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Indian Crude Oil Market Reaction towards Russia-Ukraine War: An Empirical Study of Spot and Futures Market

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Abstract

The paper examines the impact of Russia-Ukraine war news on Indian crude oil spot and futures markets. The event study Methodology is employed to examine the abnormal returns in crude oil spot and futures markets on the Russia-Ukraine War announcement date. For robustness of results, traditional market model as well as the market model + GARCH (1,1) model is used for analysis purposes. A non-parametric test (modified Corrado test) has been employed to test the significance of abnormal returns. The findings indicate that the war announcement generates significant excess returns for investors who take a long position most of the day during the event window. Information asymmetry is found in the Indian crude oil market, as in the case of the spot market, it takes four days to impound information into prices, and in the case of futures prices, it takes two days for reflection. These findings of research are useful for traders in the formation of their short-term trading strategies as well as for the government in the formation of effective energy policy strategies.

Keywords: Crude Oil, Information asymmetry, Event Methodology, Russia-Ukraine war

JEL Classifications: G01, G12, G14

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1. Introduction

In the era of globalization, the concept of self-reliant countries (closed economies) has become outdated, and all countries are connected to each other for their needs. Every country has its own unique characteristics; some are rich in natural resources, and on the other hand, some are blessed with fertile agricultural land. For instance, Russia held most of the natural resources amounting to 75 trillion US dollars, which include oil, coal, natural gas, timber, and many more (Statista, 2021). Besides this, there is diversity in those natural resources that a country has. Therefore, each country is dependent on other countries for their products, and they fulfil each other's needs by way of trade (import and export).

However, when any kind of negative event happens around the world in any country that is a major source (exporter) of any resources, it also impacts the dependent country (importer). Nowadays, theRussia-Ukraine war is the main headline in the news. These two nations were part of the Soviet Union before its dissolution in 1991. The conflicts of interest between these countries are not very new, and the world has witnessed them occasionally. However, this time the reason for the conflict is that Ukraine wants to become a member of NATO ("North Atlantic Treaty Organization"), but Russia doesn't want it (Kingsley, 2022). Consequently, the trade that these two countries are doing with other countries is disrupted.

In view of Russia is the second-largest crude oil exporter (International Energy Agency, 2022) and India being the third-largest importer (BP, 2021; Sunilkumar, 2023) for the fulfilment of its requirements. Because of this reason, all the international events which have a direct influence on the supply of crude oil affect India also.

Crude oil is a scarce natural resource, and it is formed from ancient submarine organisms. It is used as a raw material for transportation fuel and aviation fuel. Despite that, investors can use this asset for investment purposes as well. They get returns in the form of price appreciation on this asset. Likewise, for other financial assets, e.g., stocks and bonds, there is also an exchange available for the trade of crude oil. Electronic trading also happened for futures contracts in this asset class.

According to efficient market hypotheses, every piece of information that is released into the market is immediately incorporated into the prices of financial assets. This theory is widely checked by researchers all over the world with respect to stock prices, but there is little evidence found for commodity prices. So, the research article will check this hypothesis with respect to the crude oil market in India.

This research paper is divided into 5 sections: the first section covers the introduction of the research problem; the second section gives the background information; data collection and methodology are dealt with in the third section; and the fourth section discusses the result. Finally, the fifth section is the conclusion and policy implications of the study.

