VOLATILITY CLUSTERING: AN EMPIRICAL EVIDENCE FROM INDIAN COMMODITY DERIVATIVES MARKET PERSPECTIVES

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ABSTRACT

Volatility clustering is a decisive component of the commodity derivative emporium because it supports to comprehend the nature and structure of the commodity derivative emporium, which enables emporium partakers to make trading choices. Therefore, this investigation scrutinizes the spot and future rates of crude oil in MCX to inspect for vacillation clustering. This study provides an empirical examination of daily spot and futures log-returns for 7 years. In the Indian commodity derivatives emporium, clustering of vacillations in crude oil spot and futures values was discovered. From a practical point of view, these discoveries denominate that the 'agent-based model' is compatible with the Indian commodity derivatives emporium, particularly the spot and future values of crude oil during the investigation epoch. It can be annotated that there is a lot of probable for future progress in this emporium. In other words, when there is a vacillation in this emporium, emporium partakers swiftly upsurge the counteractions with the vacillation in the emporium.

KEYWORDS: *Volatility Clustering; Commodity Derivatives Market; ARCH; Spot & Futures.*

INTRODUCTION

Vacillation clustering denotes that vicissitudes in the value of assets in commodity derivatives are well associated. The great precariousness or small precariousness of the commodity derivative market is focussed over an epoch of time, which is termed the vacillation clustering. The phenomenon of clustered vacillations and arch effects found within a *'multiagent framework'* associated to the actions of emporium partakers is pervasive in financial datum. According to the differences in emporium

movements, emporium partakers observe emporium movements and devise emporium strategies and emporium participants make changes in their emporium behaviour.

Price vicissitudes primarily befalls when there is an unevenness among the demand as well as supply of underlying assets. Often the price vicissitudes of the underlying asset in an unwavering and effectual emporium are created by the abrupt ephemeral stages of the normal serene performance volatility of the market. If precariousness breaks out then such stages terminate swiftly by alleviating such movements. The beginning of this vacillation clustering is in the characteristics of emporium partakers and the tidings influx process. There is an association among such deviations in emporium motion and the characteristics of emporium partakers and the tendency of instability clustering. Price is partially wrapped by numerous forms of peril. Hence facing escalating demands for price peril extenuation. Similarly, the perception of emporium partakers' vacillation is also imperative.

The interrogation of whether there is vacillation clustering across time in numerous asset prices and asset returns is very pertinent. This study therefore scrutinises the empirical confirmation of vacillation clustering nature from Indian commodity derivatives emporium viewpoints.

LITERATURE REVIEW

Attainable works associated to these perspectives are cognizance and deliberated over a period of time:-

Kim and Singal (2000) demonstrate that stock returns upsurge instantaneously after emporium opening without a concomitant upsurge in instability.

Kanayan & Pate (2006) detected that the reaction of instability from the virtuous and the debauched tidings is disproportionate in CEE.

Kamakar (2007) examined the *'heteroscedastic'* performance of the Indian stock emporium. It was detected that the instability is a lopsided task of previous invention, growing respectively high during emporium weakening.

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Emenike (2010) inspected instability *'clustering, leptokurtosis and leverage-effect'* for the Nigerian Stock-Exchange yields sequences. This study detect that instability of stock yields is enduring in Nigeria. This study also recognised *'leverage-effects'* in Nigerian-stock yields.

Josh (2010) scrutinised the stock emporium instability in the incipient stock emporiums of India and China. The discoveries exposed that the perseverance of instability in Chinesestock emporium is bigger than Indian-stock emporium.

Ibrahi and Srinivas (2010) endeavored to model and estimate the instability of the SENSEXIndex yields of Indian-stock emporium. Outcomes exhibited that the existence of *'leverage effect'*.

Shama and Mehta (2011) concentrated to scrutinise the epoch capricious instability of Indian stock emporium precisely in equity emporium. The discoveries of this paper to that the Indian-equity emporium has observed the occurrence of epoch capricious where the previous instability has highly momentous influence on the existing instability.

Jagajeevan (2012) scrutinised the perseverance of instability, peril-yield trade-off and lopsided instability in earnings, on every day and regular earnings on the all share rate index of the Colombo stock-exchange. This study only recognised instability clustering in everyday earnings, but not in regular yields. This study also recognises a *'leverage-effect'* in everyday yields, where the stock emporium becomes bigger instable when undesirable shock takes place as paralleled the affirmative shock.

