{i=2}^{n} \theta_i \Delta P_{t-i}^D + u_t \tag{4}
\end{equation}

The null hypothesis for unit root for the differenced series is \( H_0: \delta = 0 \) vs \( H_1: \delta < 0 \). Dickey and Fuller (1979) show that under the null hypothesis of a unit root, test statistic does not follow the conventional Student's t-distribution, and they derive asymptotic results and simulate critical values for various test and sample sizes. More recently, MacKinnon (1991, 1996) implements a much larger set of simulations than those tabulated by Dickey and Fuller. In addition, MacKinnon estimates response surfaces for the simulation results, permitting the calculation

\textsuperscript{10} A series is said to be (weakly or covariance) stationary if the mean and auto-covariance of the series do not depend on time. Any series that is not stationary is said to be non-stationary. If a series is strictly stationary, its mean and variance do not depend on time (Gujarati, 1995).
of Dickey-Fuller critical values and values for arbitrary sample sizes. The more recent MacKinnon critical value calculations are used by Eviews (Econometric views) in constructing test output. If the null hypothesis is rejected with the critical values of Mackinnon in the level form implies that original series is stationary and integrated of order zero I(0). Otherwise, it is appropriate to differentiate the price series to attain the stationarity.

The alternative test for the existence of a unit root is suggested by Phillips (1987) and extended by Perron (1988) and Phillips and Perron (1988). Rather than taking account of extra terms, in the data generating process by adding them to the regression model, a non-parametric correction to the t-test statistic is undertaken to account for the autocorrelation that will be present. That is, while the DF procedure aims to retain the validity of tests based on white-noise errors in the regression model by ensuring that those errors are indeed white noise, the Phillips and Perron (PP) procedure modifies the statistics after estimation in order to take into account the effect that auto correlated errors will have on the results (Banerjee et al. 1993). Sources of critical values for the PP test include Phillips and Ouliaris (1990), MacKinnon (1991), and Davidson and MacKinnon (1993).

Let \( P_t^D \) and \( P_t^W \) denote the prices of an agricultural commodity in two locations namely in domestic and world markets and if they are integrated of the same order, there exist a cointegrating relationship between \( P_t^D \) and \( P_t^W \) in long-run equilibrium and it can be represented as

\[
P_t^D = \beta_0 + \beta_1 P_t^W + \varepsilon_t \quad (5)
\]

In order to determine the cointegration of the domestic prices and world market prices, we have to establish the stationary property of the residuals \( \varepsilon_t \) of (5). The standard ADF and PP are suitable to determine the stationarity of the residuals. The ADF equation for the unit root of the residuals is

\[
\Delta e_t = \eta_0 e_{t-1} + \sum_{i=1}^{k} \eta_i \Delta e_{t-i} + u_t \quad (6)
\]

If the residuals of equation (5), i.e., \( \varepsilon_t \) is stationary, it establish the co-movement of domestic market price and the world market prices and it further means that world market price are transmitted to the domestic markets in long-run. However, the results of cointegration alone was unable to shoot the way in which world price transmitted to domestic market. This problem would leads to the urgency of estimation of error-correction representation by Engle and Granger, 1987.
According Engle and Granger (1987), if the price series are cointegrated, there exits an error-correction representation of the dynamic model and the residuals from the equilibrium regression can be used to estimate the error that corrects in long-run. Therefore, estimating price adjustment as the impact of a change in one price on another price should be based on error correction models (ECM). The Engle and Granger (1987) error correction representation can be written as

\[ \Delta P_t^D = \alpha_0 + \alpha_1 (P_{t-1}^D - \beta P_{t-1}^W) + \sum_{i=1}^{k} \phi_i \Delta P_{t-i}^D + \sum_{i=1}^{k} \delta_i \Delta P_{t-i}^W + \nu_t (7) \]

where \( \nu_t \) is white noise errors, which are independently and identically distributed. Allowing all \( \phi_i = 0 \) and all the \( \delta_i \)'s except \( \delta_1 \) to be zero equation 7 reduces to

\[ \Delta P_t^D = \alpha_0 + \alpha_1 (P_{t-1}^D - \beta P_{t-1}^W) + \delta_1 \Delta P_{t-1}^W + \nu_t \quad (8) \]