2. Literature Review

There is a vast amount of literature available on information efficiency in respect of different countries' stock markets (Anderson, 2009; Chowa et al., 2014; Chowdhury & Abedin, 2020; Dharmarathne, 2013; Gao & Tse, 2004; Lozada et al., 2022; Tweneboah-Koduah et al., 2020). Although in the literature, very few studies have been conducted in respect of crude oil market efficiency. In the literature, many studies have been conducted in respect of announcements made by OPEC[2] ("organization of petroleum exporting countries") and SPR[3] ("strategic petroleum reserve") regarding the oil supply that is mentioned below. Firstly, Draper (1984) examined the behavior of heating oil futures contracts traded on NYMEX (New York Mercantile Exchange) with respect to scheduled and special OPEC meetings. The findings of this study show that before the occurrence of meetings, there is a consistent positive return, although after the occurrence of meetingsthere is a consistent negative return. Wirl & Kujundzic (2004) measured the impact of OPEC policy decisions on world crude oil prices from 1984 to 2001. The study findings indicate that world crude oil prices are efficient in terms of conference decisions. A similar study conducted by Guidi et al. (2006) examined the impact of OPEC policy decisions on oil and stock prices in the US and UK from 1986 to 2004. This study examined the impact of OPEC policy during conflict and non-conflict periods. The findings of the study indicated that during a conflict period, there was an asymmetry in information reflection concerning OPEC policy decisions. However, in the case of a non-conflict period, crude oil prices reflect information efficiently. Another study conducted by Hyndman (2008) examined the impact of the OPEC decision with respect to increasing, decreasing, and no change on both crude oil prices and stock returns in the oil industry. The study result depicted that when OPEC reduces the quota, it induces a significant positive return, and when OPEC takes action, it generates a significant negative abnormality, although when OPEC increases the aggregate quota, it has no impact on the crude oil industry. Considine et al. (2015) examined the efficiency of the SPR (Strategic Petroleum Reserve) announcement on the world crude oil market and concluded that the SPR (Strategic Petroleum Reserve) stock sales reduce oil prices in the event of a major supply disruption. Demirer & Kutan (2010) examined the impact of OPEC and SPR announcements on crude oil spot and futures prices from 1983 to 2008. The findings of the study suggest that OPEC production generates excess returns for investors. Although concerning the SPR (strategic petroleum reserve) announcement, the crude market was found efficient.

There have been some recent studies that measure the effect of the Russia-Ukraine war on the world financial market. Some studies (Ahmed et al., 2022; Boungou & Yatié, 2022; Sun et al., 2022; Yousaf et al., 2022) exhibit that the regional countries which are adjacent to Russia, Ukraine, and the European Union generate a significant negative abnormal return. The effect of the Russia-Ukraine war is different on various industries, i.e., manufacturing, financial services, and service providers, depending on the regions adjacent to the battlefield. Moreover, oil and gas firms generate a positive

[2] OPEC is an organisation of major petroleum exporting countries that have control over the supply of petroleum products. Founded in 1960 by 5 founding members (Venezuela, Saudi Arabia, Iran, Iraq, and Kuwait), its mission is to coordinate and unify the supply of petroleum products.

[3] SPR (strategic petroleum reserve) is created by the US to ensure crude oil supply in case of deficiency. SPR is an outcome of the 1973 energy crisis, when Arab countries declined to supply crude oil to the US due to its support for Israel in the war.

abnormal return (Sun et al., 2022). Likewise, Umar et al. (2022) revealed that the European clean energy market was first hit by the war news, followed by the metals market. In another study, Alam et al. (2022) examined the Russian-Ukraine war's impact on the spillover of five commodities (oil, gas, platinum, and silver) in the G7 and BRIC (stock market). The findings of the study revealed that there was extreme connectedness among all commodities and stock markets (G7 and BRIC) during the crisis period. Likewise, Ha (2022) examined the dynamic linkages between the US crude oil, gold, and stock markets during the 2022 Russian-Ukraine war and disclosed that while the US oil and gold markets are the transmitters of volatility shocks, the oil market is the major contributor to volatility transmission.

Although this study is different from the previous study in that it examines the impact of Russia Ukraine war on the Indian crude market. Secondly, most of these previous studies used the traditional market model to measure abnormal returns, while this study used the market model as well as the market model + GARCH (1,1) model. The study used non-parametric test (modified Corrado test (Ataullah et al., 2011)) for the significance of abnormal return, as the parametric test requires certain assumptions regarding abnormal return to be fulfilled. Besides these, the study considered both the spot and futures markets for crude oil in India.