Achra *et* al. (2013) detected a great diffusion of instability of the US emporium to advanced stock emporiums.

Ghosh and Chaudhuri (2015), positioned *'artificial neuralnetwork'* centered outline for estimate of stock emporium instability in the Indian-stock emporium via instability of NIFTY earnings and instability of gold yields.

Aforementioned works have described the appearance of oscillation clustering in stock emporiums and equity emporiums from financial emporiums. But the flakiness of oscillation clustering in commodity derivatives emporiums has not been testified much in the Indian ambiance.

THEORETICAL FORMWORK

This work summarizes an agent-based model of the contemporary affairs of the emporium. Ambiguity plays a decisive mission in financial principles. Although there are innumerable theoretical elucidations for this empirical upshot, its manifestation has not been well recognised by many empirically grounded investigations. This line of thoughtful is unique of an assortment of lines of thoughtful proposed from evenness theory and the associated assumption of cogent anticipations, in which stakeholders or agents decipher optimization glitches by allocating particular possibility distributions over forthcoming proceedings. This work offerings a novel derivation of instability clustering in financial time sequences generated by arrangements of intermingling agents. Every agent is allotted an anarchic subcategory of a provided set of prognosticators. At every phase every agent produces an action grounded on its allotted prognoses. At every phase the indicator rate is produced only by the collective movements of the agents in the present antiquity of the time sequences. Under the dynamics resultant from the elimination of deprived performers, the arrangement develops to a state and the interval sequences instability produced by these arrangements demonstrations clustering. Grounded on accurate emporium practices, deducements are reached about emporium price really emerging or emporium price directional prognosis likelihoods. These detections will have optimistic stimulus and repercussions for the up-to-date theory.

OBJECTIVES

To scrutinizes the empirical proof of vacillation clustering behavior from Indian commodity derivatives emporium perspectives.

HYPOTHESIS

H0: Spot and futures returns are *'normally distributed'*.

H0: Spot and future return series has a *'unit root'*.

H0: There is *'no ARCH effects'* in the daily spot and future return series.

METHODOLOGY

This investigation concentrates on the vacillation clustering behaviour in the incipient Indian commodity derivatives emporium. For that intendment crude oil from multi commodity exchange was

opted in the investigation to symbolise the Indian commodity derivatives emporium. Daily closing returns were elected for a 7-year sample tenure from 2013-2020. The datum is accumulated from the authorised website of *'Multi Commodity Exchange'*. The datum utilised comprises the daily return of elected underlying asset over an epoch of 7 years. Assorted statistical appliances were operated to scrutinize the datum. The *'ARCH-LM Test'* with the uppermost prophetic power was utilised to detect vacillation clustering. Because through the *'arch effect'*, vacillation clustering can be prophesied most efficaciously.

DISCUSSION

Vacillation-clustering is one of the greatest usual stylistic phenomena in economic time sequences; this phenomenon has captivated copious investigators and paved the path for the enlargement of stochastic techniques in finance. Certain approach in this investigation advocates how to recognise these processes behind emporium price enlargement. The datum used comprise daily returns of selected components over a 7-year epoch. Futures and spot rates were evaluated as return by selecting the first difference of the log values i.e. $Rt=(Pt/Pt - 1)$. Figure 1 exhibits the time sequences design of spot and future return of crude oil.

