

# Commodity Transaction Tax (CTT): Nature of Correlation Dynamics and Volatility Linkages Between Indian Commodity and Equity Markets

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## ABSTRACT

This study aims to examine the time-varying correlations and volatility linkages between commodity and equity markets before and after the implementation of the commodity transaction tax (CTT) in India in 2013. The study utilizes symmetric and asymmetric DCC-EGARCH model to estimate correlation dynamics. Evidence suggests that the volatility and dynamic correlation linkages between commodities and equity markets are significantly affected by the triggering events. The time-varying correlations of Comdex-Nifty 50 show an unintended steep decline in the post-CTT period. It is an indication of a “flight to quality” phenomenon, where investors move capital from non-agricultural commodity futures to other cross markets and international markets. However, DCC of Comdex-Dhaanya pair is highly volatile in the post-CTT period and also noticed an increased correlation and volatility between the Dhaanya-Nifty 50 pair. Moreover, the correlation dynamics reveal a certain degree of interdependence between the cross markets, which are lower especially during the triggering episodes.

## KEYWORDS

Commodity Transaction Tax, DCC-EGARCH, Interdependence, Time-Varying Correlations, Volatility

## INTRODUCTION

The futures trading was launched in Indian commodity markets with the essential twin objectives of efficient price discovery and better price risk management, which would bring benefits to farmers, investors, and consumers. The derivatives trading commenced in the securities market in June 2000 and it has been growing at high speed, while the commodity derivatives markets, which has been operational since 48 years and still in a nascent stage. However, subsequent few years have witnessed significant changes in the commodity spectrum despite several institutional constraints. Significant reforms have initiated in commodity futures markets in India since the last few years. The government of India implemented the Commodities Transaction Tax (CTT) of 0.01% on non-agricultural commodity futures contracts like gold, copper, and oil on 1 July 2013. However, the agricultural futures contracts were exempted from CTT. This tax is in line with the earlier tax imposed on transactions in the Securities Market, the Securities Transaction Tax (STT). The difference between the STT and CTT in India is that STT is imposed on both buyers and sellers whereas CTT is levied on non-farm commodity derivatives and the tax is payable by the seller only. However, the STT had no negative impact on the securities markets, which have witnessed tremendous growth in both cash

DOI: 10.4018/ijabim.20210401.oa2

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and derivatives segments. Due to the key role of commodities in hedging stock portfolios, most of the studies concentrate on the estimations of the timevarying comovements and the evaluations of hedging effectiveness across several estimation techniques (Arouri et al., 2011; Sadorsky, 2014; Kang, McIver, & Yoon, 2016; Mensi et al., 2013). However, these studies ignore the transaction costs.

The rationale for introducing CTT was to bring commodity market on par with the securities market where a STT levied. Finance Minister Mr. Chidambaram (2013) stated, that “There is no distinction between derivative trading in the securities market and derivative trading in the commodities market, only the underlying asset is different”. Imposition, of these taxes, aims to reduce the price volatility and increase tax revenue, whether it can achieve the objectives is debatable and questionable since the levy of the tax adversely affected the traded volume of the contracts. Pavaskar, M. & Ghosh, N. (2008) Even as a source of revenue to the exchequer, ctt is a short-sighted move.

The performance of the Indian commodity derivatives market can discern from the movement of the benchmark indices—MCX Comdex and NCDEX Dhaanya. MCX Comdex is 10 Agri commodities represent a composite index of three sub-indices, i.e., MCX Metal, MCX Energy, and MCX Agri indices, NCDEX Dhaanya.

Commodity market volumes and values witnessed broadly three distinct phases of growth. The first phase, from 2003–04 to 2005–06, recorded phenomenal growth of more than 200% per annum. The second phase (2006–07 to 2011–12) marked a steady and robust annual average growth rate of about 44% per annum. In the third phase (2012–13 to 2016–17) volumes fell at an average rate of 16% per annum, the essential reasons for the precipitous fall in volumes where the levy of CTT and the impact of the NSEL fraud. However, the NSEL fraud indirectly affected broking firms, which are volume contributors for futures trading, and a significant amount of their funds trapped in NSEL. Further, it affected the general sentiments of market participants, making them skeptical about the functioning of commodity futures markets. The fears expressed by commodity traders that the CTT would lead to a drastic fall in the futures trading volumes are grossly exaggerated. Given the enormous profit opportunities and risk appetite among the trading community, a small levy of 0.01 percent would be quickly absorbed (Kavaljit Singh 2013). Though CTT mainly aims at discouraging excessive

**Table 1. Exchange-wise Traded Value in Commodity Futures from 2004 to 15-16 (Rs. lakh crore)**

Year	MCX	NCDEX	Others	Total	Growth (%)
2004-05	1.7 (29.0)	2.7 (46.5)	1.4 (24.5)	5.7	342
2005-06	9.5 (44.2)	10.9(50.6)	1.1 (5.2)	21.6	273.7
2006-07	22.9 (62.4)	11.6 (31.7)	2.2 (5.9)	36.8	72.3
2007-08	31.3 (76.9)	7.7 (19.0)	1.7 (4.1)	40.7	10.6
2008-09	45.9 (87.4)	5.3 (10.2)	1.3 (2.4)	52.5	29.1
2009-10	63.9 (82.3)	9.2 (11.8)	4.5 (5.9)	77.7	47.9
2010-11	98.4 (82.4)	14.1 (11.8)	7.0 (5.8)	119.5	53.9
2011-12	156.0 (86.0)	18.1 (10.0)	7.2 (4.0)	181.3	51.7
2012-13	148.8 (87.3)	16.0 (9.4)	5.7 (3.3)	170.5	-6
2013-14	86.1 (84.9)	11.5 (11.3)	3.9 (3.8)	101.4	-40.5
2014-15	51.8 (84.0)	9.0 (14.7)	0.8 (1.3)	61.7	-39.2
2015-16*	56.3(84.1)	10.2(15.2)	0.4(0.6)	66.9	8.4
2016-17*	58.6(90.2)	5.9(9.18)	0.37(0.57)	64.9	-2.9

Figures in brackets refer to the percentage share in total. Growth % represents Year Over Year growth.

Source: [www.fmc.gov.in](http://www.fmc.gov.in) (\*2015-17 [www.sebi.gov.in](http://www.sebi.gov.in)).

speculations similar to other financial transactions, it has significantly driven trade volumes towards “Dabba” trading and international exchanges. “Dabba” trading describes off the market and informal trade activities where speculators indulge in speculative trading without paying any transaction taxes or transaction fees. For investors, CTT is an additional burden other than the deposit margins; stamp duties, brokerage and transaction charges which traders were already paying. According to Agrawal, D. R., & Mardan, M. (2019) From a policy perspective, unless there is a change in the enforcement technology, the incentives of auditors, the resources devoted to enforcement, or the salience of detection, detection probabilities are likely to remain low and destination-based taxation at the full (sales tax) rate is undesirable.

## Motivation and Objectives of the Study

The motivation behind the study is to find whether the rationale of introducing a CTT can bring commodity market on par with the securities market? To examine this rationale, time-varying conditional correlations and volatility linkages between commodity and equity markets in pre-CTT and post (during) CTT period. The objectives of this study are 1) to investigate and examine the time varying correlations between commodity and equity indices at pre and post CTT periods 2) To understand how dynamically the co-movements have been changing in between the commodity and equity markets? 3) To investigate the news (good/bad news) impact on the dynamic relations of commodity-equity markets at pre & post CTT periods. 4) To examine the shift in the traded volume of commodity markets.