3. Data Collection and Methodology

3.1 Data

The study used the daily spot as well as daily futures prices series of crude oil. As MCX ("Multi Commodity Exchange") is the largest commodity exchange in India, spot prices as well as futures price series of crude oil are extracted from MCX. There are different maturity futures contracts available on MCX, out of which futures contracts with maturities of one month, two months, and three months are taken into account. Due to the maturity effect's (Samuelson, 2015) concerns on the prices of futures contracts, the series are constructed by rolling over seven days before their expiration. In the case of the spot price series, there are two sessions (morning and evening) of data available for Mumbai on MCX as the study used daily closing futures series, so session II (evening) data is taken for the spot price series. Given that Russia declared war on 24 February, 2022, the respective date was considered for examining the impact of war on crude oil prices. The study considers only trading day data in the analysis, and it is from 25th March, 2021 to 17th March, 2022.

3.2 Methodology

Event study methodology

In light of event study methodology, it has the significance of examining the corporate and external events impact on stock prices. There is huge literature available on the usage of this methodology in stock and other asset classes (Chowa et al., 2014; Chowdhury & Abedin, 2020; Lozada et al., 2022; Miyamoto, 2016; Uylangco et al., 2010). In respect of the crude oil market, these respective studies (Considine, 2015; Demirer & Kutan, 2010; Draper, 1984; Guidi et al., 2006; Hyndman, 2008; Wirl & Kujundzic, 2004) used this methodology for examining the impact of the OPEC announcement on crude oil prices, therefore, the study used this respective methodology.

The core of the event study is getting the abnormal return ($er_{t)}$ which is calculated by subtracting the normal return (NR_t) from the actual return (R_t), could be defined as

$$er_t = R_t - NR_t \quad (1)$$

For return purposes, the logarithm returns have been used. For estimation of normal return, the study has used the market model as well as the market model + GARCH (1, 1).

The market model is also known as a mean model; in this model, normal returns are calculated based on the market index. In this study, we used the MCX ICOMDEX composite index as a proxy for the market return. This model could be defined as

$$NR_t = C + \beta(MR_t) \quad (2)$$

$$R_t = C + \beta(MR_t) + er_{1t} \quad (3)$$

Here NR_t Stands for normal return (spot and futures crude oil) and MR_t is the return of the MCX ICOMDEX composite index, while er_{1t} represents the error term with a mean of 0 and a constant standard deviation. Here er_{1t} is the first measure of abnormal return.

Market model + GARCH model (1, 1)

The market model assumed an error term with a 0 mean and constant standard deviation, but in a real-world scenario, this assumption does not hold, due to the time-varying nature of volatility in time-series data, and the mean model estimator may be biased. Therefore, accounting for this limitation, for estimating the Market Model + GARCH (1, 1)[4] model was also used for estimating the normal return parameter. This model could be defined as

$$R_t = C + \beta(MR_t) + er_{2t} \quad (4)$$

Where er_{2t}= error term with mean 0 and time-varying variance, error term variance is defined as

$$h^2 = \mu + \alpha_1 er_{2t-1}^2 + \beta_1 h_{t-1}^2 \quad (5)$$

Here

h^2= variance of error term
μ= average long-term volatility
α_1 = ARCH term
β_1 = GARCH term
C = average return of crude oil
β= responsiveness of crude oil return to MCX ICOMDEX composite index, in other words, systematic risk.

Here er_{2t} is the second measure of abnormal return.

[4] Engle's ARCH effect(Engle, 1982) found in futures and spot market data at 5 % and 10% significance levels, respectively. In that scenario, the GARCH Model is best (Bollerslev, 1986) ,so it is used in the study.

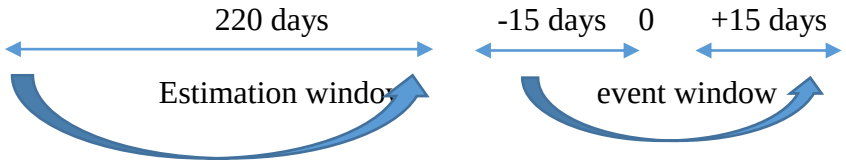
Cumulative abnormal returns are also calculated to see the persistency of abnormal returns after the announcement of war, which is calculated according to the below equation.

$$CER_m = \Sigma_{t=1}^{m} er_t \quad (6)$$

Where CER_m denotes cumulative abnormal returns of m period beyond the event period t, in this study we calculated m =5, 10, 15 periods of cumulative abnormal returns. This period is selected in line with the study of Demirer & Kutan (2010).