This is one of the simplest forms of the ECM in which change in domestic price is explained by change in domestic price and world price in the previous period (long term adjustment) and immediate change of price in the world market and the estimated coefficients would provide clear picture of the path of transmission. However equation (7) incorporates several lags of change in domestic price and world price. Substitute the residuals in the previous period from the long-run equilibrium relation of (5) instead of \( (P_{t-1}^D - \beta P_{t-1}^W) \) in (7), it becomes

\[ \Delta P_t^D = \alpha_0 + \alpha_1 (P_{t-1}^D - \beta P_{t-1}^W) + \delta_1 \Delta P_{t-1}^W + \nu_t \quad (9) \]

This is the general form of an error correction specification wherein change in domestic price is explained by the lagged change in world price and lagged change in domestic price. The term \( (P_{t-1}^D - \beta P_{t-1}^W) \) is called the error correction term or the feed back coefficient or the long-term speed of convergence. If we consider equation (8) to explain changes in the domestic prices, we could seen that change in domestic prices is simultaneously explained by constant term \( (\alpha_0) \), deviations from the long-run equilibrium denoted by \( \text{ECT}_{t-1} \), and lagged short-term reactions to previous changes in world market prices. The most important feature of (9) is the economic interpretation of the parameters \( \delta_1 \) and \( \gamma \); the first coefficient \( \delta_1 \) indicates how much of a given change in world price is transmitted to the change domestic prices in the current period or it is known as the short run effect which capture disturbance in \( \Delta P_t^D \). While \( \gamma \) represents how much of the past price difference between domestic and world price is eliminated in each period to attain the equilibrium or it is known as speed of adjustment or feedback coefficient or speed of convergence.

5. Data Sources
As already stated, the present study focuses on the major commercial crops like coffee, tea, cardamom, black pepper, rubber and coconut. For undertaking the analysis we need the month-wise price (both domestic and international) of these commodities. The domestic market price is represented by the price in the major market in Kerala, within the country. The world market prices are also defined similarly. The appropriate sources of data of these crops are the publications of the concerned commodity boards under the Commerce Ministry in India. These Commodity Boards play major role on research, promotion, development and marketing.

Coffee

Coffee production in India is prominent in the hilly regions of southern states Karnataka, Kerala and TamilNadu. Even though, there are a number of species of coffee, *Coffee Arabica* and *Coffee Robusta*, known as Arabica coffee and Robusta coffee, are commonly cultivated varieties in all the major producing countries. Karnataka state is the major producer of coffee in India accounting for 70 percent, followed by Kerala (23.4%) and Tamilnadu (5.5%) (see the table1). However, Robusta coffee, which was introduced by Muslim pilgrimage during the end of nineteenth century for planting in estates at lower altitude, is intensively cultivated in Kerala. India’s total export during 2001-02 was 2.13 lakh tones compared to 2.46 lakh tones in 2000-01. Moreover, arabica export accounted for 65,500 tonnes (31.7 percent) and robusta for 1,45,500 tones (68.3 percent) and Kerala accounts for substantial part of robusta export11.

