NRPPD Discussion Paper

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IMPACT OF FUTURES MARKETS ON PRICES OF PLANTATION CROPS: THE INDIAN EXPERIENCE

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ABSTRACT

In order to make the plantation sector vibrant and to sustain its past glory, and also to safeguard the welfare of the various market participants, the Government of India has come up with various interventions. Futures market is one of the interventions by the government with the objective of delivering two key economic functions namely better price discovery and price risk management. However, the impact of futures trading on the prices realised by the growers in general and its bearing on growing price instability in particular, is yet to receive the attention of scholars. Beyond domestic fundamentals (supply and demand conditions) a host of other variables do influence the price level and the change therein (instability). These include global demand and supply, exchange rates, food price inflation and WTO commitments and others. This paper attempts to compare the price trends in the plantation crops before and after the commencement of futures trading at national level during 2003-04. The performance of these crops (pepper, cardamom, coffee, rubber) *Vs* non exchange traded commodity like tea has also been compared using statistical and econometric tools.

Findings of the study indicates that in case of exchange traded plantation crops, except natural rubber, the observed price instability and volatility were higher before commencement of futures as compared to the period since futures trading was introduced. In case of non-exchange traded commodity (tea), the level of price volatility was much lower as compared to other crops. The impact of futures markets by way of price discovery and price risk management made the spot prices of these commodities to realign their path to have a co-movement. Some policy suggestions have been made for the welfare of the plantation sector to revive its pride.

1. Introduction

Plantation crops in India are considered to play a major role in the agricultural and industrial development of the country as a whole. They contribute a significant amount to the national exchequer and country's exports by way of excise and export earnings. They also provide direct and indirect employment to large number of people in the country who are actively engaged in the commodity value chain of the plantation crops. Realising their importance, the Government of India has identified some prominent crops as high-value crops of great economic importance and set up commodity boards to provide better opportunities for the entire value chain participants of the plantation sector.

During the recent past, the plantation sector in India has been facing numerous hurdles. Risks emerging from the production front associated with vagaries of weather, quality cultivars, decrease in planting areas due to various reasons like rapid urbanisation, labour migration, increased wages, non availability of quality inputs, risks confronted at the marketing side like stiff competition from global players, trade agreements, tariff structure, government intervention, price transmission from the global markets, fluctuating currency, etc. add pressure to the mere survival of this sector.

The Government of India has already taken a number of initiatives for the growth and development of the plantation sector and one such

measure introduced in the marketing side is the facility to trade in the futures platform. With the twin economic objectives of price discovery and price risk management, the advantages of futures markets are promoted for the commercial crops at the initial phase. Even though, futures' trading has a long history in India, the Government has set up national multi commodity exchanges to trade in an electronic platform at the national level and made access to market participants to trade in futures markets whether they are from production region, or from consumption region, in a transparent manner.

The findings of the Abhijit Sen Commitee Report (2008) about the impact of commodity futures trading on select agricultural commodity prices revealed that futures trading can increase price actually received by farmers who themselves do not trade in futures as the causality runs from futures to spot prices. This can be through discovery of future spot prices that help farmers make better cropping decisions. With respect to the ability of futures markets to reduce spot price volatility, a mixed trend is observed for major agricultural crops. Hence, the general presumption that it is not possible to make an unambiguous statement to the effect that futures markets always stabilize markets and reduce price volatility.

Similarly, Indian Institute of Management, Bangalore (IIMB, 2008) has conducted a study to analyse the impact of futures trading on some important agricultural commodities which had reasonable volume. The report revealed that futures trading had a positive and significant causal impact on both the average level of spot prices and their volatility in case of select commodities and led to increase in prices in case of few crops, probably because of fall in supply.

According to Naik et al.,(2002) a large number of agricultural commodities and their by-products are traded in several exchanges and the commodity markets in India are yet to develop fully as efficient

mechanisms of risk management and price discovery. Ahuja (2006) has tried to bring out some facts regarding India's attempt to re-introduce futures contract in several commodities, and also the issues such as introduction of new market-based products, standardisation of warehousing, nature of contract settlement, functions of regulator, and integration of the markets, which need urgent attention for the successful functioning of the market.