Event window estimation and hypotheses testing

In the event study methodology for calculating normal and abnormal returns, we have to specify two time windows; 1) estimation period window and 2) the event window. The estimation period is used for calculating the model parameter of normal return during the event period. Therefore, in our study, considering the event date as t=0, we used an event window of 31 days, which includes a pre-event and post-event period of 15 days, as a shorter event window does not capture the event and a longer period is not taken because of confounding event impact (Khanthavit, 2022; Nazir et al., 2014) . An estimation window of 220 days, i.e., from -236 to -16 days before the declaration of the Russian-Ukraine War, is used as displayed below.



After computation of the abnormal return and cumulative abnormal return, their significance is checked by a non-parametric test (modified Corrado test), as parametric tests have to fulfil the normality assumption of abnormal returns. In this study, the significance of abnormal and cumulative abnormal returns following null hypotheses has been established.

H_{0a} there is no significant abnormal return during the event window.
H_{0b} there is no persistency in abnormal return.

Under the modified Corrado test, abnormal returns have been ranked in ascending order after their ranking Corrado test statistic is computed based on the below formulas for checking the significance of abnormal returns and cumulative abnormal returns, respectively.

$$R = \frac{K_t - E(K)}{S(K)} \quad (7)$$

$$R_m = \frac{K(CER_m) - m*(N+1)/2}{\sqrt{m(N+1)(N-m)/12}} \quad (8)$$

where K_t is the respective rank of abnormal return at period t

E (K) = Average rank of abnormal return $E(K) = \frac{N+1}{2}$

S (K) = Standard deviation of the rank $S(K) = \sqrt{\frac{N^2-1}{12}}$

K (CER_m) = sum of the rank of abnormal return for m period.

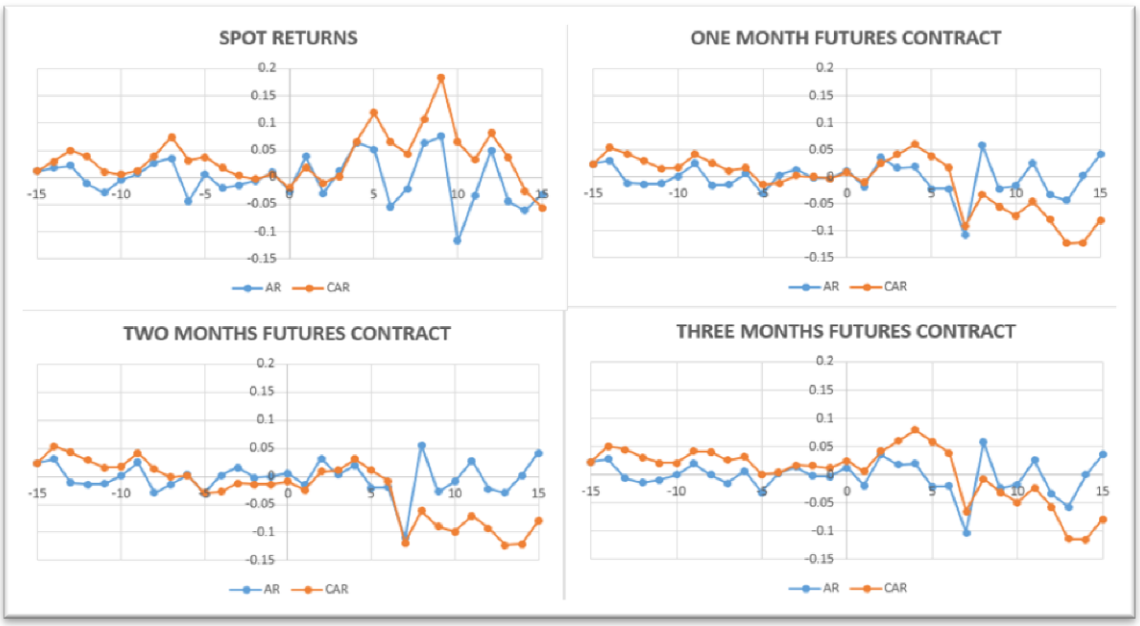
Here, N is the total number of observations, including the estimation window and event window.