Table 1 State-wise and Variety wise production of Coffee in India

<table>
<thead>
<tr>
<th>State</th>
<th>Arabica( %)</th>
<th>Robusta(%)</th>
<th>% to India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerala</td>
<td>1.2</td>
<td>36.4</td>
<td>22.24</td>
</tr>
<tr>
<td>Karnataka</td>
<td>82.2</td>
<td>60.8</td>
<td>69.4</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>13.8</td>
<td>2.7</td>
<td>7.2</td>
</tr>
<tr>
<td>Others</td>
<td>2.8</td>
<td>0.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Publications of the coffee board are one of the major sources of data for domestic and international price of coffee *arabica* and coffee *robusta*. One of the major coffee markets in India is situated in Karnataka, but the non-availability of the monthwise data from this market forced me to adopt the data published by ICO

11 More than 95 percent area under coffee in Kerala is planted with robusta variety and this accounts for 36 percent of all India robusta production. There is more than 20 categories of coffee available for the export with respect to these two varieties.
for the present analysis. ICO website is another major source of data which provides month wise nominal price data of arabica and robusta in US dollar per pound paid to the farmers in the producing countries. Also it provides ICO indicator price (nominal) in US$/pound of arabica and robusta milds at New York market. Therefore, month wise prices paid to the farmers in the producing countries in dollar per pound for the period from 1986 to 2002 and the ICO indicator price at the New York market for the same period collected were considered as domestic and world prices of coffee and utilized for the present analysis of coffee.

Pepper

Pepper is one of the major spices in Kerala exported since pre-colonial era\textsuperscript{12}. It has an organizational set up (under state government as well as central government) to promote research, development, extension and marketing. Spices Board, under the Ministry of Commerce is handling export and marketing, not through direct market intervention but in the sense that the entry of exporters and traders is regulated by a system of licensing, which has become more liberal over time. Also the Spices Board acts as an important market link between producers and traders by providing latest information regarding the price in main markets and other markets particularly in world markets. In the case of pepper, the main market is Cochin from where most of the trade transactions take place and hence the nominal price of MG1 variety in Cochin market is considered as the domestic price. These prices are quoted in publications of Spices Board as well as in the publications of Directorate of Coca, Areca nut and Spices. New York is one of the major world market of pepper wherein trade takes place and thus the nominal price of MG1 in New York market US$/kg) is taken as the world price of pepper. Domestic price is expressed in Rs/kg and it is converted into US$ /kg using the exchange rate. In order to avoid the discontinuity of the month wise data during 1992 and 1993, the analysis for the entire period of analysis market integration was carried out using year wise data from 1970 to 2003. But, in order to measure the pre and post liberalization effect the present study intends to utilizes month wise data from 1980 to 1991 and 1994 to 2002.

Cardamom

In India cardamom cultivation is confined to the three major states Kerala, Karnataka and Tamilnadu. Kerala accounts for 72 percent of production followed by Karnataka (20%) and Tamilnadu (8%). Marketing of cardamom is different

\textsuperscript{12}Kerala is the major producer of black pepper in India and that accounts for more than 90 percent to all India production. Recently there has been sharp increase in production, almost 98 percent increase from 1980-81 to 200-01.
from other crops like coffee pepper and rubber wherein the producers sell their products directly to the dealers. In case of cardamom, bulk of the product marketed through an auction system, wherein the auctioneers bring together the growers, dealers and exporters and the price of each lot is decided through bidding. Studies have shown that the market is characterized by high level of concentration at all levels (auctioneers, exporters and also growers) and there is significant variation between the prices received by the small and large growers. Joseph (1985). There are a number of auction centers in Kerala, most of them are operating from a particular region Idduki where the production is mainly concentrated. Spices Board publishes the month wise price data of cardamom in Kerala, which is actually the weighted average obtained from different auction centers and yearly average price is considered as the price of cardamom in domestic market. Price of Indian cardamom in New York market is taken as the corresponding world price. Whole period analysis of cardamom is dropped because of discontinuity in the year wise as well as month wise data. But the period wise market integration is carried out on the basis of monthly data for the period 1983 to 1991 (pre-reform period) and 2000-2003 in the post reform period.