Hence, it is imperative to know how far these markets are helpful in achieving their economic objectives apart from providing livelihood and better business opportunities for various stakeholders of the plantation sector. So it is conceived to assess the impact of futures markets on the prices of plantation crops with the following specific objectives:

1. To analyse the possible impact of futures markets on the prices of select plantation crops (black pepper, cardamom, coffee and rubber) in terms of prices of these commodities before and after the introduction of futures trade in these commodities;

2. To compare the observed trends in these crops with that of tea wherein futures trade does not exist; and

3. To analyse, using appropriate econometric tools, the role of different factors (including futures market and world market integration) on the observed trend in the prices of above mentioned plantation crops.

2. Data and Methodology

The nature of data, sources of data collection and the research methodology adopted to analyse the objectives formulated for the current study are given briefly in this section.

For the present study, time series data of spot and futures prices of coffee, cardamom, pepper, rubber and spot prices of tea were collected from various sources. Futures prices of exchange traded commodities

were sourced from the national commodity exchanges like NMCE and NCDEX which are mainly trading in agricultural commodities. Spot prices were collected from the commodity board websites, the World Bank pink sheets and IndiaStat.com.

In the case of exchange traded commodities, futures and spot prices were collected from the date of commencement of futures trading in the exchange platform till date and they were daily price series with discontinuous nature in the sense except for declared holidays and the regulatory intervention of the commodity market regulator to suspend the futures trading in these crops to a certain period.The possible impacts of futures price on spot prices and *vice-versa* were analysed using this data.

To analyse the trend in the spot price movement of these plantation crops, monthly price series prior to commencement of futures trading (since May, 1997) and after commencement of futures trading in the national commodity exchanges for these crops (except tea) till December, 2011 were taken. The period of commencement of futures trading in rubber and pepper was 2003-04 and for coffee and cardamom it was 2004-05.

To fulfill the proposed research objectives, the following time series econometric and statistical tools were employed.

The instability in spot prices of plantation crops is measured in relative terms by the Cuddy-Della Valle index which is used in recent years by a number of researchers as a measure of variability in time series data. The simple coefficient of variation over estimates the level of instability in time-series data characterised by long term trends whereas the Cuddy-Della Valle index corrects the coefficient of variation.

The instability index I_X, is given by the expression:

$$I_x = CV^* SQRT (1-R^2)$$

Where, CV = Coefficient of variation (in per cent), R^2= Coefficient of determination from a time-trend regression adjusted by the number of degrees of freedom.

The spot prices of the plantation crops were estimated for the price instability using the Cuddy-Della Valle index.

The major issue of approaching time series data is the problem of non stationarity. Before analysing any time series data, testing for stationarity is a pre requisite since econometric relation between the time series has the presence of trend components. This involved testing for stationarity of the variables using Augmented Dickey Fuller (ADF) test. The ADF tests consider the null hypothesis that a given series has a unit root, i.e., it is non- stationary. The test is applied by running the regression of the following form:

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \alpha_i \sum \Delta Y_{t-1} + e_t$$

If the coefficient δ is not statistically different from zero, it implies that the series have a unit root, and, therefore, the series is non-stationary. To verify that the first differenced price series are indeed stationary, Augmented Dickey-Fuller (ADF) unit root tests are used. The null hypothesis of non-stationary is tested using a t-test. The null hypothesis is rejected if estimated variable is significantly negative. For testing stationarity in the above equation, *Y* denoted the commodity futures and spot prices of plantation crops.

The Granger test is based on the premise that if forecast of some variable, say *X*, obtained by using both the past values of *X*, and the past values of another variable *Y*, is better than the forecast obtained using past values of *X* alone, *Y* is then said to cause *X*. The model proposed by Granger was:

$$Y_i = a_i Y_{t-i} + b_i X_{t-i} + e_i \qquad (1)$$

$$X_i = c_i Y_{t-i} + d_i X_{t-i} + v_i \qquad (2)$$

Where, X_i and Y_i are two stationary time series with zero mean e_i and v_i are two uncorrelated series, lag length is assumed to be finite and shorter than the time series considered. Based on equations (1) and (2), unidirectional causation from one variable X to Y (i.e. X Granger causes Y) is observed if the estimated coefficient on the lagged X variable in equation (1) is statistically non-zero as a group and the set of lagged Y coefficient is zero in equation (2). Similarly, unidirectional causation from Y to X (i.e. Y Granger causes X) is implied if the estimated coefficient on the lagged in equation (2) are statistically different from zero as a group and the set of estimated coefficient on the lagged variable in equation (1) is not statistically different from zero. Feedback or mutual causality (bi-directional) would occur when the set of coefficients on the lagged X variable in equation (1) and on lagged variable Y in equation (2) are statistically different from zero. Finally, independence exists when the coefficients of both X and Y variables are equal to zero. For the proposed study, X_i and Y_i denote the futures and spot prices of plantation crops respectively.