This study provides an empirical evidence of dynamic comovements of commodity and equity markets. The study mainly focused on agri and non-agri commodity markets dynamic correlations with the equity market. The study employed symmetric and Assymetric DCC-EGARCH model to analyse the data. ADCC-EGARCH framework will provide an evidence of news impact on the timevarying comovements of commodity-equity markets at pre & post CTT Periods.

The remaining paper is organized as follows - section 2 Reviews the Literature, section 3. Methods and Materials, section 4. Describes the Data and Preliminary analysis, section. 5 present the Empirical Results & Discussions, and section 6. Conclusions.

## REVIEW OF LITERATURE

Nations, hardly prefer to impose transaction tax, because of its proven adverse impact on the international finance, which is dominated by cut-throat competition and which failed to generate additional revenue over the long-term. Many nations have explored transaction taxes similar to India's CTT. These efforts were typically ephemeral and burdened with unintended adverse consequences. Some reviews of existing literature on Commodity Transaction Tax and dynamic conditional correlations between the commodity and equity markets.

The traditional wisdom provides the varied opinions on the impact of transaction tax on trading liquidity, volatility, revenue, and trade migration. (Keynes 1936; Tobin 1978; Stiglitz 1989; & Summers and Summers 1989) suggested that the introduction of a transaction tax would make speculative trading less profitable, which would reduce excess market volatility and stabilize the financial markets. However, Roll (1989) showed that there is an inverse relation between transaction tax and volatility. Edwards (1993) found that a transaction tax may reduce speculative trading in the futures markets, but may not be able to reduce price volatility in futures or spot markets. He concludes that the tax would place markets at a disadvantage vis a vis foreign market, leading to a shift to foreign markets. Umlauf (1993) finds an increase in the volatility of Swedish stocks with the imposition of transaction tax. Campbell and Froot (1994) provided evidence of a transaction tax leading to a shift in the traded volume from Swedish exchange to London.

In the last decade a few studies have addressed the aspect of taxing commodity derivative transactions. Most of the studies explained the adverse impact of imposition of transaction tax on

commodities. Sehgal, S., & Agrawal, T. J. (2019) stated that the withdrawal of CTT would be ideal for Indian commodities market development, improving its liquidity and making it more internationally competitive. Madhoo Pavaskar and Nilanjan Ghosh (2015) stated that CTT is a recipe for disaster not only to commodity markets but even to the government as well. Sahoo and Kumar (2008) in their study they revealed that if the government imposes CTT, it will lead to higher volatility and lower trading activity affecting market efficiency and liquidity. Increased volatility may lead to more speculative activity and fail to achieve the price discovery and resource allocation objectives of the commodity markets. Charles M. Seeger (2013) said that the CTT significantly harm the hedging, price discovery and economic functions of commodity derivatives. Saon Ray & Neha Malik (2014) study argues that imposition of CTT might not augur well for the Indian commodity market as it may reduce the liquidity and hampers overall efficiency. Diganta Mukherjee (2016) stated that the introduction of CTT has adversely impacted the market on all counts, with the impact being of such a magnitude that it is doubtful that the market will recover to its original position. Rudra Prosad Roy and Saikat Sinha Roy (2016) provide evidence that the volatility is transmitted to commodity market mostly from gold market and stock market. Arpita Pattanaik and Susan Thomas (2017) loss of market share implies there is a loss of business revenue of transactions domestically and provide opportunities for exchanges abroad. However, Schulmeister (2009) suggests an imposition of financial transaction tax on commodities is likely to reduce short-term price volatility of futures contracts due to increased transaction costs. On similar lines, Nissanke (2011) proposes a multi-tier tax system for commodity derivatives to stabilize prices and curb excess price volatility. Perumandla, S., & Kurisetti, P. (2018) Shortly after the implementation of the commodity transaction tax, the results show a steep decline in correlations between Sensex-Comdex, Nifty-Comdex indices for a few years. Domestic policy changes have a more significant impact on commodity and equity markets in India. Agrawal, D. R., & Mardan, M. (2019) they developed a tax competition model that allows for the setting of both an origin-based and a destinationbased commodity tax rate in the presence of avoidance and evasion. Kumar, J., Adhikary, A., & Jha, A. (2017) Tax Saving Schemes and Long term safety of investment critical for Small Active Investors' (SAI), this may be taken into consideration by fiscal policy makers and RBI.

Recent research studies employed Dynamic Conditional Correlation-Generally Auto Regressive Conditional Heteroskedasticity (DCC-GARCH) to study the dynamic relations between the commodity and equity markets. Jitmaneroj, B. (2018) using DCCGARCH model estimated dynamic minimum variance hedge ratio, hedging effectiveness, transaction costs, and the Transaction Cost/Hedge Effectiveness ratio for multiple rebalancing horizons. Shelly Singhal & Sajal Ghosh (2016) empirically investigated the time-varying co-movements between crude-oil and Indian stock market returns, both at the aggregate and sector level using VAR-DCC-GARCH framework. Ruslan Nagayev et al. (2016) studied correlations between commodity markets and the Dow Jones Islamic Market World Index uses MGARCH-DCC. Mehmet Fatih Öztekin, Nadir Öcal (2016) time-varying correlations between commodity and stock markets to uncover the dynamic nature of correlations during the financialization of commodity markets. Shawkat Hammoudehet. al. (2014) examined the implications of co-movements for asset allocation among commodity and the stock markets in China by using copula functions. Syllignakis & Georgios P. Kouretas (2011) studied dynamic correlations of financial contagion. Pierre Andreasson (2015) study shows a strong evidence of unidirectional linear causality from commodity returns to excess speculation in the majority of the considered commodities, in particular for agriculture commodities. Jain and Biswal (2016) investigated the dynamic linkages between crude-oil and stock markets in Indian context considered by volatility transmissions at market level.

Hence the present study focuses on time-varying correlations between commodity and equity markets in pre and post CTT periods. It helps to understand the CTT impact on correlation dynamics of commodity and equity markets.

## METHODOLOGY

### The Univariate GARCH Model and Asymmetric Extensions

The GARCH model introduced by Bollerslev (1986) expressed conditional variance as a linear function of the past square values of the series. A generic GARCH (p,q) model can be described as follows:

$$R_t = \mu + \varepsilon_t \quad (\text{Mean Equation}) \quad (1)$$

$$\sigma_t^2 = \omega + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^p \beta_j \sigma_{t-j}^2 \quad (\text{Variance Equation}) \quad (2)$$

where the  $\alpha_i$  and  $\beta_j$  are nonnegative constants and  $\omega$  is a positive constant.

Since the conditional variance in equation (2) is a function of the lagged residuals and not their signs, the model enforces a symmetric response of volatility to positive and negative shocks.