**Rubber**

Kerala is the major producer of natural rubber in the country accounting for nearly 95 per cent of all India production. Indian Rubber Statistics published by Rubber Board, a statutory body under the Ministry of Commerce for the promotion of production, research, and export, is the major source of data. This publication provides price data on various grades of natural rubber in Kerala. Kottayam is one of the major domestic markets in Kerala and price data for all the grades of natural rubber are available from this market. The various grades of natural rubber are RSS1, RSS2, RSS3, RSS4, RSS5, EBC 2X, LATEX and ISNR13. For the present study price of RSS4 that accounts for the bulk of domestic production (Varma 2001) at Kottayam market is taken as the domestic market price. Malaysia is one of the major producers of rubber in world and the price of RSS3 in Kuala Lumpur is taken as the price of rubber in the world market. In order to capture the integration of whole period analysis, year wise data for the period from 1968 to 2003 is used.

6. **Empirical Results**

Estimates of unit roots and error correction model for different crops are presented in table 2, 3 and 4. Let us begin with the result of the analysis commodity wise for the whole period and later move towards the result of the analysis for the sub periods to reflect on the implications of reform. The unit root of the individual price series ie, the domestic

---

13 Rubber Board (2002) Previously the different grades were known as RMA 1,RMA2, RMA3, RMA4 and RMA5, and changed to RSS1, RSS2, RSS3, RSS4 as per vide Gazette Notification No. G.S.R.5612(E) dated July 1994, Ministry of Commerce, India.
and world prices tested by both ADF and PP test statistics with trend and constant term in the models for all the crops and the results of unit roots are presented in table 2. ADF and PP were carried out to the logarithmic price series in level form and to the differenced series.

The results of preliminary analysis of unit root using ADF and PP in the case of coffee from table (2) revealed that both domestic and world market prices were non-stationary in level form but attain stationarity after differencing once (at 1 percent level of significance) for two varieties arabica and robusta. That is price in the domestic market and the world market are integrated of order one I (1) and hence we can conclude that both have satisfied the necessary condition for the cointegrating relationship of prices in the long run. In other words, domestic price and world price are integrated of the same order in the case of both varieties of coffee.

### Table 2 Results of Stationary test on Domestic and World prices

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Price in levels</th>
<th>First difference of the Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ADF</td>
<td>PP</td>
</tr>
<tr>
<td>Domestic price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log arabica</td>
<td>-2.25 (4,TI)</td>
<td>-2.23</td>
</tr>
<tr>
<td>Log robusta</td>
<td>-1.77 (1, TI)</td>
<td>-1.98</td>
</tr>
<tr>
<td>Log pepper</td>
<td>-3.88** (2,TI)</td>
<td>-2.20 (2, I)</td>
</tr>
<tr>
<td>Log rubber</td>
<td>-2.93 (1, TI)</td>
<td>-1.12 (3, I)</td>
</tr>
<tr>
<td>World Price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log arabica</td>
<td>-2.67 (2, TI)</td>
<td>-2.20 (2, TI)</td>
</tr>
<tr>
<td>Log robusta</td>
<td>-1.90 (1, I)</td>
<td>-1.73</td>
</tr>
<tr>
<td>Log pepper</td>
<td>-4.40** (2, I)</td>
<td>-2.29 (3, I)</td>
</tr>
<tr>
<td>Log rubber</td>
<td>-2.93 (1, TI)</td>
<td>-2.37 (3, TI)</td>
</tr>
</tbody>
</table>

Note:. ADF stands for Augmented Dickey-Fuller tests and PP stands for Philip-Perron tests. The two forms of augmented Dickey-Fuller (ADF) regression equations used for the stationary test of the price series are

\[
\Delta P_t^D = \gamma_0 + \gamma_1 t + \delta P_{t-1}^D + \sum \theta_i \Delta P_{t-i}^D + u_t
\]

\[
\Delta P_t^{D,D} = \gamma_0 + \delta P_{t-1}^{D,D} + \sum \theta_i \Delta P_{t-i}^{D,D} + u_t \text{ (with drift)}
\]
where $t$ is the time trend variable.

