Original Article

Impact Of Covid-19 On The Linkages Between Indochina Metal Futures Markets

Ravi Kumar[1*], Dr Babli Dhiman[2]

[*1] Research Scholar, Mittal School of Business, Lovely Professional University, Phagwara, Email: - ravi.kr24193@gmail.com, Orcid id- https://orcid.org/0000-0003-4348-6381
[2] Professor, Mittal School of Business, Lovely Professional University, Phagwara, Email: babli.dhiman@lpu.co.in

***Corresponding Author: -** Ravi Kumar

*Research Scholar, Mittal School of Business, Lovely Professional University, Phagwara, Email: - ravi.kr24193@gmail.com, Orcid id- https://orcid.org/0000-0003-4348-6381
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Abstract

This paper attempts to test whether the Covid-19 pandemic has an impact on the linkages of the metal futures market of India and China. Taking Daily closing prices from 4 Jun 2016 to 23 Apr 2021 for the seven metals, including copper, aluminum, zinc, lead, nickel, gold, and silver, have been included in the study in the pre-announcement and post-announcement of covid-19 as a pandemic. The autoregressive distributed lag (ARDL) bound test and Johansen cointegration test report no cointegrating relationship between the markets for all the metal futures before the covid period. There is no change in the absence of cointegration in the post-announcement period of Covid-19. Similarly, Granger causality results report no change in the short-run relationship between the metal futures markets except for silver futures. The results have implications for portfolio managers and investors looking to reshuffle their portfolios in the light of changes in the market due to the covid-19 pandemic.

Keywords: Linkages, metals, futures markets, Covid-19 pandemic, Cointegration, Granger causality

JEL Classification: G10, G14, G15

INTRODUCTION

Since the outbreak of the covid -19, it has claimed lives in almost all countries. The pandemic caused a sudden stop in economic activities. The slowdown caused by the coronavirus pandemic across the world left no industry untouched. Amidst this crisis, the economy witnessed a loss of production and daily wages; lockdowns caused unemployment for lakhs of factory- workers. Stock indices and other investments fell drastically, and disinvestments made people lose hope in the system. The global economic cycle has significantly been affected due to a sudden increase in market uncertainty, government policies and investors' behaviour (Adekoya and Oliyide 2021). This pandemic in the market now represents supply shocks, demand shocks, policy uncertainties and unprecedented mitigation measures by governments (Ezeaku, A. Asongu, and Nnanna 2021).

Troster (2020) addresses the importance of studying the effect of the covid-19 crisis on the global commodity market and especially on commodity-dependent countries. There is a significant impact of the covid-19 pandemic on the price of industrial and precious metals; however, the price decline is higher in oil (Rajput et al. 2020). Various other authors, including Adekoya and Oliyide (2021), have addressed the issue of connectedness among the global commodity and financial market in light of the covid-19 pandemic. The authors bring to the notice that the covid-19 pandemic has certainly caused a change in the relationship of various financial markets. The contagion of disease has caused the transfer of risk and thus caused the integration of markets, including commodity futures in emerging economies. We believe this pandemic has brought a change in the degree of connectedness between the metal futures markets of the two largest emerging economies. The change in the relationship is expected due to their similar production and consumption behaviour, similar population size and effect of the covid-19 pandemic on both countries. The objective of the paper is to test whether the contagion of the covid-19 virus from China has caused any change in the long run and short-run linkages between the metal futures markets of India and China. In the metals, we cover precious metals like gold and silver with industrial metals (copper, aluminium, zinc, lead and nickel). Various authors have studied linkages in the Stock indices of different markets in the light of covid-19; however, such studies are rare in the commodity market segment. This study attempts to fill this gap by analyzing the short-run and long-run relationship between MCX (Multi Commodity Exchange) and LME (London Metal Exchange) metal futures. The paper has important implications for portfolio managers and investors looking for diversification and reshuffling of portfolios in view of the changes that occurred in the markets due to the pandemic.

LITERATURE REVIEW

The commodity and stock markets are significantly impacted by the COVID-19 pandemic (Amar et al., 2021). In China, the pandemic has significantly impacted the financial markets (Corbet et al., 2021). The disease spread to the rest of the world and impacted the world economy and global markets. Salisu, Akanni, and Raheem (2020) employed a global fear index to find its impact on the returns of commodities and the stock market. As the fear of the pandemic rises, commodity market returns follow the upward movement and prove to be a safe haven during the pandemic. On the other hand, the stock market maintains a negative association with the Global fear index. The pandemic has significantly impacted the global demand and supply of commodities; industrial and precious metals witness a decline in demand and supply (Rajput et al., 2020).