The Exponential GARCH model is the first that investigates the leverage effects; which refers to the fact that down movement are more influential in predicting volatility than the upward movements. Nelson's (1991) EGARCH attempts to model fat tails in stock index returns by using a generalized exponential distribution, in formulating the model can be represented as follows:

$$\log \sigma_t^2 = \omega + \beta \log \sigma_{t-1}^2 + a \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \quad (3)$$

Equation (3) allows negative values of  $\varepsilon_t$  to have different impacts on volatility. Since the coefficient  $\gamma_i$  is typically negative, the model claims for an asymmetric behavior in volatility.

### DCC and ADCC- GARCH Model

As we mentioned, the main purpose of the study is to analyze the dynamic conditional correlations of the commodities, stocks and combined commodity-stock portfolios. We looked into the Dynamic Conditional Correlation [DCC] - GARCH model introduced by Engle (2002) is a generalization of the CCC model, which allows the correlation matrix to vary over time rather than requiring them to be constant. Cappiello et al. [2006] introduced the asymmetric version of DCC GARCH to address the impact of asymmetric information on the time-varying correlations. In the first step, residuals are GARCHED in three ways [standard, threshold and exponential]. At the second step time, varying correlations were estimated by relying on lagged values of residuals and covariance matrices. In the present study both symmetric and asymmetric version [DCC - GARCH [Engle, 2002] and ADCC - GARCH [Cappiello et al., 2006] of modelling time-varying correlations were used. The Covariance matrix in DCC GARCH [Engle, 2002] defined as:

$$H_t = D_t R_t D_t \quad (4)$$

$H_t$  is the conditional covariance matrix.  $D_t$  is the  $k \times k$  diagonal matrix of time-varying standard deviations from univariate GARCH models with  $[\sigma_{i,t}^2]^{1/2}$  on the  $i_{th}$  diagonal:

$$D_t = \begin{bmatrix} \sqrt{\sigma_{c,t}^2} & 0 \\ 0 & \sqrt{\sigma_{e,t}^2} \end{bmatrix} \quad (5)$$

$R_t$  is the time varying correlation matrix:

$$R_t = \begin{bmatrix} \varepsilon_{cc,t} & \varepsilon_{ce,t} \\ \varepsilon_{ec,t} & \varepsilon_{ee,t} \end{bmatrix} = \begin{bmatrix} 1 & \varepsilon_{ce,t} \\ \varepsilon_{ec,t} & 1 \end{bmatrix} \quad (6)$$

Further, R has to be definite positive, and all the parameters should be equal to or less than one. In order to ensure this  $R_t$  has been modeled as:

$$= Q_{ce,t}^{*-1} Q_{ce,t} Q_{ce,t}^{*-1} \quad (7)$$

where:

$$Q_{ce,t} = [1 - \theta_1 - \theta_2] Q^* + \theta_1 [\varepsilon_{c,t-1} \varepsilon_{e,t-1}] + \theta_2 [Q_{ce,t-1}] \quad (8)$$

where  $Q_{ce,t}$  is the unconditional variance between series and i and j and follows a GARCH process,  $Q^*$  is the unconditional covariance between the series estimated in step 1 and the scalar parameters  $\theta_1$  and  $\theta_2$  are non-negative and satisfy  $\theta_1 + \theta_2 < 1$ .

Following the methodology of Engle [2002], the parameters  $\theta_1$  and  $\theta_2$  are estimated by maximizing the log-likelihood function. The log-likelihood function can be expressed as:

$$= -\frac{1}{2} \sum_{t=1}^T (k \log 2\pi) + 2 \log([D_t]) + \log([R_t]) + \varepsilon_t' R_t^{-1} \varepsilon_t \quad (9)$$

As the above model DCC model does not allow for asymmetries and asset specific news impact parameter, the modified model of Cappiello et al. [2006] for incorporating the asymmetrical effect and asset specific news impact can be written as:

$$Q_{ce,t} = [1 - \theta_1 - \theta_2] [Q^- - \theta_3] \xi_t^- + \theta_1 [\varepsilon_{c,t} \varepsilon_{e,t-1}] + \theta_2 [Q_{ce,t-1}] + \theta_3 (\varphi_{t-1} \varphi'_{t-1}) \quad (10)$$

where:

$$\xi_t^- = E[\overline{\varphi_{ct} \varphi_{et}}] + \text{and } \overline{\varphi_{ct}} = (I \overline{\varphi_{ct}} [ < 0 ] c \overline{\varepsilon_{ct}})$$

Here  $\theta_3$  is the asymmetric term which captures periods where both commodity and stock market experience bad news making  $[\varphi_{ct} \varphi_{et}] = I_t$ . This model is estimated using Maximum Likelihood techniques based on BFGS optimization algorithm. We adopt student-t multivariate distribution of the time series returns, which is more suitable and gives better estimation results.

## DATA AND PRELIMINARY ANALYSIS

The study explores the time-varying correlations between equity and commodity markets in India; the study uses weekly returns of the MCX Comdex, Nifty 50, and Daanya. MCX Comdex index is India's maiden real-time composite commodity index based on commodity futures prices of an exchange. It is a composite index of Metal, Energy, and Agri. The MCX Metal (adjusted weights are 40%) index includes gold, silver, copper, aluminum, nickel, zinc, and lead. The MCX Energy (adjusted weights are 40%) index is the composite of crude oil and natural gas. MCX Agri (adjusted weights are 20 percent) index includes cardamom, the oil, crude palm oil, and cotton. The Nifty 50 index is National Stock Exchange of India's benchmark stock market index for Indian equity market. It consists of 50 stocks, which belongs to different sectors of the economy. Therefore, Nifty fifty indicates the average movements of these sectors and also the representative of the Indian equity market. Dhaanya – an agriculture index based on the ten most liquid contracts that contribute about 75 percent of total agricultural futures trading on the exchange's platform. Proper diversification ensures index components have been selected from various sub-sectors.

The above-selected indices data is sourced from their official exchange websites such as the National Stock Exchange (NSE), Multi Commodity Exchange (MCX) and National Commodity and Derivative Exchange (NCDEX). First, the authors converted weekly prices into log returns of the two successive prices, i.e.,  $\log(P_t/P_{t-1})$ . The time span of the study runs from 1st Jan 2009 to Dec 31st, 2017. It covers the impact of macroeconomic and financial factors on commodity and equity markets domestically as well as globally. Indian stock market trading operations vary from commodity trading operations in time. Daily or monthly data is not feasible for capturing the time-varying co-movements. Hence we consider weekly data to obtain the dynamic interactions between commodity and stock markets. Preliminarily, it is essential to understand the trends in the price movements of the indices hence we have analyzed pre and post-CTT periods price Figures.

Figure 1 depicts the Pre and Post-CTT Price series Figures of selected commodity and equity indices. Figure 1 to 6 displays the price Figures of indices in pre and post-CTT periods. Figure 1 represents pre CTT price series of MCX Comdex index, and Figure 2 represents post CTT price series of MCX Comdex index. Fig 1 displays a significant upward movement during the entire time frame in the pre-CTT period. Figure 2 shows a steep decline in the prices of the Comdex index in the post CTT period. Implementation of CTT on non-farm commodities has affected the MCX Comdex index because the Comdex index is the composite index, which includes the significant compositions of energy 40% and metal 40%. In the post CTT period, the prices started increasing due to policy measures taken-up by the government of India and shown a positive effect on the price movements. However, it is low relative to the pre CTT period.