The null hypothesis $\delta = 0$ (there is a unit root) is rejected by comparing critical values of Mackinnon. The Mackinnon critical values for lag 4 at 1%, 5%, 10% are respectively $-1.62, -1.94,$ and $-2.57$ and for lag 1 are $-3.51, -2.90, -2.58$. The number lags represents the number of auto correlated terms to achieve the white noise errors. ‘∗’, ‘∗∗’ and ‘∗∗∗’ indicates statistical significance at the 10 per cent, at the 5 per cent, and at the 1 per cent level.

$I$ represents intercept and $TI$ represents trend and intercept.

If world market prices and domestic market prices are integrated of the same order, OLS estimate of cointegrating regression using equation (5) provides consistent estimates. The estimated model appears to be robust, going by the value of adjusted $R^2$ presented in the table 3. The results of ADF and PP on the residuals of cointegrating regression in (table 3 last two columns) suggests that error is stationary which indicate that domestic price and world price are moving in the same direction.

The results of ECM according to equation (7) for arabica and robusta are presented in table 4. The estimated price elasticity coefficient using error correction model for robusta robusta variety in the long run and short run were respectively -0.08 and 0.21 and found statistically significant at 1 percent level. Even if the long run and short run adjustment coefficients (elasticity) are significantly different from zero, the explanatory power of the model as evident from the value of adjusted $R^2$ is very low.

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Dependent variable- Domestic price.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Constant</td>
</tr>
<tr>
<td>Robusta</td>
<td>1.15</td>
</tr>
<tr>
<td></td>
<td>(10.01)</td>
</tr>
<tr>
<td>Arabica</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td>(4.03)</td>
</tr>
<tr>
<td>Pepper</td>
<td>-0.77</td>
</tr>
<tr>
<td></td>
<td>(4.03)</td>
</tr>
<tr>
<td>Rubber</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td>(5.81)</td>
</tr>
</tbody>
</table>

Critical values for ADF and PP for 10%, 5%, 1% are respectively $-2.58, -1.94, -1.64$. Figures in the brackets are $t$-values and in square brackets represents number of lags.
As expected, similar results were obtained for the estimates for other variety of coffee arabica (see table 3) with greater speed of convergence (-0.18). While the short run price transmission (0.25) was fond to be more or less in similar in the case of both varieties.

**Pepper**
The preliminary analysis of unit root using ADF and PP test to logarithmic values of price series suggests that both price series were integrated of order one I(1)) as per PP and I(0) as per ADF. Further, ADF and PP test results for stationary on the residuals of cointegrating regression are presented in the last column of Table 3. This suggests the co-movement of prices of Black pepper in the Cochin and New York market. The whole period estimates of short run and long run price elasticity were found to be 1.00 and –0.51 respectively. The higher value of the estimated of short run elasticity indicates immediate transmission of entire change of world price to the domestic price. Also a fairly high value of long run coefficient implies the convergence of price in domestic market and world market at a speed of 51 percentages every year. Thus, as compared to coffee the extent of integration was very high in the case of black pepper with greater speed of convergence.

**Rubber**
The results of ADF and PP tests of unit root indicate that both price series were not integrated in level form but attains stationary after differencing once. Thus two price series were integrated of the same order. Further, the estimated statistic of ADF and PP on residuals (last column of table corresponding to rubber) of cointegrating regression suggests that price of rubber in Kottayam market and Kula Lumpur market has been integrated. The estimated short run and long run elasticity on the basis of error correction representation were respectively 0.37 and –0.42. This finding is in tune with an earlier estimate (Varma 2001). It may also be noted that even if the domestic price is above the price in Kula Lumpur, two price series converge at the rate of 42 per cent every year. Moreover, the high value of short run elasticity coefficient implies that any changes in price of rubber in Kula Lumpur market would be reflected immediately on the price of rubber in Kottayam.