The price volatility in the spot and futures of the plantation crops were estimated through GARCH models. In analysing the time series data the conditional variance of the forecast error term is not constant resulting in the violation of OLS assumptions. The tools described in this section differ by modeling the conditional variance, or volatility, of a variable. More efficient estimators can be obtained if heteroskedasticity in the errors is handled properly. Autoregressive Conditional Heteroscedasticity (ARCH) models are specifically designed to model and forecast conditional variances. The variance of the dependent variable is modeled as a function of past values of the dependent variable and independent or exogenous variables. ARCH models were introduced by Engle (1982) and generalised as GARCH (Generalised ARCH) by Bollerslev (1986).

The GARCH model had two distinct specifications: one for the conditional mean and one for the conditional variance are provided and the standard GARCH (1,1) specification was presented below:

$$Y_t = \gamma_0 + \gamma_1 X_{1t} + ... + \gamma_k X_{kt} + e_t \qquad (1)$$

$$\sigma_t^2 = \omega + \alpha\, e_{t-1}^2 + \beta\, \sigma_{t-1}^2 \qquad (2)$$

The mean equation (1) was a function of exogenous variables with an error term. The conditional variance equation (2) was a function of three terms namely:

(i) The mean: ω

(ii) Volatility from the previous period (measured as the lag of the squared residual from the mean equation): e_{t-1}^2 (the ARCH term)

(iii) Last period's forecast variance: σ_{t-1}^2 (the GARCH term)

An ordinary ARCH model was a special case of a GARCH specification in which there were no lagged forecast variances in the conditional variance equation. The ARCH component (α) indicating the lag of the squared residual from the mean equation and the GARCH term (β) implying the last period's forecast variance, the resultant sum of these coefficients ($\alpha + \beta$) were estimated. The sum of coefficients very close to 1 would indicate the volatility shocks are quite persistent in the series.

The Vector Auto Regression (VAR) is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The VAR approach sidesteps the need for structural modeling by modeling every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system.

The mathematical form of a VAR is as follows:

$$F_{1t} = \alpha + \sum_{j=1}^{k} \beta_j F_{t-j} + \sum_{j=1}^{k} \gamma_j S_{t-j} + u_{1t} \quad (1)$$

$$S_{1t} = \alpha' + \sum_{j=1}^{k} \theta_j S_{t-j} + \sum_{j=1}^{k} \vartheta_j F_{t-j} + u_{2t} \quad (2)$$

Where '*F*' denotes futures prices, '*S*' indicates spot prices of the plantation crops and '*u*' stochastic error term.

Since only lagged values of the endogenous variables appear on the right-hand side of each equation, there is no issue of simultaneity, and OLS is the appropriate estimation technique.

Simultaneous Equations Models (SEM) are the class of that depend on more than one equation interacting together to produce the observed data. Unlike the single-equation model in which a dependent variable is a function of independent variables, other dependent variables are among the independent variables in each SEM equation. The dependent variables in the system are jointly or simultaneously determined by the equations in the system.

$$F_{1t} = \alpha + \sum_{j=1}^{k} \beta_j F_{t-j} + \sum_{j=1}^{k} \gamma_j ER_{t-j} + \sum_{j=1}^{k} \lambda_j OIR_{t-j} + u_{1t} \quad (1)$$

$$S_{1t} = \alpha' + \sum_{j=1}^{k} \theta_j S_{t-j} + \sum_{j=1}^{k} \vartheta_j F_t + \sum_{j=1}^{k} \sigma_j WP_{t-j} + u_{2t} \quad (2)$$

In a simultaneous equations system, variables that appear only on the right-hand side of the equals sign are called exogenous variables. They are truly independent variables because they remain fixed. Variables that appear on the right-hand side and also have their own equations are referred to as endogenous variables. Unlike exogenous variables, endogenous variables change value as the simultaneous system

of equations grinds out equilibrium solutions. They are endogenous variables because their values are determined within the system of equations. Fortunately, there are ways to consistently estimate the coefficients in the system. The most common approach is called the method of instrumental variables. When several instrumental variables are available, they are combined via regression (the first stage) and then used in a second regression. This procedure is called two-stage least squares, 2SLS (or TSLS).