Figure 1: Time Series Plot of Spot and Future Return of Crude Oil

A. Spot Return of Crude Oil

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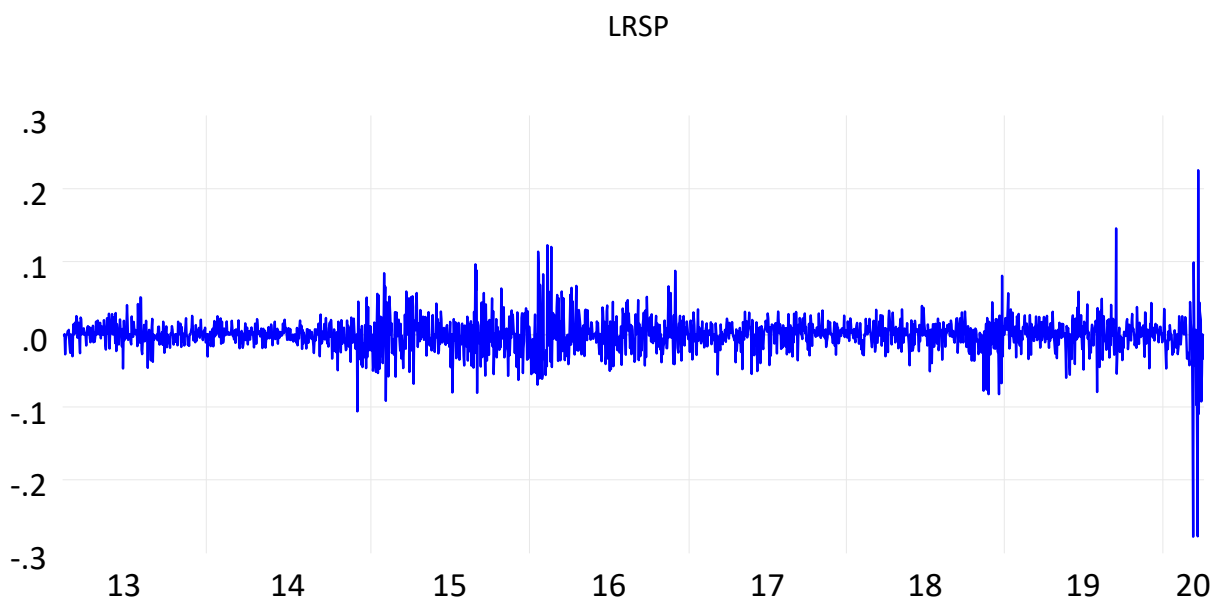
B. Future Return of Crude Oil
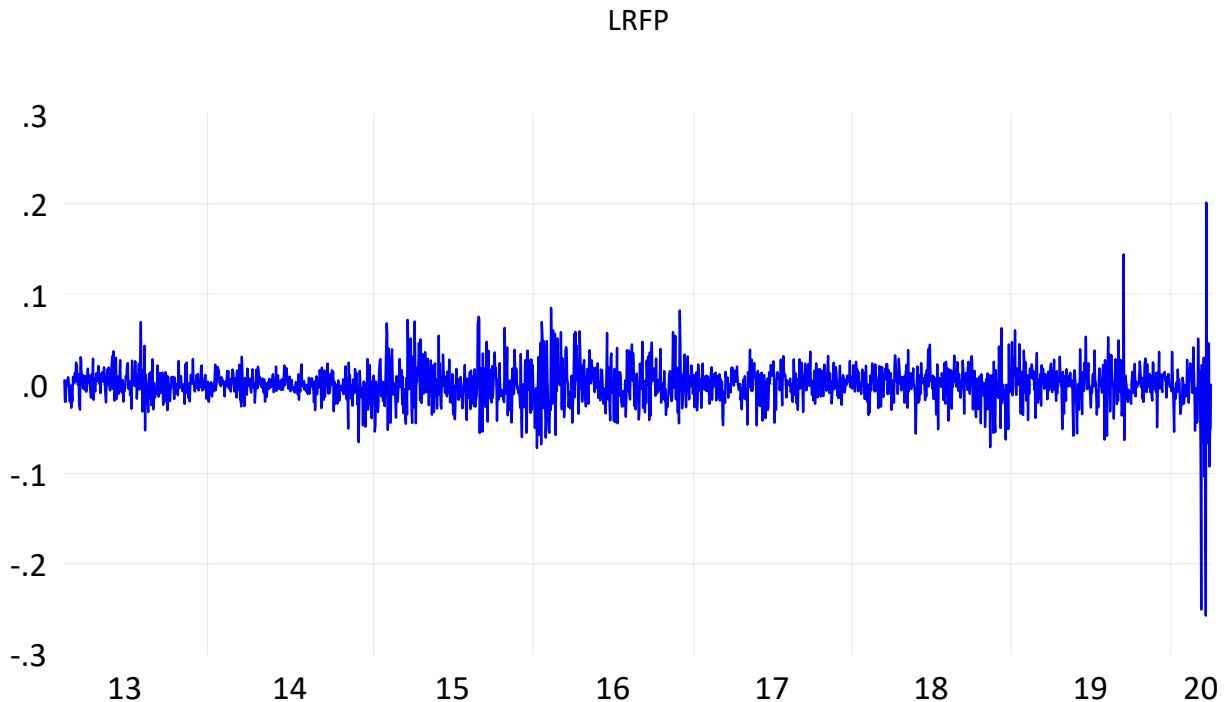
Source: Authors' Estimation.