**Table 4 Results of Error Correction Model on Domestic Price.**

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Constant</th>
<th>Short run</th>
<th>Long–run (ECT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

16
Impact of Reforms

It is evident from the previous section that domestic price and world price of all the crops are cointegrated for the whole period of analysis. However, during this period there were drastic changes in the domestic and trade policies on account of economic liberalization, globalization and free trade agreements. It is evident that the reform measures were not similar for all the crops and hence, it is worthwhile to look at the major reforms at the crop level (see Appendix 1 for details). Also different crops were subjected to different bound tariffs, for instance, natural rubber being considered as an industrial raw material, had lower bound tariff as compared to other crops.

Coffee

Table 7 and 8 reports the period wise estimates for the crops, which enable us to reflect on the impact of reforms initiated in the 1990s. The estimates of short run and long run adjustment coefficients in the pre-reform period were respectively (0.22) and (-0.12) and found to be significant at 5 percent level. This tends to suggest that even prior to liberalization period coffee market in India has been integrated with world market and that price changes were getting transmitted to the domestic market. However it may be noted that the estimated values of the coefficients were low which in turn tends to suggest that the extent of integration has been at a lower level.

As we move to the post reform period, the estimated value of short-term adjustment coefficient (0.25) is almost equal to that of pre reform period. However, the estimated long-term adjustment coefficient was -0.19 indicating a substantial increase in the elasticity as compared to pre-reform period (-0.12). The implications and WTO on market integration could be discerned from the estimated elasticity coefficient from 1996 to 2002. The estimated short run elasticity coefficient of arabica is 0.54 and that of robusta 0.58. These estimates may be compared with 0.22 and 0.17 for arabica and robusta respectively, obtained for pre reform period. This tends to suggest that with WTO and
globalisation, the extent of integration of India’s coffee market with that of world market increased substantially. Along with the increase in short term elasticity coefficient there has also been a commensurate increase in the value of long-term elasticity coefficient. In the case of robusta, this increase has been marginal (from -.10 to -.16. But the interesting fact is that relatively less significant (10%) short run price elasticity (0.17) in the pre–reform period changed into highly significant (0.58) in the post WTO period, the increase has been three fold. Similar pattern was observed in the case of arabica also.

Table 9 Period-wise Cointegrating Regressions.

<table>
<thead>
<tr>
<th></th>
<th>Cointegrating Regression dependent variable- Domestic price.</th>
<th>Unit root test of Residuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Const</td>
<td>World price</td>
</tr>
<tr>
<td>Robusta</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-reform (1986-1992)</td>
<td>1.76 (14.67)</td>
<td>0.51 (18.18)</td>
</tr>
<tr>
<td>Post Liberalization (1993-2002)</td>
<td>0.85 (3.34)</td>
<td>0.73 (18.59)</td>
</tr>
<tr>
<td>Post WTO (1996-2002)</td>
<td>-0.23 (1.54)</td>
<td>1.01 (27.54)</td>
</tr>
<tr>
<td>Arabica</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-reform (1984-1992)</td>
<td>2.27 (10.01)</td>
<td>0.44 (9.49)</td>
</tr>
<tr>
<td>Post Liberalization (1993-2002)</td>
<td>0.56 (3.34)</td>
<td>0.79 (21.94)</td>
</tr>
<tr>
<td>WTO period (1996-2002)</td>
<td>-0.35 (2.85)</td>
<td>0.99 (37.81)</td>
</tr>
<tr>
<td>Pepper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-reform (1980-1990)</td>
<td>0.46</td>
<td>0.89 (25.67)</td>
</tr>
<tr>
<td>Post Reform (1994-2002)</td>
<td>-0.474 (3.69)</td>
<td>1.05 (47.70)</td>
</tr>
</tbody>
</table>
In general, with the establishment of WTO, the short–run transmission of price changes in the world market substantially influence the current period price of the commodity in the domestic market. On the whole the present analysis tends to suggest that with liberalization and globalisation, the integration of domestic markets with that of world market increased and the increase in integration is mainly attributed by the substantial improvement in short-run elasticity rather than long run. Or in other words globalisation and liberalization had significant influence in terms of integrating the domestic coffee market with the world market.