3. Research Findings

The major trend observed in the prices of plantation crops before and after the commencement of futures trading in the national multi commodity exchanges, instability in prices, the interrelationship between futures and spot prices of these crops, and prevailing price volatility in both the markets. Finally, the impact of futures prices on the spot market prices of major plantation crops of India were estimated and presented below.

The spot prices of the plantation crops were estimated for the price instability using the Cuddy-Della Valle index (I_x). The price instability is measured in relative terms by the instability index which is used frequently in recent years as a measure of variability in time series data. Except for tea, the remaining four plantation crops chosen for the current study viz., coffee, cardamom, black pepper and rubber are being traded in the national commodity exchanges since 2003-04 though pepper was traded in the regional commodity exchanges even before. The monthly series of the spot prices of all these crops since May 1997 till their commencement for futures trading and behaviour of the same after commencement of futures trading were analysed using Cuddy-Della Valle Index and the results were presented in Table 1. The results reveal that among the exchange traded plantation crops; price instability was more pronounced in the case of cardamom followed by pepper, coffee and rubber before the commencement of futures trading during 2003.

Table 1: Instability in Spot Prices by CV Index

Commodity	Commencement of Futures in National Commodity Exchanges			
	Before		After	
Exchange traded	CV	Ix	CV	Ix
Coffee	36.398	22.848**	25.748	14.857*
Cardamom	37.812	36.745	51.838	30.469
Pepper	42.131	31.597*	34.274	16.388*
Rubber	31.767	20.629**	44.106	25.809
Non Exchange traded				
Tea	11.987	11.464**	24.299	13.352*

NB: CV – Cuddy Della Valle index
Note: *** significant at 1 percent level
** significant at 5 percent level
* significant at 10 percent level

After granting permission for national commodity exchanges to trade in futures markets, price instability in the spot markets of these crops were comparatively low except for rubber. One possible conclusion is that the price discovery in the futures markets could possibly restrict the price instability in the spot markets. In the case of rubber, apart from the futures prices, it is also heavily influenced by the shocks exerted by the crude oil prices which are prone to high volatility during the recent period when compared to two decades before. It was also evident that in the case of non-exchange traded commodities like tea, the price instability was more after the commencement of futures in the national commodity exchanges when compared to the previous period (before 2003-04) which might lead us to think the price instability was less in the plantation crops traded on the exchange platform.

Before exposing any time series data for econometric analyses, the price series should be made stationary. To verify level and first differenced price series were indeed stationary, Augmented Dickey-Fuller

(ADF) unit root test was used. The equations were estimated with an intercept and time trend. The results are presented in Table 2 for Augmented Dickey-Fuller (ADF) unit root tests for each series. The null hypothesis of non-stationarity was tested based on the critical values reported by MacKinnon. All the price series appeared non-stationary in the levels, but all the series were stationary after taking first differences and ready for further analyses.

The causal relationships between the spot and futures prices of exchange traded commodities were approached through Granger's

Table 2: Results of ADF Test

Variable	Level	First difference
CF	-2.5477	-19.5524***
CS	-2.3446	-18.2423***
KF	-2.4518	-19.8607***
KS	-0.3915	-21.8469***
PF	-0.2079	-25.5375***
PS	2.2235	-24.5214***
RF	-2.4048	-25.8790***
RS	-2.1121	-24.3936***
TEA	-2.4031	-10.3504***

*** significant at 1 percent level

{Note: CF, KF, PF & RF – futures prices of coffee, cardamom, pepper & rubber CS, KS, PS & RS – spot prices of coffee, cardamom, pepper & rubber}

Causality technique. The casual relationship was presented in Table 3 and it could be seen that existence of bidirectional causality from spot to futures and *vice-versa* for the prices of exchange traded plantation crops confirmed the reasons for the co-movements between spot and futures prices of coffee, cardamom, pepper and rubber significant at 1 per cent level in most of the cases. Only the spot price influence of