Figure 3 and 4 represent pre CTT price series and post CTT price series respectively of Dhaanya index. Figure 3 displays a significant upward movement during the entire time frame in the pre CTT period. Figure 4 displays high volatility in price series during the whole time frame in post CTT period. It may be due to investors' preference towards agricultural commodities as the commodity transaction tax is not levied on agricultural commodities. However, the impact of CTT is significantly felt in cross-markets. General investment sentiments of the investors are affected by the CTT; hence high volatility is seen in the prices of the Dhaanya in the post CTT period. It is evident from the fact that Jobbers, speculators, who survived on meager transaction costs and wafer-thin margins found it difficult to sustain as costs have dramatically increased.

### Pre and Post-CTT Price Series Figures of Selected Commodity and Equity Indices

Figure 5 and 6 represents pre CTT price series and post CTT price series of Nifty 50 index. Figure 5 shows that there is significant upward movement during 2009 to mid-2010 again started decreasing from mid-2010 to 2013. Figure 6 shows post CTT period price movements which have an increasing trend. However, interestingly, it shows a downward trend from mid-2014 to mid-2015.

Figure 1. Pre-CTT MCX Comdex Price Series

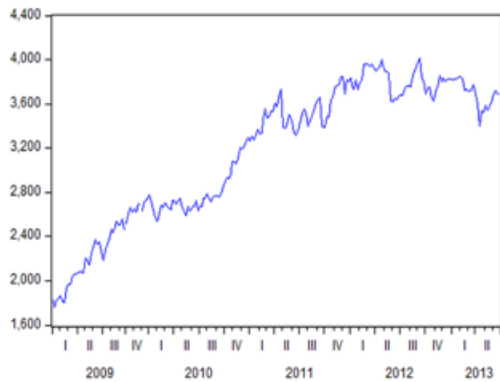


Figure 2. Post-CTT MCX Comdex Price Series



Figure 3. Pre-CTT Dhaanya Price Series

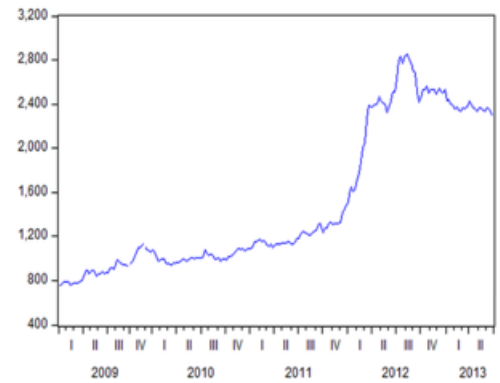




Figure 4. Post-CTT Dhaanya Price Series



Figure 5. Pre-CTT Nifty 50 Price Series



Figure 6. Post-CTT Nifty 50 Price Series



The descriptive statistics reveal that the characteristics of the data at a preliminary stage. Table 2 presents the results of return indices for pre and post-CTT periods.

Table 2 shows descriptive statistics of commodity and equity market indices, namely Comdex, Dhaanya and Nifty 50. From table 2 authors notice some significant changes in average returns of Comdex index, which offers favorable returns (0.002909) to investors at the Pre-CTT period, while it provides negative returns (-0.00013) at Post-CTT period. As is evident from Table 2, Investment in agricultural commodity market index (Dhaanya) provides highest average weekly returns (0.0049%) at the Pre CTT period. However, there is a significant decrease in post CTT period. The stock market index Nifty 50 is riskier, as approximated by a standard deviation of 0.03%, followed by Dhaanya (0.022%) and Comdex (0.021%) markets in the Pre CTT period. Besides, the fat tail property of financial time series also noticed from the excess kurtosis of all indices. Hence extreme returns are more likely. In the Pre-CTT period, the Nifty50 and Dhaanya index are right-skewed implying that the significant negative returns are not as likely as substantial positive returns which mean those indices are not riskier regarding losses either. However, in post-CTT period Comdex and Dhaanya are right-skewed. Moreover, findings of the Jarque-Bera test indicate that all indices returns do not have a normal distribution in the pre CTT period while it is normally distributed for Nifty 50 and Dhaanya in the post CTT period. To establish the dynamic nature of the correlation between asset returns and presence of financial contagion, time series properties of asset returns and specific diagnostic tests need to be carried out. Asset prices and returns often exhibit trending behavior or non-stationarity in the mean. Authors checked these series for stationarity using Augmented Dicky Fuller (ADF) unit root test and Philip Pherron tests. The ADF and PP test checks for stationarity in the data series as against the null hypothesis of a unit root presence. The results revealed that the null hypothesis is rejected at the 1% level of significance for each return series with intercept and trend.

Table 3 presents unconditional correlations between commodity and equity indices in pre-CTT and post-CTT periods.

**Table 2. Descriptive Statistics**

	Pre CTT			Post CTT		
	Comdex	Nifty50	Dhaanya	Comdex	Nifty50	Dhaanya
<b>Mean</b>	0.002906	0.002806	0.004909	-0.00013	0.002529	0.001171
<b>Std. Dev.</b>	0.021048	0.030143	0.022588	0.01845	0.019683	0.017413
<b>Skewness</b>	-0.69092	0.378494	0.481219	0.302559	-0.16871	0.053623
<b>Kurtosis</b>	5.69237	5.170247	4.673978	4.410597	3.457619	3.144435
<b>Jarque-Bera</b>	88.53032*	51.06903*	36.04207*	22.97053*	3.151892	0.31554
<b>Phillip Pherron</b>	-16.5212*	-15.1123*	-11.7955*	-13.5059*	-14.9774*	-13.886*
<b>ADF (constant&amp;trend)</b>	-10.4589*	-3.9234*	-15.112*	-13.4865*	-14.7498*	-10.2493*

Notes: between parentheses: p-values. JB are the empirical statistics of the jarque bera test for normality based on skeweness and kurtosis. ADF test refers to the Augmented Dickey Fuller and Philip Perron test for the presence of unit roots for . \* denotes the rejection of null of normal distribution and non stationary at 5%significance level.

**Table 3. Unconditional Correlations**

Asset Pairs	Pre-CTT	Post-CTT
<b>Comdex-Nifty50</b>	0.250489	-0.3232
<b>Comdex-Dhaanya</b>	0.153262	0.16228
<b>Dhaanya-Nifty50</b>	-0.00204	-0.00237

Table 4. Univariate Parameter estimates of symmetric and asymmetric DCC-EGARCH

Panel A: Pre-CTT Univariate EGARCH			
	MCX Comdex	Dhaanya	Nifty50
Panel A Variance Estimates			
$\omega$	0.003849(0.0017)*	0.003323(0.0083)*	0.001361(0.412)
$\alpha$	0.04098(0.8419)	-0.07647(0.028)**	0.233688(0.0433)**
$\beta$	0.37282(0.6505)	0.957418(0)*	0.962857(0)*
$\lambda$	-0.1334(0.3665)	0.138411(0)*	-0.07577(0.2516)
Log likelihood	578.7692	573.1511	502.9253
AIC	-4.374486	-4.88923	-4.28384
SIC	-4.84853	-4.80009	-4.1947
Arch effect	0.671049(0.4135)	0.297440(0.5860)	0.057184(0.8112)
Panel B: Post-CTT Univariate EGARCH			
	MCX Comdex	Dhaanya	Nifty50
$\omega$	-0.00027(0.8109)	0.001233(0)*	0.002591(0.0395)*
$\alpha$	0.113286(0.2703)	0.037756(0.355)	0.189195(0.1859)
$\beta$	0.921086(0)*	-0.95621(0)*	-0.58853(0.0184)*
$\lambda$	-0.3902(0.4548)	0.064404(0.0732)***	-0.18037(0.0534)**
log likely hood	607.6265	618.9488	592.9592
AIC	-5.142107	-5.238879	-5.016745
SIC	-5.053509	-5.150281	-4.928147
Arch effect	0.238579(0.6257)	0.027449(0.8686)	0.101120(0.7508)

Notes: Figures in parentheses are p-values, \*denotes significant at 1%, \*\*denotes significant 5%, and \*\*\*denotes significant at 10%. Arch Lag Range Multiplier statistics correspond to the null of no arch effect. AIC represents Akaike information criterion, SIC represents Schwarz information criterion.