Figure 1 stipulates that vacillations in Crude Oil's futures and spot return series insist big for certain epoch of time and continue diminutive for another epoch, designating the oscillation clustering structures of this range.
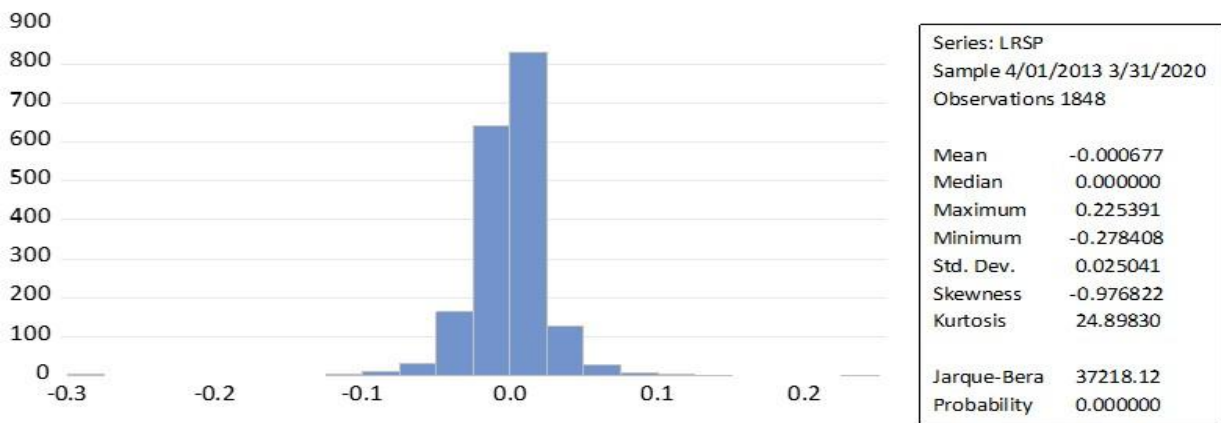
DESCRIPTIVE STATISTICS

'Descriptive statistics' can be predominantly operated to comprehend the rudimentary mathematical characteristics of the return components. Descriptive exploration demonstrates the manifestation of numerous characteristics of financial time sequences viz., *'fat-tailed distribution'* and *'skewness'*. On the word of Nattenburg (1996) "financial asset returns exhibit non- normal skewness and kurtosis". These discoveries are also reinforced by the exploration of Corrad and So (1991), Blattbrg and Gonede (1974) and Clark (1973). Apart from this, Ghysel *et* al. (1996) contended that vacillations clustering and fat tails of investment classes returns are greatly associated.

Hence before operating the econometric appliances, certain key mathematical behaviour of the return sequences of spot and futures of the selected asset, the descriptive measurements covering *'mean, standard-deviation, skewness, kurtosis and JarqueBera'* are figured. These properties are essentially vital earlier electing every accurate sculpting outline. The descriptive statistical methods, evaluated for the return sequences of all the elected asset both in futures and cash emporiums, can be operated to illuminate the univariate statistical characteristics of the associated components.
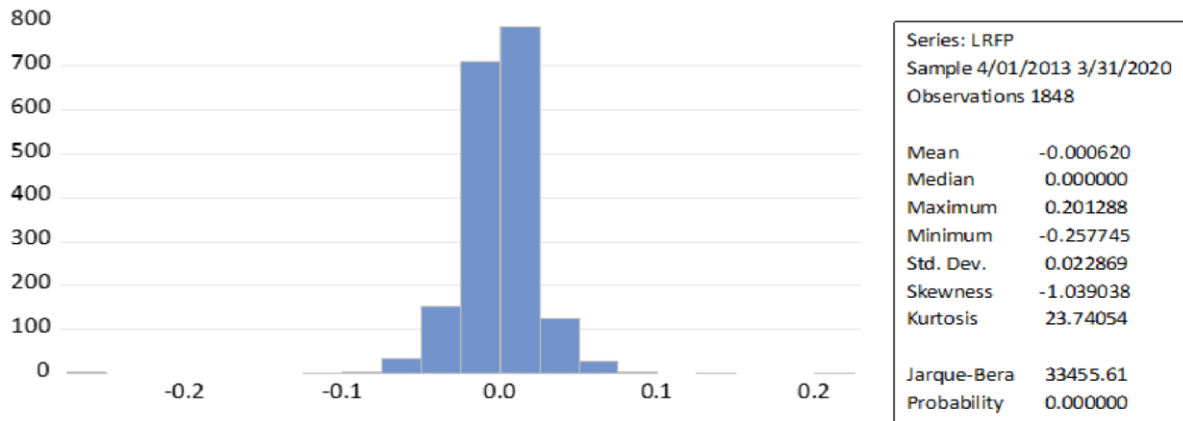
The descriptive-statistics of the Crude Oil spot and futures yield sequences are illuminate in Figure 2. This figure comprises the *'mean, standard deviation, skewness, kurtosis and jarque-bera test'* report of elected components of the work. It delivers a rudimentary inkling about the statistical characteristics of the concerned components.