Table 3: Results of Granger Causality Test

Null hypothesis	F – statistic	P -value
CF does not Granger Cause CS	10.4345***	0.0005
CS does not Granger Cause CF	49.5306***	0.0000
KF does not Granger CauseKS	13.9433***	0.0000
KS does not Granger Cause KF	3.0559**	0.0474
PF does not Granger Cause PS	132.1201***	0.0000
PS does not Granger Cause PF	16.6014***	0.0000
RF does not Granger Cause RS	209.2839***	0.0000
RS does not Granger Cause RF	2.9876*	0.0957

Note: *** significant at 1 percent level
** significant at 5 percent level
* significant at 10 percent level

The test for causality is based on F statistics that is calculated by using unconstrained and constrained forms,

$$F= \{SSE_r + SSE_f)/ m\} / \{SSE_f/ (T-2m-1)\},$$

Where SSE_r and SSE_f are residual sum of squares of the reduced and full models respectively; T= total number of observations, and m= number of lags.

{NB: CF, KF, PF& RF – futures prices of coffee, cardamom, pepper & rubber; CS, KS, PS & RS – spot prices of coffee, cardamom, pepper & rubber}

cardamom on its futures and the spot price influence of rubber on its futures were significant at 5 per cent and at 1 per cent level respectively. Possible implications of the results were prices discovered in the futures platform for the standardised graded commodity of these plantation crops served as the reference for the spot price movements.

The volatility in the spot and futures prices of the plantation crops were estimated through GARCH models. The ARCH component (α) indicating the lag of the squared residual from the mean equation and the GARCH term (β) implying the last period's forecast variance, the resultant sum of these coefficients ($\alpha + \beta$) were presented in Table 4. Among the commodity price series, cardamom spot prices were more volatile as witnessed through the sum of ARCH and GARCH effect (1.0294). In many cases, spot prices of exchange traded commodities were relatively more volatile than their corresponding futures prices. For non-exchange traded commodity tea, price volatility was quite

Table 4: Results of GARCH (1,1) Test

Variables	ARCH (1)	GARCH(1)	Total Effect
CF	1.2530	-0.8536	0.3994
CS	1.3388	-0.8572	0.4816
KF	1.1368	-0.4610	0.6758
KS	0.9670	0.0624	1.0294
PF	1.0329	-0.9344	0.0985
PS	1.0617	-0.9772	0.0845
RF	1.4661	-0.9560	0.5101
RS	1.6759	-0.9985	0.6774
T I	0.9039	-0.0836	0.8203
T II	1.2062	-0.3452	0.8610

{NB: CF, KF, PF& RF – futures prices of coffee, cardamom, pepper & rubber CS, KS, PS & RS – spot prices of coffee, cardamom, pepper & rubber T I & T II Tea prices: Before and after commencement of futures trading }

similar even after the commencement of futures trading in the national commodity exchanges as it was before.

It was inferred that the spot prices, mainly the average sum of various quality attributes exerted relatively more price volatility when compared to their graded, standardised and exchange traded variants. So, in a way, futures markets for plantation crops exhibited relatively less volatility than the spot markets to serve its economic function of price risk management for its various market participants.

Since both the futures and spot prices were influencing each other, the Vector Auto Regression (VAR) modeling of these variables involved equations for each of the spot and future variables of exchange traded plantation crops. The estimation of VAR results were presented in Table 5. In each commodity equation, two lags of spot and futures prices of respective commodities were incorporated (endogenous) and constant term was the only exogenous variable. The highlighted values indicated the significance of the coefficients of the variables included in the model and the order of lag was 2 in all the cases. From the results, it could be inferred that spot prices of plantation crops were highly influenced by the lagged futures and spot prices but the reverse was not so. In the case of cardamom, both the spot and futures prices were influenced only by its own lag. Similarly, the rubber futures price was influenced by its own first lag. Hence, further analysis from VAR estimates like variance decomposition and impulse response may give some forecast about the price trends of the plantation crops.