Table 3 provides the unconditional correlations of return pairs in the pre CTT period and post CTT period. Comdex-Nifty 50 shows the highest positive correlations in the pre-CTT period, however, it shows negative correlations in the post-CTT period. Comdex-Dhaanya pair unconditional correlations are positive in the pre and post CTT period. The pair Dhaanya-Nifty50 shows negative correlations in the pre and post CTT period. The worth noticing point is the Comdex-Nifty 50 pair shows significant changes in their correlations. Unconditional correlations are not enough to understand the market dynamics while framing the strategies or making policy decisions. Hence, it is essential to investigate the time-varying relationships to identify the dynamic nature of asset pairs. Moreover, it is also crucial to understand the changes of time-varying correlations in pre and post CTT periods in Indian commodity and equity market.

## EMPIRICAL RESULTS AND ANALYSIS

Section 5, provides the results of the univariate and DCC parameter estimates (Symmetric and Asymmetric versions of DCC-EGARCH). The first step of the DCC model consists of fitting univariate GARCH specification of all three indices returns. Table 4 summarizes the information about GARCH process and the estimated parameters. The authors examined the stability conditions of all the three

series. All the estimates from GARCH models satisfy the stability conditions. Therefore, study proceeds to draw some inferences.

Table 4 (panel A) provides the results of univariate EGARCH model in pre-CTT period,  $\beta$  coefficient is positive and significant for Dhaanya and Nifty 50, indicates that the market shocks have a positive impact on volatility and highly persistent in the long run. The ARCH coefficient ( $\alpha$ ) is positive and significant for Nifty 50 and negative and significant for Dhaanya conveying that the shocks are persistent in the short term. Asymmetry measure  $\lambda$  is positive and significant for Dhaanya implies that the positive shocks increase volatility while adverse shocks decrease volatility. However,  $\lambda$  is insignificant for Comdex, and Nifty 50 suggests that the positive and negative shocks reduce the volatility equally.

Panel B, provides the results of univariate EGARCH model in post-CTT period, the results shows that  $\beta$  coefficient is negative and significant for Dhaanya and Nifty 50, indicates that the market negative shocks have a and highly impact on volatility and shocks are persistent in the long run. However,  $\beta$  is positive and significant for Comdex demonstrates that the market positive shocks have a significant impact on volatility of the return series. The ARCH coefficient ( $\alpha$ ) is insignificant for all indices conveying that the shocks are not persistent in the short term. Asymmetry measure  $\lambda$  is positive and significant for Dhaanya implies that the positive shocks increase volatility while adverse shocks decrease volatility. However,  $\lambda$  is negative and significant for Nifty 50 suggests that the persistence of the leverage effect and bad news generates more volatility rather than the good news. Worth noticing points are  $\beta$  coefficients positive and significant for Dhaanya and Nifty 50 in the pre CTT period while it is negative and significant in the post CTT period. It is insignificant in the pre-CTT period and positively significant in the post CTT period. Asymmetry measure  $\lambda$  is positive and significant for Dhaanya in the pre CTT period and the post CTT period also. It is insignificant for Nifty 50 in the pre CTT period while it is negative and significant in the post CTT period. It indicates that after the implementation of Commodity Transaction Tax the significant changes have been taking place in the volatility of the return series, hence it is essential to understand those changes while framing the strategies. After the univariate estimates, the authors investigate the Dynamic Conditional Correlations of commodity and equity pairs by using symmetric and asymmetric versions of the DCC EGARCH model.

Results from the Table 5 (part 1 panel-A) for the E-GARCH Symmetric DCC model in the pre-CTT period, the estimated coefficients  $\theta_1$  and  $\theta_2$  are statistically significant. It indicates the long run persistence of shocks ( $\theta_2$ ) to the conditional correlations is positive and insignificant for the all the series in the pre-CTT period. The short-run persistence of shocks to the conditional correlations are negative and significant for MCX Comdex – Nifty 50 and MCX Comdex- Dhaanya. (Part 1 Panel-B) The ADCC EGARCH coefficient  $\theta_3$  is positive and significant for Comdex-Dhaanya and Dhaanya-Nifty 50. It implies that the positive shocks increase volatility while adverse shocks decrease volatility for these pairs in the pre-CTT period. Coefficients of  $\theta_1 + \theta_2$  are less than one which proves the stability condition of all pairs. The persistence measure theta 1 and theta 2 is significant and close to 1 implies that the shocks are somewhat persistent in the series. This means the high volatility today includes the high volatility in the future. Further, more persistence can be taken as an indicator of the market efficiency inefficient market any shocks should be absorbed immediately with no persistence in volatility.

Results from the Table 5 (part 2 panel-A) for the E-GARCH Symmetric DCC model in the post CTT period. It indicates the long run persistence of shocks ( $\theta_2$ ) to the conditional correlations is positive and significant for Comdex-nifty 50 and Dhaanya-Nifty50 series. The short-run persistence of shocks to the conditional correlations is negative and significant only for Dhaanya-Nifty 50. (Part 2 Panel-B) The ADCC EGARCH coefficient  $\theta_3$  is negative; however, it is insignificant for Comdex-Nifty 50. Coefficients of  $\theta_1 + \theta_2$  are less than 1 which proves the stability condition of all pairs. The persistence measure theta 1 and theta 2 is significant and profoundly close to 1 implies that the shocks are highly persistent in the series. This means the high volatility today includes the high volatility in