The commodity market has experienced unprecedented effects due to sudden alterations in demand and supply in the covid-19 period. This alteration has a serious impact on commodity-dependent and developing economies (Troster and Kublbock 2020). With the gold market as an exception, volatility in the commodity market also experiences a negative impact due to uncertainty caused by a pandemic (Bakas and Triantafyllou 2020). During the covid-19 pandemic, the linkages between the financial and commodity markets significantly increased, causing significant transmission of risk among the markets (Adekoya and Oliyide 2021). Bouri et al. (2021) studied the connection among commodities, equities, currencies and bonds to report that the inter-market connectedness has increased significantly in the latter part of the year 2020. Such connectedness, in times of uncertainty, causes the weakening of diversification benefits. Oil is an essential commodity for its impact on the price of other commodities and financial markets. Salisu, Ebuh, and Usman (2020) report the possibility of an increase in the experience of own market shocks and cross-market shocks. Gil-Alana and Monge (2020) report shocks in the oil prices during the covid-19 pandemic period are long-lasting. Gharib, Mefteh-Wali, and Jabeur (2021) finds bilateral contagion effect of bubbles in the covid-19 period.

In the category of precious metals, gold has drawn the attention of researchers in periods of economic crisis. Baur and McDermott (2010) found that gold has not been a safe haven or good hedging instrument in times of crisis for Australia, Canada, Japan and large emerging economies like BRICS nations. However, the result is reversed for the economies of Europe and the US. This analysis period includes all the major market turmoil from the year 1979 to 2009. Some authors also discovered outcomes for developing and emerging economies, such as the BRICS, that were in contrast to those of Baur and McDermott (2010). According to Gurgun and Unalmis (2014) and Chkili (2016), gold has been observed to function as a hedge and safe haven during the crisis in the majority of these emerging economies. The result has been verified in the post-2008 crisis period and is valid for both domestic and foreign investors, so the authors suggest diversification of a portfolio in gold would be better for risk-adjusted return. During the Global financial crisis and Eurozone sovereign debt crisis, gold and other commodity markets have been found to be strong, safe-haven assets (Dimitriou, Kenourgios, and Simos 2020). Baur and Lucey (2010) add UK and Germany with the US market in the study, and an analysis of gold is done with not only the stock market but also bonds. The result supports the conclusions of Baur and McDermott (2010) for all three markets against equity, but for bonds, gold is not found as a hedge or safe haven in the crisis period. The result is the same for all three economies. Agyei-Ampomah, Gounopoulos, and Mazouz (2014) also came up with the same result for bonds and gold and further added that among the precious metals, palladium offers a better hedge against the losses in bonds. Beckmann, Berger, and Czudaj (2015) tested the hypothesis of Baur and Lucey (2010) for 18 individual markets for a period of 42 years on a monthly frequency and found the strong character of gold as a safe asset in times of crisis. Copper is found to surpass gold and other metals in the race to come up as a hedging instrument in the immediate post-shock period of bonds. However, Lucey and Li (2015) find that other palladium, platinum and silver are better hedging instruments than gold against equity markets losses during the crisis period. (Rehman, 2021) at times when gold does not act as a safe- haven, then the other three do, and when gold is acting as a safe- haven, silver, palladium, and platinum are better than gold in hedging the loss of equity. Bredin, Conlon, and Potì (2015) find a positive correlation between gold and equity during the market contraction of the early 1980s, causing no diversification benefits. The authors have also investigated gold's ability to act as a hedge against foreign equity in both the long- and short-term time frames, and they discover that for time frames up to a year, gold does function well in the US, UK, and German markets. According to Beckmann, Berger, and Czudaj (2019) the role of gold has changed significantly since the 2008 collapse of Lehman Brothers. Before the collapse, gold used to be a good tool for hedging the risk of the equity market. But after the crisis, gold is showing a positive relationship with stocks and bonds. Białkowski, Bohl, Stephan, and Wisniewski (2015) studied to detect a bubble in gold during the boom in the gold market. The author suggests not to believe in the existence of a bubble in the gold and accounts for various reasons for the swings observed in the gold market.