Figure 2: Descriptive Statistics of Spot and Future Return of Crude Oil

A. Spot Return of Crude Oil

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B. Future Return of Crude Oil

Source: Authors' Estimation.

Figure 2 demonstrates that the mean rate of Crude Oil spot is -0.000677 and the mean value of futures is -0.000620 respectively. Consequently, the mean rate of futures Crude Oil is upper than the mean value of spot during the investigation epoch. The standard deviation rate of Crude Oil Spot is 0.025041 and the standard deviation rate of Crude Oil Futures is 0.022869 respectively. Hence the vacillations in the spot rate of Crude Oil are comparatively bigger than the vacillations in the futures rate of Crude Oil, as the spot emporium seems to be grasping the effect of rate modifications. The skewness values of the Crude Oil spot and futures range from -0.976822 to -1.039038. This specifies that the existence of *'negatively skewed'* in the commodity spot is relatively bigger than that of negatively skewed in the futures emporiums. It also spotlight that the distribution with a long tail extending towards left side. The kurtosis values of spot returns of Crude Oil is 24.89830 and the kurtosis of futures yields of Crude Oil is 23.74054 respectively. Hence both the sequences were leptokurtic distribution. *'Jarque-Bera test'* evaluates the *'normality of distribution'*, the P-value of *'Jarque-Bera-test'* precluded the nullhypothesis. Consequently the distributional particularises of Crude Oil spot and futures returns were *'non-normal'*.

UNIT ROOT TEST

If the datum sequences value returns to its high-tenure average rate and the particularises of the datum ranges are not affected by the alteration over stretch, it is called *'stationary time series'*. Contrariwise, if the time ranges does not recurrence to its high tenure average rate, then its covariance, variance and mean also modification in process of time is called *'nonstationary time sequences'*. If the

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epoch ranges is *'nonstationary'*, it is supposed to have a *'unit-root'*. Consequently, in econometrics, the - stationarity of a stretch ranges is inspected by actuating unit-root-test. Accurately, the ranges Yt is stationary if:

$$E(Y_t) = E(Y_{t-s}) = \mu, \text{ for some } s > 0$$

$$Var(Y_t) = Var(Y_{t-s}) = \sigma y^2 \text{ and}$$

$$Cov(Y_t, Y_{t-s}) = \gamma_s$$

Where,

$E(Y_t)$ = Expected value of Y at period t

Var = Variance, the variation or spread of Yt from $E(Y_t)$

Cov = Covariance, the joint variation of Y_t and Y_{t-s}

Y_{t-s} = Lag of Y up to period $_{t-s}$

The mathematically procedure engaged to corroborate the stationarity of a sequences is termed *'unit-root-test'*. The *'Augmented Dickeye Fuller (ADF) test'* is the superlative common practice for inquest *'unit-root'*. Presume, there is a ranges yt for scrutinising unit-root. Then, ADF practise unit-root is computes as follows.

$$\Delta yt = \mu + \delta yt - 1 + \sum_{i=1}^{k} \beta i \Delta yt - 1 + et$$

where,

$\delta = \alpha - 1$

α = coefficient of y_{t-1}

Δyt = first difference of yt, i.e. $yt - yt - 1$

The null-hypothesis of 'ADF is $\delta = 0$' in contrast to the alternative-hypothesis of

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'$\delta < 0$'. If null-hypothesis is not disproved, the ranges is 'nonstationary' while rebuff discloses the ambits is 'stationary'. Predominantly, the modus operandi elect for time ranges investigation is primary on the 'unit-root-test' upshots which summarize the 'stationarity' of the components. If the test statistic is superior to the critical value then the null hypothesis of '$\delta = 0$' is corroborated and 'unit root' is abiding and the sequences become 'nonstationary'.