Table 5. Estimates of DCC and ADCC EGARCH in Pre and Post CTT periods

Part-1: Pre CTT – DCC & ADCC Egarch			
	Comdex-Nifty50	Comdex-Dhaanya	Dhaanya-Nifty50
Panel A: DCC parameters			
$\theta_1$	-0.0347(0.0000255)*	-0.03765(0)*	0.033068(0.639696)
$\theta_2$	0.688344(0.106)	0.655739(0.1488)	0.503569(0.4228)
$\theta_1 + \theta_2$	<1	<1	<1
DF	7.00844	7.118295(0.000114)	16.06934(0.075272)
log likelihood	1093.252	1158.471	1080.366
AIC	-9.31252	-9.87554	-9.10374
SIC	-9.23463	-9.79686	-9.12354
Panel B: Asymmetric DCC parameters			
$\theta_1$	-0.03623 (NA)	-0.04014 (3.35E-14) *	-0.03157(0.312026)
$\theta_2$	0.779732 (NA)	0.872032(0)*	-0.29418(0.4822)
$\theta_3$	0.053877 (NA)	0.038801(0.0132)*	0.180736(0.010897)*
$\theta_1 + \theta_2$	<1	<1	<1
DF	6.945334 (NA)	7.427321(0.000289)	16.29723(0.078472)
Log likelihood	1095.363	1158.744	1081.459
AIC	-9.35438	-9.91618	-9.20289
SIC	-9.20899	-9.75538	-9.08912
Part -2: Panel-A: Post CTT DCC and ADCC EGARCH			
	MCX Comdex-Nifty50	Comdex-Dhaanya	Dhaanya-Nifty50
Panel A: DCC Parameters			
$\theta_1$	0.018452(0.523795)	-0.01933(0.41776)	-0.0157(0.019699)*
$\theta_2$	0.888935(0)*	0.528691(0.5806)	1.003096(0)*
$\theta_1 + \theta_2$	<1	<1	<1
DF	20.22516(0.128125)	18.0179(0.081785)	718.2207(0.865906)
log likelihood	1203.819	1233.725	1214.823
AIC	-10.1788	-10.4189	-10.2421
SIC	-10.1005	-10.3561	-10.1946
Panel B: Asymmetric DCC			
$\theta_1$	0.034316(0.547345)	-0.011629(0.661725)	-0.066575 (NA)
$\theta_2$	0.672381(0.3515)	0.782917(0.0001)*	0.202834 (NA)
$\theta_3$	-0.097969(0.67081)	-0.081736(0.24535)	0.102423 (NA)
$\theta_1 + \theta_2$	<1	<1	<1
DF	21.3557(0.153648)	17.10798(0.072521)	1433.091 (NA)
Log likelihood	1204.236	1234.732	1213.983
AIC	-10.23117	-10.47627	-10.2567
SIC	-10.06061	-10.32125	-10.14391

Notes: figures in parentheses are p-values, \*denotes significant at 1%, \*\*denotes significant at 5%, and\*\*\*denotes significant at 10%. AIC represents Akaike Information Criterion, SIC represents Schwarz Information Criterion.

the future. Further, more persistence can be taken as an indicator of market efficiency in an efficient market any shocks should be absorbed immediately with no persistence in volatility.

The worth noticing points are  $\theta_2$  is insignificant for all the series in the pre-CTT period while it is positive and significant for Comdex-Nifty50 and Dhaanya-Nifty 50 in the post CTT period. From the empirical results we found the significant changes in time-varying correlations of the pairs in pre and post CTT periods.

Figure 8 depicts the dynamic conditional correlations of the commodity and equity pairs in pre and post CTT periods. Figure 7 and Figure 8 presents the dynamic conditional correlations of the commodity and equity pairs in pre and post CTT periods respectively.

### Pre and Post-CTT Period Dynamic Conditional Correlations of MCX Comdex and Nifty 50

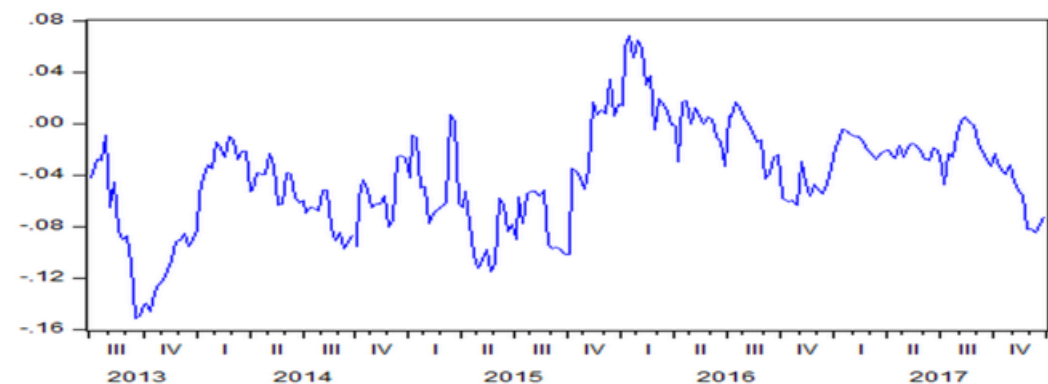
Figure 7 represents the correlations are positive and time-varying across the span of 2009 to 2013 (Pre CTT period). In early 2009 the correlation was more, and it peaks until 0.7. Correlations decline again and hover in the range of 0.1 to 0.3 from mid-2009 to 2013. In a nutshell the correlation between Comdex and Nifty 50 is time-dependent and unstable. Hence, assuming a constant measure of correlation might be misleading.

Figure 8 displays the time-varying correlations between Comdex and Nifty 50 indices in post CTT period. Visual inspection of Figure 2, show a steep decline in correlations in 2013, which is

Figure 7. Pre-CTT period Dynamic Conditional Correlations of MCX Comdex and Nifty 50



Figure 8. Post-CTT period Dynamic Conditional Correlations of MCX Comdex and Nifty 50



unintended. The authors observed low and negative correlations from 2013 to mid-2015. Correlations started declining from 2016 again. An unintended steep decrease in correlations is observed because of the implementation of CTT on non-farm commodities, As Comdex is a composite index of metal, energy, and agriculture. Levy of commodity transaction tax affected the commodity trading volumes adversely. As a result of that volume fell at an average rate of 16% per annum. It has also impacted negatively on the general investment sentiments of the market participants. Managing price risk and cost-effectiveness are the primary determinants in the futures market in framing hedging strategies. High transaction costs of futures contracts affected the profitability adversely. Moreover, huge entry and exit loads will necessarily deter the hedgers from entering futures markets. High transaction costs will drive out the day traders and small speculators from the market. Small traders, scalpers, and jobbers who often trade on thin margins (1%) will prefer illegal market channels like bucket shops and dabbas. After its imposition, the bid-ask spread for gold has risen from Rs 1.5-2 to Rs 5-7 per 10g and India lost the opportunity of becoming a price setter, is one complaint. Adverse shocks increase volatility, and positive shocks decrease volatility for this pair in post CTT period. Hence, if the positive news hits the market, then the volatility of this pair will decrease.

Figure 9 displays the time-varying conditional correlations between Comdex and Dhaanya indices in the pre-CTT period and post-CTT period respectively.

Figure 3 displays the time-varying correlation between the Comdex and Dhaanya in the pre-CTT period. Throughout the time frame the correlations are positive, and in the long-run no significant shocks are persistent. But in short -run the considerable market shocks are persistent for this pair. The positive shocks increase volatility while adverse shocks decrease volatility for this pair in the pre CTT period.

### Pre and Post-CTT Period Dynamic Conditional Correlations of MCX Comdex and Dhaanya

Figure 10 (shows the time-varying correlations of Comdex-Dhaanya pair in post CTT period. In 2013 the relationships of this pair declined significantly. Dynamic conditional correlations are highly volatile in this period. The market shocks have a positive impact on correlations of this pair in the long run. Market shocks have a positive effect on Comdex and adverse effects on Dhannya indices. Volatility also increased in the post CTT period for this pair. Long run shocks persisted in post CTT period for this pair. CTT has not affected on commodity index Dhaanya. But the general sentiment of the market participants has affected. Hence the volatility in the market increased for this pair. Adverse shocks increase volatility, and positive shocks decrease volatility for this pair in post CTT period. Therefore, if the positive news hits the market, then the volatility of this pair will decrease.