The determinants of spot and futures prices for the plantation crops and the factors determining them have been casted into simultaneous equations framework and the results were presented in Table 6. For all the plantation crops, the lagged futures price was influencing the futures price positively and also highly significant. Open Interest was another major variable which influenced the futures prices of cardamom and natural rubber but negatively. Exchange rate

Table 5: Vector Auto Regression (VAR) Estimation Results

CF = 22.85249 + **1.156517**CF(-1) - **0.218631** CF(-2) + 0.077035 CS(-1) -0.016517 CS(-2)

R^2 =0.99

CS = 22.26808+ **0.332494** CF(-1) - **0.320167** CF(-2) + **0.837563** CS(-1) + **0.147674** CS (-2)

R^2 =0.99

KF = 2.282014 + **0.984092**KF(-1) - 0.025491 KF(-2) - 0.069428 KS(-1) – 0.032817 KS(-2)

R^2 =0.96

KS = -0.19622 + 0.059016 KF(-1) - 0.017434 KF(-2) + **0.918722** KS(-1) + 0.040171 KS (-2)

R^2 =0.98

PF = -3.157278 + **0.968204** PF(-1) - 0.020046 PF(-2) - **0.193968** PS(-1) – **0.140554** PS(-2)

R^2 =0.99

PS = -15.9808 + **0.357771** PF(-1) - **0.324779** PF(-2) + **0.918722** PS(-1) + **0.092373** PS (-2)

R^2 =0.99

RF = 17.53692 + **1.040784** RF(-1) - 0.062396 RF(-2) - 0.057065 RS(-1) + 0.077878 RS(-2)

R^2 =0.99

RS = 3.696421 + **0.450945** RF(-1) - **0.247486** RF(-2) + **0.701740** RS(-1) + **0.094073** RS (-2)

R^2 =0.99

(NB: CF, KF, PF& RF – futures prices of coffee, cardamom, pepper & rubber; CS, KS, PS & RS – spot prices of coffee, cardamom, pepper & rubber. Order of lag = 2. Co-efficient of significant variables were highlighted)

was instrumental in deciding the futures of coffee. Under 2SLS or TSLS framework, spot prices of all the plantation crops were influenced by their respective futures, followed by the world prices (barring cardamom). The same equations were tried incorporating other crucial variables

Table 6: Determinants of Spot and Futures Prices of Plantation Crops

	Cardamom		Coffee		Pepper		Rubber	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Variables								
Constant	-131.7491	-85.2841	-405.02	-355.29	2407.55	650.57	1714.662	1517.68
Exchange Rate	7.1533		94.2234***		-31.7182		-30.0089	
Futures Price		0.8874*		1.6121**		0.6669*		1.4809**
Futures Price Lagged	0.6432***		0.9394***		0.8951***		0.9743***	
Open Interest	-0.1736**		0.2223		0.0387		-0.4106**	
Spot Price Lagged		0.2577*		-0.3612		0.0938		-6.3981
World Price		-0.1822		-0.2515*		0.0386**		1.5340***
N	39	39	59	59	89	89	83	83
Adjusted R^2	0.8561	0.9073	0.9418	0.9532	0.9542	0.9850	0.9772	0.9899
F	40.27	87.03	314.09	343.99	613.34	630.65	117.29	128.67

Note: *** Significant at 1 per cent confidence level, ** Significant at 5 per cent confidence level ,

* Significant at 10 per cent confidence level

such as price inflation and crude oil prices but they were not significant in determining either spot or future prices of the plantation crops chosen.

4. Summary and Policy Suggestions

The major objective of present study was to analyse the impact of futures markets on the prices of plantation crops especially exchange traded commodities like coffee, cardamom, pepper, rubber *vis-a-vis* non exchange traded commodities like tea. The specific objectives of the proposed study were:

i) To analyse the possible impact of futures markets on the price of select plantation crops (black pepper, cardamom, coffee and rubber) before and after the introduction of futures markets in India;

ii) To compare the observed trends in these crops with that of tea wherein futures does not exists; and

iii) To analyse, using appropriate econometric tools, the role of different factors (including futures and world market integration) on the observed trend in the price of above mentioned plantation crops.

4.1. Salient Findings

The CV Index (Ix) results revealed that among the exchange traded plantation crops, the price instability was more profound in the case of cardamom followed by pepper, coffee and rubber before the commencement of futures trading during 2003. After granting permission for national commodity exchanges to trade in futures markets, price instability in the spot markets of these crops were comparatively declined except for rubber. It was also evident that in the case of non-exchange traded commodities like tea, the price instability was more after the commencement of futures in the national commodity exchanges when compared to the previous period (before 2003-04).

To verify level and first differenced price series were indeed stationary, Augmented Dickey-Fuller (ADF) unit root test was used. The

null hypothesis of non-stationarity was tested based on the critical values reported by MacKinnon. All the price series appeared non-stationary in the levels, but all the series were stationary after taking first differences and fit for time series econometric analyses.

