

Identifying Bubble Regime in Commodity Derivatives Market Using Markov Regime Switching Model

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Abstract – The Indian derivatives market is new and the volumes in this market are increasing at an increasing rate. It is an important and interesting one to identify the presence of bubble regime in the Commodity market because of the institutional investors. This study empirically investigates the bubble regime in Commodity market for a period of January 2010 to December 2019. The monthly closing price for Institutional Investors and monthly turnover for Agro commodities includes Cardamom and Crude Palm Oil (CPO), totally 120 observations have been taken for the present study. In markov regime model the regime 1, regime 2 and Transition Matrix Parameters say whether the bubble is present or not in the market. The present study found that bubble was present in the Agro Commodity market due to both the Foreign Institutional Investors (FIIs) and Domestic Institutional Investors (DIIs) during the study period.

Keywords – Bubble regime, Markov regime switching model, FIIs, DIIs, Commodity market

I. INTRODUCTION

Trading in Commodity futures in India started with the establishment of the Bombay Cotton Trade Association in 1875. After Independence, the Parliament passed Forward Contracts (Regulation) Act, 1952 which regulated forward contracts in the commodities all over India. By mid 1960s, the government imposed ban on futures trading in most of the commodities. In 1994, the Kabra Committee recommended opening up of futures trading in 17 commodities. In 2003 three National exchanges were recognized for futures trading. Commodity futures markets are governed by Forward Markets Commission (FMC) in respect of futures trading. The three most important exchanges in India are Multi Commodity Exchange of India Ltd (MCX), National Commodity and Derivatives Exchange Ltd (NCDEX) and National Multi Commodity Exchange of India Ltd (NMCE). The future trading is permissible in 95 commodities. The Agricultural commodities constitute the largest Commodity group in the futures market till 2005- 06(55.32%). From 2006-07 onwards, precious metals, energy and base metals have moved into the first position. Foreign Institutional Investors were first allowed to invest in Indian market in 1992 which is a measure of outsiders in the financial markets of particular company. DIIs refer to the Indian institutional investors who are investing in the financial markets of India. The investors of DIIs use pooled funds to trade in securities and assets of their country. The main objective of the study is to identify the bubble regime in Commodity market due to Foreign Institutional Investors (FIIs) and Domestic Institutional Investors (DIIs).

II. REVIEW OF LITERATURE

Fong & See (2002) aimed to induce a markov switching model of the conditional volatility of crude oil futures prices. This paper examined the behaviour of volatility of daily returns on crude oil futures using a generalized regime switching models to allows for abrupt changes in mean and variance, GARCH dynamics, basis driven time varying transition probabilities and conditional leptokurtosis. The data used in this study are daily returns on the second nearest crude oil futures based on the West Texas Intermediate (WTI) Cushing, Oklahoma contract traded on NYMEX. The sample period is from January 2nd 1992 to December 31st 1997 for a total of 1506 observations. The study conclude that the regime switching model provides a useful framework for the financial historian interested in studying factors behind the evolution of volatility and oil futures traders interested short-term volatility forecasts.

A. Alizadeh & Nomikos (2004) discussed about a markov regime switching approach for hedging stock indices. In this study the researchers described a new approach for determining time-varying minimum variance

hedge ratio in stock index futures markets by Markov Regime Switching (MRS) Model. Data set comprises of weekly time series of the FTSE-100 and the S&P-500 futures and spot indices for the period of May 9, 1984 to March 28, 2001. The spot and futures price data are Wednesday's closing price, data for the period of May 9, 1984 to March 29, 2000 totally 829 observations are used in-sample analysis; out of sample analysis is carried out using the remaining data in the sample for the period April 5, 2000 to March 28, 2001 totally 52 observations. All data are obtained from data stream, the delivery months for the FTSE-100 and the S&P-500 contracts are March, June, September and December. The result of the study indicates that using MRS models, market agents may be able to increase the performance of their utility.

Chen & Tsay (2011) employed a Markov Regime Switching (MRS) approach for determining time-varying minimum variance hedge ratio in energy futures markets. Data set for the study comprises of weekly spot and futures prices for three energy commodities. That is Crudeoil, Unleaded Gasoline and Heating oil covering period January 23, 1991 to July 28, 2004 resulting 706 weekly observations. Spot and futures prices are Wednesday prices, when holiday on Wednesday, Tuesday observations are used in its place. Data set are obtained from CRB-Infotech CD and datastream along with volume and open interest data. All the commodities in the study are traded on the NYMEX. Data for the period of January 23, 1991 to July 30, 2003 totally 654 observations are used in-sample analysis; out of sample analysis is carried out using the remaining data in the sample for the period August 6, 2003 to July 28, 2004 totally 52 observations. The result indicate that by using MRS models market agents may be able to increase the performance of their hedge, measured in terms of variance reduction and increase in utility.