Figure 9. Pre-CTT period Dynamic Conditional Correlations of MCX Comdex and Dhaanya

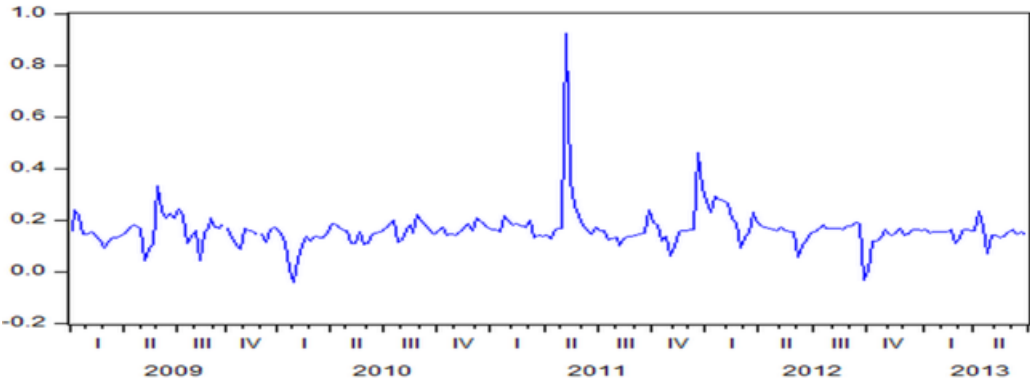


Figure 10. Post-CTT period Dynamic Conditional Correlations of MCX Comdex and Dhaanya

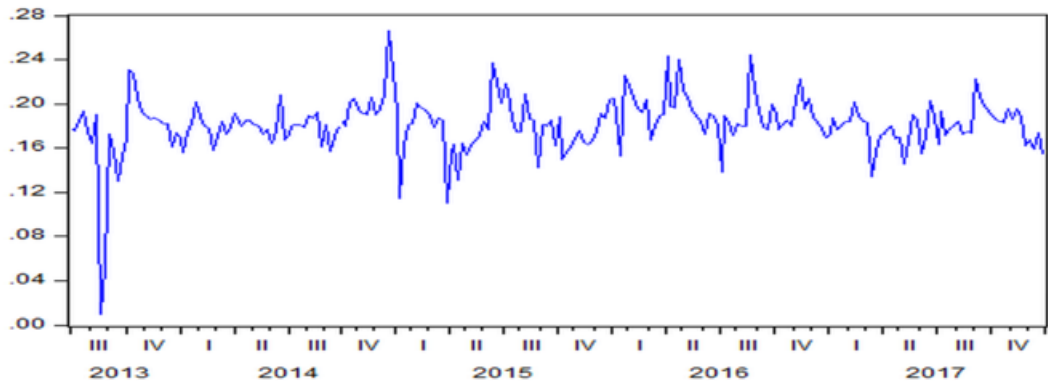
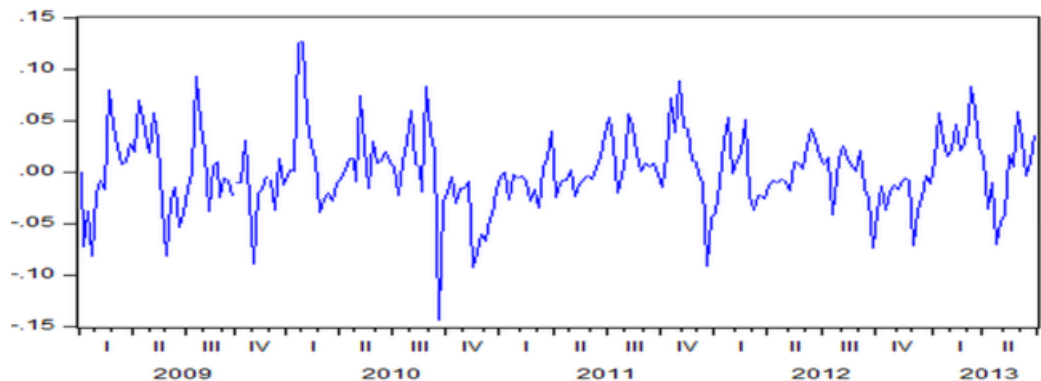


Figure 11 displays the time-varying conditional correlations between Comdex and Dhaanya indices in the pre-CTT period and post-CTT period respectively.

### Pre and Post-CTT Period Dynamic Conditional Correlations of Dhaanya and Nifty 50

Figure 12 displays the time-varying correlations of Dhaanya and Nifty 50 in the pre CTT period. A low correlation noticed for this pair in the very short run. The volatility is also high for this pair in the very short term. The positive shocks increase more volatility while adverse shocks decrease

Figure 11. Pre-CTT period Dynamic Conditional Correlations of Dhaanya-Nifty 50

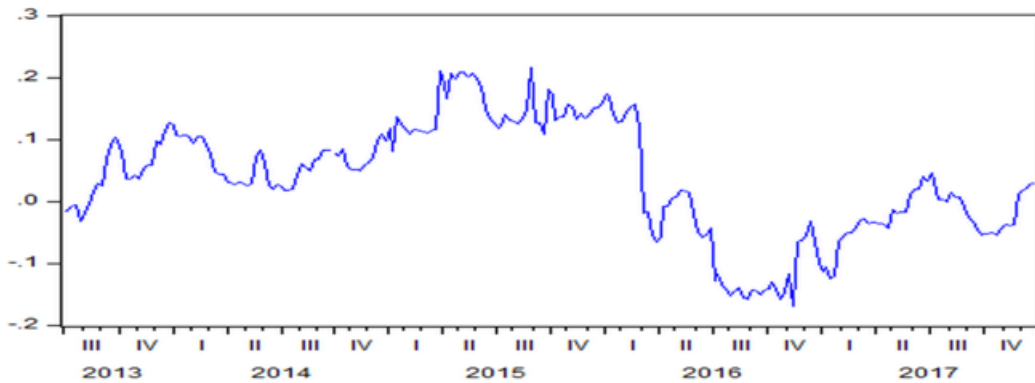


volatility for this pair in the pre CTT period.

Figure 12 displays the time-varying correlations of Dhaanya and Nifty 50 in the post CTT period. Results indicate a significant decrease in correlations and negative correlations are persistent in the short run. While positive correlations are persistent in the long term. Correlations in between the pair are increasing because the CTT is not affected the nonfarm commodities. Hence the traders are showing interest towards the investments in agricultural commodity index Dhaanya. The National Commodity and Derivatives Exchange have urged the government to exempt processed agricultural commodities from CTT levy, for the benefit of farmers. CTT levy has reduced hedging activity on complexes and, therefore, the real price discovery in Agri commodities is compromised, it says. A



Figure 12. Post-CTT period Dynamic Conditional Correlations of Dhaanya-Nifty 50



recent Nielsen study showed a spurt in illegal (Dabba) trading, which was three times the size of the regulated market even before CTT introduced. In the long run, some inflationary threats exist as spot market and futures market usually move in tandem. An expensive futures market would automatically raise the general price trend in spot markets.