Test results of Granger Causality proved the existence of bidirectional causality from spot to futures and *vice-versa* for the prices of exchange traded plantation crops which confirmed the reasons for the co-movements between spot and futures prices of coffee, cardamom, pepper and rubber significant at 1 per cent level in most of the cases. Only the spot price influence of cardamom on its futures and the spot price influence of rubber on its futures were significant at 5 per cent and at 1 per cent level respectively.

Among the commodity price series, cardamom spot prices were more volatile as witnessed through the sum of ARCH and GARCH effect. In many cases, spot prices of exchange traded commodities were relatively more volatile than their corresponding futures prices. For tea, price volatility was quite similar even after the commencement of futures trading for other plantation crops in the national commodity exchanges as it was before.

From the results, it could be inferred that spot prices of plantation crops were highly influenced by the lagged futures and spot prices but the reverse was not so. In the case of cardamom, both the spot and futures prices were influenced only by its own lag. Similarly, the rubber futures price was influenced by its own first lag. Hence, the hypotheses were empirically tested and results were in concordance with the objectives.

Simultaneous Equations Method (SEM) results indicated the strong influence of futures on spot prices of the select plantation crops as well as the role of world prices on the domestic prices of plantation crops which clearly indicated the influence of global fundamentals on

the prices of both spot and futures of major plantation crops. Also the exchange rate, one of the crucial variables for export oriented plantation sector, was also significant in determining the prices.

4.2. Policy Implications

The study has the following implications for the growth of markets as well as the development of market participants from initial producer/ grower to ultimate consumer.

- Futures markets for plantation crops deliver two key economic functions namely price discovery and price risk management. Spot prices for these commodities closely follow the futures prices discovered in the exchange platform.

- Hence, market participants are advised to closely monitor the futures prices of these crops traded on the exchange platform. Already through Price Dissemination Project (PDP), the commodity market regulator, Forward Markets Commission, has installed information kiosks at various places to help the market participants to take appropriate marketing decisions to mitigate price risks.

- Owing to standardised contracts traded in the futures market, the resultant price instability arising out of major shocks emerging out of global and domestic markets would be less than it would be in the spot markets. Also futures markets serve as the indicator for the quality preferred by the market participants for these crops. Hence, better awareness about post-harvest practices, supply chain management, distribution of better clones, advanced R&D in plantation crops etc., should be strengthened.

- Even in the case of any adverse situations, the regulator is empowered to correct the commodity market ecosystem with plenty of regulatory

tools to put the system back in order. So it should be given a free hand and more powers to implement them effectively to regulate the markets and, at the same time, it should keenly watch the domestic and global fundamentals for these crops.

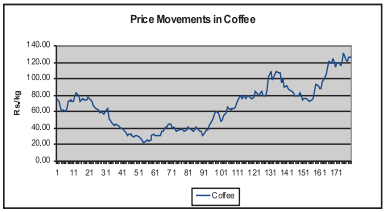
- Since physical delivery is made compulsory at the maturity of the contract for these commodities, stocks lying in the warehouses, planted area and expected output should be made known to the market players periodically through newsletters, websites, SMS alerts etc.

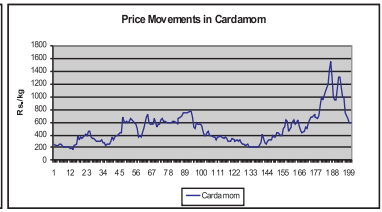
- Spot prices and futures prices are interdependent, while the futures market provides indications to the spot markets on the direction in which prices will move in the future, the futures prices are determined on the basis of the conditions in the spot markets.

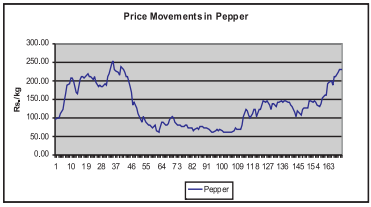
- Futures markets should be developed along with spot markets and integrated effectively to bring about greater participation by the producers and consumers of the underlying assets.