III. RESEARCH METHODOLOGY

The study be evidence for the presence of bubble regime of Institutional investors on Agro Commodity market in India. The research design is empirical in nature and it consists of secondary data for a period of ten years monthly data from January 2010 to December 2019 with 120 observations. The Variables chosen for the study are Institutional Investors, Foreign Institutional Investors and Domestic Institutional Investors; In the Agro Commodity Derivatives market Cardamom and CPO Commodity were selected for the present analysis. The data are obtained from Securities Exchange Board of India (SEBI), Multi Commodity Exchange (MCX) and National Stock Exchange (NSE). Econometric tools adopted for the study are Augmented Dickey-Fuller Unit Root test and Markov Regime Switching Model (MRSM).

Markov Switching Model

The Markov switching regression model extends the simple exogenous probability framework by specifying a first-order Markov process for the regime probabilities. The model begins with describing the regime probability specification and then discusses about likelihood computation, filtering and smoothing.

Regime Probabilities

The first-order Markov assumption requires that the probability of being in a regime depends on the previous state, by using the equation

$$P(S_t = j | S_{t-1} = i) = p_{ij}(t)$$

IV. RESULTS AND DISCUSSION

Stationarity of Institutional Investors and Selected Commodities in Indian Derivatives Markets in India: Augmented Dickey-Fuller (ADF) Test and Philips-Perron (PP) Test:

H₀: There is no stationarity in Foreign Institutional Investors (FIIs), Domestic Institutional Investors (DIIs) and selected Commodities in Indian Derivatives market.

Table 1

Augmented Dickey-Fuller (ADF) Test and Philips Perron (PP) Test of Institutional Investors and Select Commodities in Indian Derivatives market for a period from January 2010 to December 2019

SEGMENTS	VARIABLES	LEVEL				FIRST DIFFERENCE				RESULT
		ADF		PP		ADF		PP		
		Intercept	Trend and Intercept	Intercept	Trend and Intercept	Intercept	Trend and Intercept	Intercept	Trend and Intercept	
Institutional Investors	FII	-7.502 (0.00)*	-7.847 (0.00)*	-7.501 (0.00)*	-7.770 (0.00)*	-	-	-	-	Level
	DII	-6.304 (0.00)*	-7.23 (0.00)*	-6.464 (0.00)*	-7.231 (0.00)*	-	-	-	-	Level
Agro Commodities	Cardamom	-3.468 (0.01)*	-4.500 (0.00)*	3.210 (0.02)*	-4.333 (0.00)*	-	-	-	-	Level
	CPO	-2.821 (0.05)	-2.821 (0.19)	-2.728 (0.07)	-2.720 (0.23)	-12.652 (0.00)*	-12.596 (0.00)*	-12.793 (0.00)*	-12.734 (0.00)*	First Difference

Source: Compiled and Calculated from NSE and MCX

The result of unit root test of Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) test criterion applied to determine the order of integration among the time series data is presented in the Table 1. The ADF test and PP test were used at level and first difference based on the assumption of constant, trend and intercept. According to the result of the test of FII, DII and Cardamom data contain unit root at level which indicates that these time series are stationary at level, the degree of integration appears as $I(0)$. CPO was not stationary on level, but it became stationary when its first difference was taken while appearing both the cases of Augmented Dickey-Fuller (ADF) test and Philips-Perron (PP) test. That is, the degree of integration of this series is $I(1)$. Hence the null hypothesis is rejected at 5% level of significance, There is stationarity in Foreign Institutional Investors (FIIs), Domestic Institutional Investors (DIIs) and selected Commodities in Indian derivatives market.

Bubble Regime of Cardamom Agro Commodity Derivatives Market

H_0 : There is no bubble regime in Cardamom Agro Commodity market due to Institutional Investors.

Table 2
Markov Regime Switching Model for Cardamom Agro Commodity using Institutional Investors for a period from January 2010 to December 2019

Dependent Variable: CARDAMOM				
Method: Markov Switching Regression (BFGS / Marquardt steps)				
Included observations: 120				
Number of states: 2				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
FII	-0.0003	0.0001	-2.9586	0.0031
DII	0.0001	0.0002	0.4769	0.6335
LOG(SIGMA)	1.4377	0.4518	3.1819	0.0015
Regime 2				
FII	-3.36E-07	7.25E-06	-4.64E-02	0.9630
DII	4.08E-06	1.04E-05	3.91E-01	0.6958
LOG(SIGMA)	-9.57E-01	7.25E-02	-1.32E+01	0.0000
Common				
AR(1)	0.85486	0.09262	9.23024	0.0000
AR(2)	0.06598	0.07747	0.85163	0.3944
AR(3)	0.15506	0.06380	2.43034	0.0151
AR(4)	-0.08476	0.05656	-1.49867	0.1340
Transition Matrix Parameters				
P11-C	2.73335	2.50200	1.09247	0.2746
P21-C	-4.78670	1.15643	-4.13922	0.0000