The study also focused on the pairwise volatility in pre and post-CTT periods by using EGARCH modeling. The results presented in Table 6.

Table 6 results show the pre-CTT period,  $\alpha$  is negative and significant for Nifty 50 indicates that the internal shocks have a significant impact on Nifty50 returns, whereas  $\beta$  is positive and significant conveys that the volatility of Comdex returns has a positive influence on the volatility of Nifty 50 returns. Asymmetric term  $\lambda$  (-0.038571) is negative and significant indicates that the bad news generates more volatility than the good news for this pair. The post-CTT period  $\alpha$  is negative and insignificant for Comdex indicates that the internal shocks have no significant impact on Comdex returns, whereas  $\beta$  is negative and significant meaning that the volatility of Comdex returns has the negative influence on the volatility of Nifty 50 returns. Asymmetric term  $\lambda$  (-0.18918) is negative and significant sense that the negative news generates more volatility for this pair.

Table 6. Estimates of EGARCH in Pre and Post CTT periods

	Nifty50 -Comdex	Dhaanya-Comdex	Nifty 50-Dhaanya
<b>Panel A estimates Pre CTT</b>			
$\omega$	0.323238(0)*	0.152029(0.0085)*	-0.042426(0.5203)
$\alpha$	-0.067227(0.0308)*	-0.082371(0.0141)*	-0.060775(0.0766)***
$\beta$	0.989542(0)*	0.1572(0)*	0.996382(0)*
$\lambda$	-0.038571(0.0536)	0.948521(0)	-0.048047(0.0177)
	Nifty50 -Comdex	Dhaanya-Comdex	Nifty 50-Dhaanya
<b>Panel B estimates-Post CTT</b>			
$\omega$	0.002561(0.0451)**	0.16502(0.0102)*	-0.015847(0.0439)**
$\alpha$	0.178723(0.2154)	0.000128(0.9992)	0.191415(0.1869)
$\beta$	-0.56964(0.0242)**	-0.519073(0.2262)	-0.568473(0.0224)**
$\lambda$	-0.18918(0.0498)**	0.139309(0.2111)	-0.185505(0.0506)**

Source: Author's computation Notes: figures in parentheses are p-values, \*denotes significant at 1%, \*\*denotes significant at 5%, and\*\*\*denotes significant at 10%

In the pre-CTT period,  $\alpha$  is negative and significant for Dhaanya proves that the internal shocks have a substantial impact on Dhaanya returns, while  $\beta$  is positive and significant conveys that the volatility of Comdex returns has a positive influence on the volatility of Dhaanya returns. Asymmetric term  $\lambda$  is positive and significant meaning that the good news generates more volatility for this pair. In the post-CTT period,  $\alpha$  is positive and insignificant whereas  $\beta$  is negative and insignificant.

In the pre-CTT period,  $\alpha$  is negative and significant for Nifty 50 meaning that the internal shocks have a substantial impact on its returns, whereas  $\beta$  is positive and significant meaning that the volatility of Dhaanya returns has a positive influence on the volatility of Nifty 50 returns. Asymmetric term  $\lambda$  is negative and significant indicates that the negative news generates more volatility for this pair.

## PRACTICAL IMPLICATION AND CONCLUSION

The outcomes indicate that the relationship between the commodity and equity markets significantly changed over time and intensified during the Commodity Transaction Tax Period. Evidence suggests that the linkages between commodities and equity markets are significantly affected by the triggering events. In particular, there is evidence that passive commodity index investment caused a massive bubble burst in non-agricultural commodity futures prices. In the post-CTT period, the time varying-correlation between the Comdex-Nifty 50 pair shows the steepest decline in 2013, which is unintended. The authors observed low and negative correlations from 2013 to mid-2015. An unexpected abrupt decrease in relationships taken place may be the possible cause of implementation of CTT on non-farm commodities. Moreover, asymmetric term  $\lambda$  is negative and significant in pre and post CTT periods conveys that the bad news generates more volatility for Comdex-Nifty 50. Dynamic conditional correlations of Comdex- Dhaanya pair is highly volatile in post-CTT period because the fears in the market exaggerated the volatility in correlation dynamics. While asymmetric term  $\lambda$  is negative and significant indicates that the negative news generates more volatility for Comdex-Dhaanya. The authors notice an increased time-varying correlation and volatility between the Dhaanya-Nifty 50 pair. Perumandla, S., & Kurisetti, P. (2018) Domestic policy changes have a more significant impact on commodity and equity markets in India. One possible explanation is that the contagion effect takes place early in the crisis and that herding behavior dominates the latter stages. In particular, the time-varying correlations reveal a certain degree of interdependence between the cross markets, which are lower especially during the triggering episodes. However, it is also evidenced that conditional correlation between equity and commodity returns typically declines when non-agricultural commodity futures suffer from CTT. It is an indication of a “flight to quality” phenomenon, where investors move capital from non-agricultural commodity futures to other cross markets and international markets where they have a low or no tax burden. Better-integrated commodity markets with financial Markets always encourages to expand market participation will help to decrease risk. Our results and suggestions are in line with Sehgal, S., & Agrawal, T. J. (2019) Withdrawal of CTT would be ideal for Indian commodities market development, improving its liquidity and making it more internationally competitive. Saon Ray & Neha Malik (2014) that imposition of CTT might not augur well for the Indian commodity market as it may reduce the liquidity and hampers overall efficiency. Pankaj Sinha and Kritika Mathur (2015) CTT is not desirable for the Indian commodity futures, as it still is in the nascent stage of growth. Madhoo Pavaskar and Nilanjan Ghosh (2015) CTT is a recipe for disaster not only to commodity markets but even to the government as well.

## Future Ahead

In the recent years, the government of India has been trying to expand market participation by introducing new changes in commodity markets since 2015; commodities market regulator, Forward Market Commission (FMC) was merged with Securities and Exchange Board of India (SEBI) with effect from September 28, 2015. In 2017, SEBI opened up the commodity derivatives markets to institutional investors as clients. SEBI allowed Foreign Portfolio Investors (FPIs) to participate in

commodity derivatives contracts traded in stock exchanges operating in International Financial Services Centre (IFSC). According to Bhattacharyay, S. (2018) right balance between regulations in place and liberalization process, encouraging investment for sustainable development. Banks have also been allowed to participate in the Indian commodity derivatives markets. SEBI has taken other initiatives to introduce new products and removed restrictions on booking services. For instance, commodity exchanges have been allowed to enter options trading. Besides, SEBI has permitted integrated broking activities in equity and commodity derivatives markets under a single entity. Foreign banks, large-scale private sector banks that have experience in derivatives trading would also benefit from the increased trading volume as it holds stakes in Indian commodity exchanges. The commodity derivatives to hedge funds will now raise hopes to other participants in India. From a public policy perspective, it is also essential to enhance the participation of farmers and commercial hedgers into commodity derivative market.

The authors believe that the results offer better insights to understand the dynamics of the correlations between the commodities and stocks in an emerging market, which is very essential for policy makers, international investors, portfolio managers, risk analysts and financial researchers.

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