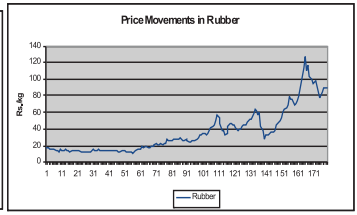
- Tea, being a different class of plantation crop which exhibits high heterogeneity, would not lend itself to classic commodity futures trading. The only alternative would be to set up a financial futures market based on a tea price index which would also serve as an effective hedge for tea growers against non-seasonal price declines.

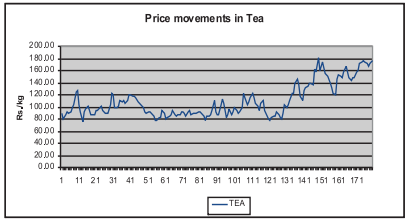
A. Spot Price Movements of Plantation Crops



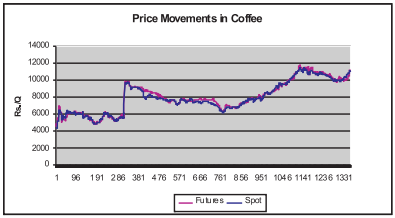


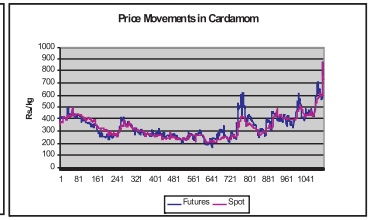


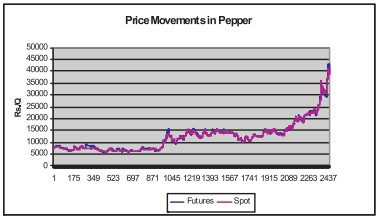


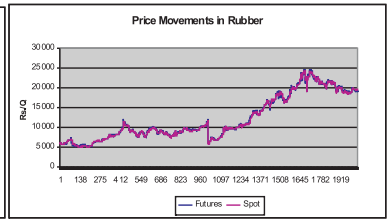


B. Future and Spot Prices Trends of Plantation Crops









Acknowledgement

At the outset, I express my heartfelt gratitude to the National Research Programme on Plantation Development at CDS and its co-ordinator Prof. K.J. Joseph for giving me an opportunity to undertake this work. I am indebted to the anonymous referee, who reviewed this article in its original version, and put me on the right track with his/her incisive but thought stimulating comments which helped me in a great deal in finalising this paper. I am also grateful to a host of other individuals and intuitions in helping me finish this task. I have taken every possible care to ensure accuracy consistency and compatibility of the data used for the analytics of this paper. However, constraints of time and resources may have led to possible errors and omissions. Finally, I am solely responsible for errors, if any.

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References

Abhijit Sen Committee (2008), *Report of the Expert Committee to Study the Impact of Futures Trading on Agricultural Commodity Prices.* Ministry of Consumer Affairs, Food and Public Distribution, Government of India.

Ahuja, N. L. (2006), 'Commodity Derivatives Market in India: Development, Regulation and Future Prospects,' *International Research Journal of Finance and Economics*; Issue 2.

Bollerslev, Tim.(1986), 'Generalised Autoregressive Conditional Heteroscedasticity', *Journal of Econometrics*, 31, 307-27.

Dicky, D.A., and W.A.Fuller (1979), 'Distribution of the Estimators for Autoregressive Time Series with a Unit Root', *Journal of the American Statistical Association*, 74, 427-431.

Engle, R.F., and C.W.J. Granger (1987), 'Cointegration and Error Correction: Representation, Estimation and Testing', *Econometrica*, 55:251-276.

Engle, Robert F (1982), 'Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation', *Econometrica*, 50(4), 987-1007.

FAO Discussion Paper (2012), *Inter Governmental Group on Tea - Working Group on Futures Market,* Intersessional Meeting, Washington DC, USA, September 17-18.

Granger, C.W.J (1969), 'Investigating Causal Relations by Econometric Models,' *Econometrica* ,37, 424-38.

Granger, C (1981), 'Some Properties of Time Series Data and their use in Econometric Model Specification', *Journal of Econometrics*, 16:121-130.

IIMB Report (2008), *'Impact of Futures Trading in Wheat, Sugar, Pulses and Guar Seed on Farmers'*, by the Indian Institute of Management Bangalore and Commissioned by the Forward Markets Commission.

Naik, G and Sudhir Jain (2002), 'Indian Agricultural Commodity Futures Markets – A performance Survey', *Economic and Political Weekly*, XXXVII (30): 3161-73.