Source: Complied and Calculated from MCX and NSE

The above table 2 portrays the markov regime switching model for Cardamom Agro Commodity derivatives market using Institutional Investors for a monthly time series from January 2010 to December 2019. In this model regime 1 says that probability values for FII (0.0031) and Log(Sigma) (0.0015) are less than 5% level of significance. In Regime 2, Log(Sigma) probability value is (0.0000) less than significance level and Common part of the model implies that AR(1) and AR(3) probability values are lower than significance level. In transition matrix parameters P21-C (0.0000) probability value is less than five percent level of significance and it also explains that the bubble was present in second state of Cardamom Commodity due to Institutional Investors. Hence the null hypothesis is rejected at 5% level of significance and it implies that there is a bubble regime in Cardamom Agro Commodity market due to institutional investors.

Table 3
Transition Results of Cardamom Agro Commodity due to Institutional Investors

Constant transition probabilities:		
$P(i, k) = P(s(t) = k s(t-1) = i)$		
(row = i / column = j)		
	1	2
1	0.93897	0.06103
2	0.00827	0.99173
Constant expected durations:		

	1	2
	16.3843	120.905

Source: Complied and Calculated from MCX and NSE

Table 3 illustrates the transition results of Cardamom Agro Commodity due to institutional investors. Constant transition probabilities model assumes that regime 1 and regime 2 (approximately 0.93 and 0.99 respectively) do not depend on the origin state. These probabilities imply that the expected duration is roughly 16.38 quarters in regime 1 and 120.90 quarters in regime 2.

Filtered Regime Probabilities

$$P(S(t)=2)$$

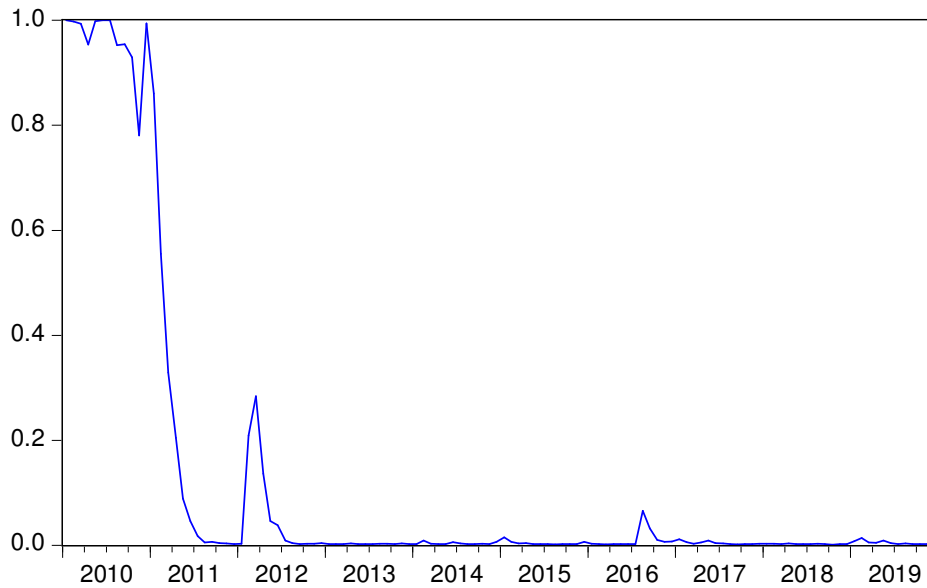


Figure 1 Regime results of Cardamom Agro Commodity by Institutional Investors

The above figure 1 depicts the regime results of Cardamom Agro Commodity due to Foreign Institutional Investors and Domestic Institutional Investors for the period of 10 years. The blue line indicates that the bubble was present in the years from 2010 – 2011, 2012 and 2016.

5.4.2 Bubble Regime of CPO Agro Commodity Derivatives Market

H_0 : There is no bubble regime in CPO Agro Commodity market due to Institutional Investors.