4. Empirical Findings and Discussion

Figure 1 : Behaviour of Abnormal Returns (AR) and Cumulative Abnormal Returns (CAR) is given during event window from -15 days to +15 days, where normal returns are estimated using Market Model

Source: Authors' calculation

Figure 2 : Behaviour of Abnormal Returns and Cumulative Abnormal Returns where normal returns are estimated using Market Model + GARCH (1,1) Model



Source: Authors' calculation

As Figure 1 and Figure 2 show the behavior of abnormal return and cumulative abnormal return during the event window, it is depicted that as far as spot returns are concerned, they are hiked after the war announcement, while in the case of futures contracts, abnormal returns are hiked but not to the extent at which spot returns are hiked. There is one thing: the abnormal returns calculated on the basis of the market model is higher as compared to the Market Model + GARCH (1, 1) Model, as the second model accounts for the time-varying nature of the error term.

The same thing has been observed in Table 1, which shows the abnormal returns and their significance according to the modified Corrado test. When the market model is employed for calculating abnormal returns in the case of spot returns during an event window of 31 days, 8 days of abnormal returns are found significant, out of which 5 days of abnormal returns are found positively significant, and all the post-event window returns are found significant. In the case of the one-month futures contract (futures1), abnormal returns are found significant for 5 days, out of which 3 days are found positively significant. In the case of a two-month maturity futures contract (futures2), 4 days of abnormal returns are found significant, out of which 3 days of abnormal returns are found positive. In the end, for a three-month maturity contract (futures3), 5 days of abnormal returns are found significant, out of which 3 days of abnormal returns are found significant.

On the other hand, when the Market Model + GARCH (1,1) Model are employed for calculating abnormal returns in the case of spot returns, 7 days of abnormal return are found significant, out of which 4 days of positive abnormal returns are observed. In the case of a futures contract, in the case of the one-month futures contract (futures1), 6 days of abnormal returns are found significant, out of which 3 days of abnormal returns are positive. Lastly, in the case of two-month maturity futures contracts (futures2) and three-month maturity futures contracts (futures3), during the event window, 5 days of futures contracts are found significant, out of which on 3 days of abnormal returns are found positive and significant.

As far as persistency of abnormal returns is concerned, Table 2 reports the significance of cumulative abnormal returns for periods 5, 10, and 15 after the announcement of war. According to Table 2, in the case of the market model for spot returns, there is persistency of abnormal return for periods 5 and 10, as the cumulative abnormal returns for these periods are significant at 5%. While 10 days period cumulative returns for futures contracts (futures1, futures2, futures3) are found to be negatively significant at 10%. On the other hand, when the Market Model + GARCH (1,1) Model is employed, in the case of spot returns, 5-day period cumulative returns are positively significant at 5 %, but 15-day period returns are negatively significant at 10%, while in the case of futures returns in all maturity contracts, 5-day cumulative returns are found to be positively significant.

From the whole analysis, it is concluded that the reaction to the war announcement is shown during the post-event window in almost all contracts. In the case of the spot market, it takes more time for the reflection of information as compared to the futures market, as in the case of spot abnormal returns, it takes 4 days for reflection, while in the case of the futures market, it takes 2 days for reflection. The reason for the faster reflection of information in the futures market is lower transaction costs and the electronic trading of futures contracts. One more behavior is absorbed: after some days, it shows unusual patterns of abnormal returns; some days it shows positives as expected, while on other days it shows negative abnormal returns. The reason for this unusual pattern in both spot and futures markets could be the speculative behavior of traders and their wrong decision, which in turn create noise in the market and

consequently lead to unusual behavior and abnormal returns in both spot and futures markets, as there is a lead-lag relationship in both the spot and futures markets (Pradhan et al., 2021).

Overall, by taking a long position in the futures contract and spot market, investors could generate a substantial return, as shown in Table 3. In Table 3, the study reported the actual average return of crude oil spot as well as futures contracts after the war announcement from day 1 to day 5. Along with the average return, their standard deviation and risk-adjusted measure, the Sharpe Ratio, are also reported. As it is clearly shown here, when an investor takes a long position for 5 days after the announcement of the war in the spot market, one-month futures contract, two-month futures contract, and three-month futures contract, he will get a positive return of 3.953%, 2.732%, 2.499%, and 2.732%, respectively, as compared to the stock market where he gets negative returns of -0.003%. Moreover, an investor gets a risk-free adjusted return of 1.041 and 0.484 in spot and futures contracts, whereas in the case of Nifty 50, the risk-adjusted return is -0.01. Therefore, efficient market hypotheses do not hold for the Indian crude oil market.