Table 10 Period wise Estimates of Error-Correction Model

<table>
<thead>
<tr>
<th>Commodity</th>
<th>EC estimates</th>
<th>Pre-reform</th>
<th>Post Liberalization period</th>
<th>Post WTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arabica</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-0.02</td>
<td>-0.003</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>Short run adjustment</td>
<td>0.22 * (2.21)</td>
<td>0.25 ** (3.19)</td>
<td>0.54 ** (6.8)</td>
</tr>
<tr>
<td></td>
<td>Long run adjustment</td>
<td>-0.12 * (1.97)</td>
<td>-0.19 ** (4.23)</td>
<td>-0.29 ** (4.3)</td>
</tr>
<tr>
<td></td>
<td>Adjusted R²</td>
<td>0.07</td>
<td>0.19</td>
<td>0.44</td>
</tr>
<tr>
<td>Robusta</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-0.003</td>
<td>-0.003</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>Short run adjustment</td>
<td>0.17 (1.69)</td>
<td>0.25 ** (2.60)</td>
<td>0.58 ** (5.13)</td>
</tr>
<tr>
<td></td>
<td>Long run adjustment</td>
<td>-0.098 (1.64)</td>
<td>-0.10 ** (2.95)</td>
<td>-0.16 ** (3.38)</td>
</tr>
<tr>
<td></td>
<td>Adjusted R²</td>
<td>0.051</td>
<td>0.12</td>
<td>0.32</td>
</tr>
<tr>
<td>Pepper</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>0.001</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Short-run</td>
<td></td>
<td></td>
<td>Long-run</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------</td>
<td>-------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.46</td>
<td>(6.10)</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.13</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td></td>
<td>0.23</td>
<td></td>
<td>0.56</td>
</tr>
</tbody>
</table>

**Cardamom**

|                |           | 0.006 |       | -0.003   |       |       |
|                |           |       |       | Short run|       |       |
|                |           | 0.51  | (ns)  | 0.64**   | (3.41)|       |
|                |           | -0.06 | (ns)  | -0.36**  | (2.97)|       |
| Adjusted R²    |           | 0.02  |       | 0.46     |      |       |

**Pepper**

The results of the empirical analysis of cointegration between price of pepper in Cochin and New York market on the basis of ADF and PP are presented in Table 7 and 8. The values ADF and PP on the residuals (in the last two columns) suggest that as in the case of pepper markets were integrated even during the pre-reform period. The estimates of short-run and long run elasticity in the pre-reform period were respectively 0.46 and -0.13 and found to be statistically significant. The estimated short-run elasticity (0.460) indicates that immediate transmission of world price change to the domestic market in the pre-reform period itself. In post-reform period the estimated short-run elasticity coefficient is 0.88, indicating that reform measures had substantial impact on the immediate transmission of price changes in world market to domestic market. The estimate of long run elasticity or the speed of convergence in the post reform period (–0.24) also implies the effectiveness of reform measures on the extent of integration of price of black pepper in domestic market and New York market. In general we can conclude that the extent of integration has increased with liberalization and the improvement was mainly on account of short run transmission rather than the effect of long run cointegration.