If 'nonstationary' elements can be conceived into a 'stationaryseries by differentiating'. If an epoch sequences becomes 'stationary after differencing single stage', the sequences is revealed to as an 'integrated of order one and implied as I(1)'. As the stationary epoch sequences need not to be differentiated, it is implied as 'I(0)'.

Copious financial time sequences exhibit acclivity deportment or non-stationarity. A clamant rudimentary econometric mission with the financial datum is to substantiate its stationarity. The upshots of 'Augmented Dickey-Fuller Test (ADF Test)' of stationarity for future and spot values of Crude Oil is portrayed in table 1.

Table 1: Result of Unit Root Test for Crude Oil

Series	Levels			
	t-Statistic	**Critical Value**	**p-Value**	**Order of Integration**
Crude Oil Spot Price	-24.32997	-2.862911	0.0000	I(0)
Crude Oil Futures Price	-39.80099	-2.862900	0.0000	I(0)

Source: Authors' Estimation.

Table 1 exhibits the upshots of 'Augmented Dickey-Fuller Test (ADF Test)' of stationarity for future and spot earnings of Crude Oil. The upshot of ADF test of stationarity exposed that Crude Oil spot yields is 'stationary at level, that's integrated to order zero'. So the null hypothesis of 'unit root at level' is repudiated, as the t statistics (-24.32997) is smaller than critical value (-2.862911) and further corresponding probability value is 0.0000, which is smaller than significance level (0.05).

In the circumstance of Crude Oil Futures earnings test statistic is -39.80099, which is smaller than critical value -2.862900 (5% level) and further corresponding probability value is 0.000, which is

smaller than significance level (0.05), thus repudiated null hypotheses, which articulates that sequences is *'stationary or series has no unit root'*.

ARCH-LM TEST

It is indispensable to distinguish whether there is imperative substantiation of *'heteroskedasticity (ARCH effects)'*. This is computed through *'auxiliary test regression'*. This investigation employed the *'ARCH-LM test'* to see if there were any *'arch effects'* on elected components.

To check the *'ARCH effects'* applying the succeeding equation:

$$e_t^2 = \hat{\delta}_0 + \sum_{s=1}^{q} \hat{\delta}_s e_{t-s}^2 + \upsilon_t$$

Where, e_t^2 residuals, v_t is the error term.

This test calculates the $\chi 2$ distribution with q degree freedom. H0 states that there is *'no ARCH'* in the residuals (et) up to the order q. According to Fama (1965) "one of the most important features of the volatility is volatility clustering or ARCH effect, meaning large changes tend to follow large changes in periods, and vice versa". This investigation therefore searches this characteristic of vacillation. The investigation uses ARCH LM test to discover vacillation clustering.

This test is elected to diagnose the arch effect on elected components. The upshots of the ARCH-LM test for spot and future returns of Crude Oil are portrayed in table 2.

Table 2: Result of ARCH-LM Test for Crude Oil

Variables	LM Statistics	P-Value
Cruid Oil Spot Return	14.47797	0.0001
Cruid Oil Futures Return	223.2935	0.0000

Source: Authors' Estimation.

(Shi et al., 2019) state that "this test to construct the jump statistic based on volatility and use this statistic to test the jump phenomenon of price series". LM statistics of Crude Oil spot and futures returns are 14.47797 and 223.2935 respectively, and its p value is smaller than level of significance. Therefore this depicts Crude Oil spot and futures returns have *'ARCH Effects'*. Hence, the null hypothesis was repudiated. Based on the discoveries, in the circumstance of crude oil, the presence and behaviour of oscillation clustering phenomenon is witnessed in MCX. Oscillation clustering is present in the Indian commodity derivatives emporium as negative tidings generates more bewilderment in the commodity derivatives emporium than positive tidings.

CONCLUSION

The present investigation scrutinizes the existence of vacillation clustering in the Indian commodity derivatives emporium. Vacillation plays an ultimate role in contemporary financial exploration. This affects the estimation of an asset and peril administration. The upshots allude the existence of ARCH effects in daily spot and future return sequences in MCX. Moreover, the current discoveries powerfully assist the hypothesis of vacillation clustering presence in the Indian commodity derivative emporium. Hence vacillation clustering plays a great imperative duty in the Indian commodity derivative emporium. Based on the discoveries, negative returns channelize to great oscillation in the emporium as contrasted to positive returns.

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