5. Conclusion

This study attempts to find out the impact of the Russian-Ukraine war announcement on the Indian crude market. The study has several contributions. Firstly, it considers both spot and futures markets, and along with that, it considers different maturity futures contracts. (one-month maturity contracts to three-month futures contracts). Secondly, it employs both the traditional market model as well as the more sophisticated model; Market model + GARCH (1, 1) model. Moreover, it uses non-parametric test (modified Corrado test) for checking the significance of an abnormal return. The findings of the study suggest that the Indian crude market is inefficient in terms of the reflection of information, as it takes in the case of the spot market four days and in the case of the futures market two days for the reflection of information. Not only this, but there is also an unusual pattern of abnormal returns, as during the post-event window, some days it showed positive and some days it showed negative abnormal returns. Finally, the study suggests that by taking a long position in the spot and futures markets of crude oil, investors get a positive return. At the same time, investors are suggested to take a short position in the Nifty 50 index.

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Appendix

Table 1 : Abnormal Return as per the Market Model and Market Model + GARCH (1, 1) Model and their Significance at 10% according to Modified Corrado Test

	Abnormal return as per market model				**Abnormal return as per market model + GARCH (1,1)**			
Days	**Spot**	**Futures1**	**Futures2**	**Futures3**	**Spot**	**Futures1**	**Futures2**	**Futures3**
-15	0.011	0.024	0.024	0.023	0.016	0.020	0.020	0.019
	[0.855]	[1.449]	[1.476]	[1.476]	[1.007]	[1.366]	[1.366]	[1.366]
-14	0.018	0.030	0.030	0.028	0.017	0.031	0.032	0.028
	[1.159]	[1.600]	[1.614]	[1.573]	[1.062]	[1.628]	[1.656]	[1.587]
-13	0.021	-0.012	-0.012	-0.006	0.023	-0.013	-0.013	-0.007
	[1.352]	[-0.924]	[-0.979]	[-0.607]	[1.393]	[-1.035]	[-1.090]	[-0.731]
-12	-0.011	-0.014	-0.014	-0.014	-0.010	-0.015	-0.015	-0.015
	[-0.979]	[-1.048]	[-1.104]	[-1.076]	[-0.938]	[-1.145]	[-1.186]	[-1.200]
-11	-0.028	-0.013	-0.013	-0.009	-0.029	-0.012	-0.012	-0.009
	[-1.407]	[-0.993]	[-1.035]	[-0.855]	[-1.393]	[0.979]	[-1.021]	[-0.828]
-10	-0.005	0.001	0.001	0.000	-0.008	0.004	0.004	0.002
	[-0496]	[0.069]	[0.013]	[-0.041]	[-0.883]	[0.455]	[0.455]	[0.289]