**Cardamom.**

The preliminary test for the market integration on the basis of residuals of cointegrating regression using ADF and PP reject the null hypothesis of unit root in residuals. This tends to conclude that the existence of market integration between domestic and world price of cardamom in pre-reform period. However, a definite conclusion is not called for because the estimates of long run and short run coefficients of error correction model are not statistically significant (see table 8). Viewed thus, the cardamom market during the pre-reform period behaved differently as compared to other crops studied. Here both the test (ADF and PP on residuals and error correction estimates) confirms the existence of market integration in the post reform period. As we move to the post reform...
period, there appears to be a major change as evident from the values of estimated coefficients. The estimates of both long run (-0.36) and short-run coefficients (0.64) are found to be highly statistically significant leading to the conclusion that the reform measures seems to have had the effect of making the domestic market highly integrated with the world market.

**Conclusion**

Against the backdrop of unprecedented policy changes, which were expected to have significant impact, among others, on integrating the hitherto protected domestic commodity markets with world market; the present paper explored the dynamics of integration of domestic market with the world market. While there are number of studies on the transmission of international prices to domestic markets in the case of food crops, there have been hardly any studies exploring the behaviour of plantation crops which are important not only as a source of foreign exchange but also as a source of employment. Hence the present paper focuses on select plantation crops from Kerala, a major producer of export oriented plantation crops.

This paper has adopted the cointegration and error-correction model to analyse the extent of transmission of world price to the domestic market. The required data for the analysis were obtained from the different commodity boards under the Ministry of Commerce, Government of India. The study pertains to the last three decades beginning from 1970, which was divided into pre-reform and post reform period. The post reform period varied from one crop to another as the reform measures were initiated at different time points in different crops. Estimates of error- correction model were made for the whole period and sub period.

The entire period analysis revealed that highest level of market integration in the case of black pepper, followed by rubber and coffee. But in the case of rubber long-run elasticity coefficient was high as compared to the short run which implies that supply conditions were more relevant rather than demand conditions. The market orientation of rubber is different from other crops in the sense that total quantum of production is consumed in the country and therefore domestic supply conditions have significant influence on domestic market price.

Period wise analysis was carried out with a view to capture the effect of policy reforms has certain results to offer. The finds that markets of all the commodities studied except that of cardamom were integrated with the world market even before the initiation of reforms. However, with reforms, the extent of market integration got accentuated as is evident from the increase in the value of estimated coefficient. Here again we noted that black pepper recorded highest level of integration as compared to others. This may be viewed against the fact that India is not only a leading producer in the world but it also exports bulk of its production to the world market. In case of coffee, though India bulk of its domestic production is exported its share in the world market is low. Though
cardamom has historically been an export-oriented crop, since 1980’s it has become more domestic market oriented and during the pre-reform period characterized by high tariff barriers, the market has been not integrated with world market. With lowering of tariff barriers in the post reform period, the domestic market became more integrated with the world market. On the whole the study finds that liberalized policies made the transmission of world price to domestic market possible, leading to increased market integration of domestic and world market. Given these findings, there are two issues of analytical importance.

Reference


Banerjee etal(1993), Cointegration, error-correction and economic Analysis of non-stationary data, Newyork, Oxford University press.


Baffes , J(1991), Some Further evidence on the Law of one Price: The Law of
One price still holds”, American Journal of Agricultural Economics 73, pp 661-669


Famiinov M, B and Benson (1990), ”Integration of Spatial Markets”, American Journal of Agricultural Economics, vol.72, pp 49-62.


Niemi Jyrki (2003) Cointegration and Error correction Modeling of Agricultural Commodity Trade. The Case of ASEAN Agricultural Exports to the EU, *Agricultural and Food science in Finland* Vlo.12, Supplement 1


Nayar Deepak and Sen Abhijit (1994), " International Trade and the Agricultural Sector in India ", in Bhalla, G.S, Economic Liberalisation and Indian agriculture, Institute of Studies in Industrial development, New Delhi, India.

UN (2002), The Least Developed countries report 2002, Escaping the poverty Trap., Part 2, Chapter 4

Varma, Poornima(2001), Impact of Trade Liberalisation on Rubber and coconut . M.phil dissertation submitted to the Jawaharlal Nehru University. Centre For Development Studies, Trivandrum.