Table 4

Markov Regime Switching Model for CPO Agro Commodity Market using Institutional Investors for a period from January 2010 to December 2019

Dependent Variable: CPO				
Method: Markov Switching Regression (BFGS / Marquardt steps)				
Included observations: 120				
Number of states: 2				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
FII	0.0542	0.0264	2.0545	0.0399
DII	0.0317	0.0400	0.7924	0.4281
LOG(SIGMA)	7.2248	0.1219	59.2748	0.0000

Regime 2				
FII	-0.01907	0.01518	-1.25613	0.2091
DII	-0.02033	0.01996	-1.01882	0.3083
LOG(SIGMA)	6.10145	0.14873	41.02479	0.0000
Common				
AR(1)	0.82195	0.11459	7.17276	0.0000
AR(2)	-0.02569	0.14674	-0.17505	0.8610
AR(3)	0.16184	0.18407	0.87924	0.3793
AR(4)	0.03343	0.15743	0.21233	0.8318
Transition Matrix Parameters				
P11-C	2.05456	0.65681	3.12810	0.0018
P21-C	-1.84116	0.54924	-3.35218	0.0008

Source: Complied and Calculated from MCX and NSE

The markov regime switching model for CPO Agro Commodity derivatives market because of institutional Investors was shown in Table 4. Markov regime is a two state model, the model Regime 1 implies that FII (0.0399) and Log(Sigma) (0.0000) probability values are less than 5% level of significance. In Regime 2 Log(Sigma) probability value is (0.0000) less than significance level and Common autoregressive error part of the model entails that AR(1) probability values (0.0000) is lower than significance level. In transition matrix parameters P11-C (0.0018) and P21-C (0.0008) probability values are less than five percent level of significance and it also explains that in both the first and second state the bubble is present in CPO Agro Commodity due to Institutional Investors. Hence the null hypothesis is rejected at 5% level of significance and it implies that there is a bubble regime in CPO Agro Commodity market due to institutional investors.

Table 5
Transition Results of CPO Agro Commodity due to Institutional Investors

Constant transition probabilities:		
$P(i, k) = P(s(t) = k s(t-1) = i)$		
(row = i / column = j)		
	1	2
1	0.88641	0.11359
2	0.13691	0.86309
Constant expected durations:		
	1	2
	8.80344	7.30384

Source: Complied and Calculated from MCX and NSE

The results of simple switching model with constant transition probabilities and constant expected duration of CPO Agro Commodity due to institutional investors is denotes in Table 5. The probabilities of regime 1 is 0.88 and regime 2 is 0.86 do not depend on the origin state. These probabilities imply that the expected duration in a regime 1 is 8.80 quarters and in regime 2 is 7.30 quarters.

Filtered Regime Probabilities

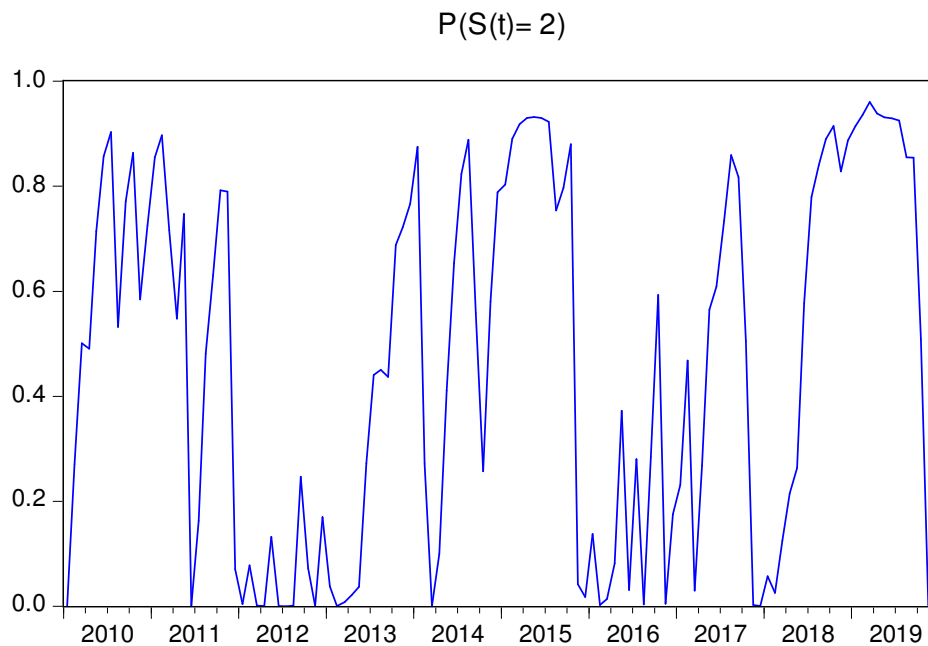


Figure 2 Regime results of CPO Agro Commodity by Institutional Investors

Figure 2 depicts the regime results of CPO Agro Commodity by Foreign Institutional Investors and Domestic Institutional Investors for the period of 10 years. The blue line indicates that the bubble was present throughout the study period that is from 2010 to 2019.

V. CONCLUSION

This study shows that the education of investors is massively important for the present situation in India. Investors before making investments need to collect investment related updates of the Commodity market. In this way, current research is helpful for both the foreign Institutional Investors and Domestic Institutional Investors to invest in the Commodity market. The outcome of the research shows that there is a presence of bubble regime in Commodity derivative market due to both the Foreign Institutional Investors and Domestic Institutional Investors (DIIs).

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