-9	0.007	0.025	0.025	0.020	0.010	0.023	0.023	0.018
	[0.510]	[1.476]	[1.490]	[1.366]	[0.648]	[1.449]	[1.462]	[1.255]
-8	0.027	-0.016	-0.029	0.000	0.022	-0.012	-0.024	0.003
	[1.476]	[-1.173]	[-1.573]	[-0.082]	[1.324]	[-0.952]	[-1.421]	[0.372]
-7	0.035	-0.015	-0.014	-0.015	0.041	-0.019	-0.018	-0.019
	[1.559]	[-1.076]	[-1.117]	[-1.117]	[1.614]	[-1.297]	[-1.297]	[-1.311]
-6	-0.044	0.006	0.003	0.006	-0.046	0.008	0.006	0.008
	[-1.573]	[0.579]	[0.331]	[0.607]	[-1.587]	[0.731]	[0.565]	[0.772]
-5	0.007	-0.031	-0.031	-0.031	0.007	-0.031	-0.030	-0.031
	[0.483]	[-1.628]	[-1.628]	[-1.628]	[0.427]	[-1.600]	[-1.600]	[-1.600]
-4	-0.020	0.003	0.002	0.003	-0.018	0.002	0.001	0.002
	[-1.283]	[0.234]	[0.151]	[0.220]	[-1.21]	[0.179]	[0.096]	[0.207]
-3	-0.014	0.013	0.015	0.013	-0.015	0.014	0.016	0.014
	[-1.104]	[0.993]	[1.173]	[1.048]	[-1.090]	[1.076]	[1.200]	[1.076]
-2	-0.006	-0.002	-0.002	-0.002	-0.007	-0.001	-0.001	-0.001
	[-0.634]	[-0.193]	[-0.248]	[-0.193]	[-0.772]	[-0.124]	[-0.110]	[0.277]
-1	0.009	-0.003	0.000	-0.003	0.011	-0.004	-0.002	-0.004
	[0.593]	[-0.317]	[-0.124]	[-0.358]	[0.703]	[-0.441]	[-0.207]	[-0.441]
0	-0.025	0.012	0.006	0.013	-0.035	0.020	0.015	0.020
	[-1.366]	[0.924]	[0.552]	[0.993]	[-1.518]	[1.311]	[1.145]	[1.407]
1	0.038	-0.018	-0.015	-0.019	0.051	-0.028	-0.026	-0.028
	[1.600]	[-1.283]	[-1.145]	[-1.297]	[1.642]	[-1.518]	[-1.476]	[-1.531]
2	-0.029	**0.035***	**0.032***	**0.036***	-0.035	**0.040***	**0.038***	**0.041***
	[-1.449]	**[1.669]**	**[1.656]**	**[1.697]**	[-1.504]	**[1.697]**	**[1.683]**	**[1.711]**
3	0.012	0.016	0.003	0.018	-0.003	0.029	0.017	0.029
	[0.938]	[1.145]	[0.220]	[1.242]	[-0.372]	[1.545]	[1.228]	[1.600]
4	**0.064***	0.019	0.020	0.019	**0.060***	0.023	0.025	0.023
	[1.711]	[1.297]	[1.380]	[1.338]	**[1.697]**	[1.435]	[1.518]	[1.462]
5	**0.052***	-0.022	-0.020	-0.021	0.045	-0.016	-0.013	-0.015
	[1.669]	[-1.380]	[-1.324]	[-1.380]	[1.628]	[-1.200]	[-1.104]	[-1.186]
6	**-0.054***	-0.022	-0.019	-0.020	**-0.065***	-0.012	-0.009	-0.012
	[-1.656]	[-1.366]	[-1.311]	[-1.366]	**[-1.683]**	[-0.993]	[-0.855]	[-0.966]
7	-0.021	**-0.109***	**-0.110***	**-0.103***	**-0.068***	**-0.071***	**-0.067***	**-0.070***
	[-1.311]	**[-1.725]**	**[-1.725]**	**[-1.725]**	**[-1.697]**	**[-1.711]**	**[-1.711]**	**[-1.711]**
8	**0.063***	**0.059***	**0.056***	**0.057***	**0.075***	**0.049***	**0.046***	**0.049***
	[1.697]	**[1.725]**	**[1.725]**	**[1.725]**	**[1.711]**	**[1.725]**	**[1.711]**	**[1.725]**

	Abnormal return as per market model				**Abnormal return as per market model + GARCH (1,1)**			
Days	**Spot**	**Futures1**	**Futures2**	**Futures3**	**Spot**	**Futures1**	**Futures2**	**Futures3**
9	**0.076***	-0.022	-0.028	-0.024	**0.098***	-0.040	**-0.047***	-0.040
	[1.725]	[-1.393]	[-1.559]	[-1.490]	**[1.725]**	[-1.628]	**[-1.656]**	[-1.642]
10	**-0.117***	-0.017	-0.009	-0.018	**-0.109***	-0.023	-0.016	-0.023
	[-1.711]	[-1.214]	[-.0841]	[-1.269]	**[-1.711]**	[-1.435]	[-1.200]	[-1.462]
11	-0.034	0.026	0.028	0.026	-0.031	0.024	0.026	0.024
	[-1.504]	[1.504]	[1.559]	[1.531]	[-1.449]	[1.504]	[1.531]	[1.504]
12	**0.049***	-0.033	-0.022	-0.034	**0.058***	-0.040	-0.030	-0.040
	[1.656]	[-1.642]	[-1.421]	[-1.642]	**[1.669]**	[-1.642]	[-1.587]	[-1.628]
13	-0.045	**-0.044***	-0.030	**-0.057***	-0.036	**-0.050***	-0.037	**-0.063***
	[-1.587]	**[-1.669]**	[1.587]	**[-1.697]**	[-1.531]	**[-1.683]**	[-1.642]	**[-1.697]**
14	**-0.061***	0.002	0.002	-0.001	-0.056	**-0.002***	-0.002	-0.004
	[-1.683]	[0.151]	[0.124]	[-0.096]	[-1.642]	**[-0.165]**	[-0.248]	[-0.386]
15	-0.031	**0.041***	**0.041***	**0.036***	-0.037	**0.046***	**0.047***	**0.040***
	[-1.462]	**[1.711]**	**[1.711]**	**[1.683]**	[1.545]	**[1.711]**	**[1.725]**	**[1.697]**

*Note: Here the logarithm abnormal return and, in parenthesis [],the calculated Corrado test statistic are given. * denotes the significance value at 10%. Futures1 Futures2 and Futures 3 denote abnormal returns of the futures contracts maturing one month, two months, and three months respectively while Spot denotes the abnormal returns of the spot market.*
Source Authors' calculation

Table 2 : Cumulative Abnormal Returns as per Market Model and Market Model + GARCH (1, 1) and their significance as per Corado Test

	MARKET MODEL				**MARKET MODEL+ GARCH (1,1) MODEL**			
PERIOD	**SPOT**	**FUTURE S1**	**FUTURE S2**	**FUTURE S3**	**SPOT**	**FUTURE S1**	**FUTURE S2**	**FUTUR ES3**
5	**0.137****	0.031	0.019	0.034	**0.117****	**0.048***	**0.041****	**0.049***
	[4.049]	[1.312]	[0.712]	[1.449]	**[2.799]**	**[1.774]**	**[2.474]**	**[1.862]**
10	**0.085****	**-0.080***	**-0.090***	**-0.074***	0.048	-0.048	-0.051	-0.047
	[2.102]	**[-1.651]**	**[-1.913]**	**[-1.651]**	[0.938]	[-1.362]	[-1.218]	[-1.308]
15	-0.036	-0.087	-0.070	-0.103	**-0.054***	-0.070	-0.047	-0.090
	[-0.745]	[-1.348]	[-1.386	[-1.499]	**[-1.672]**	-1.288	-0.188	[-1.371]

*Note: Here the logarithm of the cumulative abnormal return and, in parenthesis [],the calculated Corrado test statistic is given. ** denotes the significance at 5%, and * denotes the significance at 10%. Futures1 Futures2 and Futures 3 denote the cumulative abnormal returns of the futures contracts maturing one month, two months, and three months, respectively, while Spot denotes the cumulative abnormal returns of the spot market.*
Source: Authors' calculation

Table 3 : Post-announcement Period Returns following Russia-Ukraine War Announcement

	Average returns	**Standard deviation**	**Sharpe Ratio**
Spot returns	3.953%	3.784%	1.041
One month futures contract return (Futures 1)	2.732%	5.615%	0.484
Two months futures contract return (Futures2)	2.499%	5.129%	0.484
Three months futures contract return (Futures3)	2.732%	5.615%	0.484
ICOMDEX	1.175%	2.249%	0.516
Nifty 50	-0.003%	1.655%	-0.010

Note: Here average return is calculated for post-announcement from day 1 to 5 and there is a respected standard deviation and shape ratio, i.e., (R_t- r_f)/s.d where $r_f$is daily risk-free return; here we take the 91 days t- bill rate as the risk-free rate, and s.d is the standard deviation of excess return(R_t- r_f). Here we calculated the average return, standard deviation, and Sharpe ratio of ICOMDEX and Nifty 50 for comparison purposes.

Source: Authors' calculation