METHODOLOGY

ARDL Bound Test

To test the long-run relationship between the variables, we use ARDL bound test proposed by Pesaran, Shin, and Smith (2001). This model can be used for variables that are integrated of order zero or one. However, variables under consideration must not be integrated of order two.

To test the long-run relationship between the variables, the model used F statistics or the Wald test. Computed F- statistics are compared with the upper bound and lower bound at a particular significance level. If the calculated F statistics are lower than the lower bound, no cointegration is reported, and if the F statistics are higher than the upper bound, cointegration is confirmed between the variables. The result remains inconclusive in case the F statistics lie between the lower bound and the upper bound. The model is mathematically expressed as

$$\Delta Y = C1 + \sum_{i=1}^{n} \alpha_{1i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{1i} \Delta X_{t-i} + a1Y_{t-1} + b1X_{t-1} + €_{1t}$$

$$\Delta X = C2 + \sum_{i=1}^{n} \alpha_{2i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta X_{t-i} + a_2Y_{t-1} + b_2X_{t-1} + €_{1t}$$

Where Δ is the (first) difference operator, Y and X are the commodity price series from Indian and Chinese exchanges, respectively.

Johansen Cointegration Test

It measures the long-run relationship between the variables. A linear relationship containing both the variables has a lower order of integration then the two series are said to be co-integrated. Order of integration is the number of set differences that can transform the non-stationarity in the series into stationarity. Order of integration is used to describe a unit root process. Methods for testing the cointegration include the Engle granger two-step method, Philips- ouliaris cointegration test and Johansen test. For this study, the Johansen cointegration test has been used. Johansen test is preferred over Engle granger cointegration test as this model avoids the issue of marking the explained variable and gives more accuracy in multivariate analysis. For applying this test, the precondition is that all the variables under consideration should be integrated at the same level (all the variables should be either I (1) or all should be I (2)). Furthermore, before applying the test, optimal lag is required to be found. The mathematical equation used in the test can be written as follows.

$$X_t = \mu + \pi_1 X_{t-1} + \ldots\ldots + \pi_p X_{t-p} + €_t \qquad (6)$$

Johansen's method for the cointegration test uses two different statistics. These are the Trace test and maximum Eigen-value test. However, most of the time, both methods yield a similar result.

GRANGER CAUSALITY

Granger causality is used to know the direction of a causal relationship between the two variables. If the past values of one variable help predict the current value of another variable, then the first one is said to Granger cause the latter variable. This causal relationship could be unidirectional or bidirectional. This test is applied to stationary series only. We get the log return series of all seven pairs of variables to test Granger causality between them.

DATA

Multi commodity exchange (MCX) and Shanghai futures exchange (SHFE) are the largest exchanges in India and China, respectively, for metal futures trading. The official websites of MCX and SHFE have been used to collect daily data from 4 Jan 2016 to 23 Apr 2021. We split data into pre-announcement and post-announcement covid -19 data from the date (11 Mar 2020) when WHO announced the COVID-19 outbreak as a global pandemic (Albulescu 2020). A total number of seven metals, including copper, aluminium, zinc, lead, nickel, gold, and silver been considered for the study. Continuous series of futures prices in China has been prepared considering the contracts with the highest open interest (Y. Yan and Guiyu 2019) (Z. Yan et al. 2020). For price series from the Indian market, we rely on the MCX Comdex individual commodity indices for different metals. MCX Indices provide already prepared continuous series with a predefined methodology by the exchange. The returns series has been calculated using

RESULTS AND DISCUSSION

Table 1: Correlation between the Metal Futures Prices of India and China

Commodity	Pre-covid	Covid
COPPER	0.86***	0.987***
ALUMINIUM	0.567***	0.904***
ZINC	0.905***	0.963***
LEAD	0.692***	0.629***
NICKEL	0.91***	0.978***
GOLD	0.9***	0.931***
SILVER	0.522***	0.981***

Note. *, ** and *** shows significant at 10% , 5% and 1% respectively.

The correlation coefficients are summarized in table 1 for all seven metals. We find that in the covid period, there is an increase in the correlation coefficient for all the metals futures prices except for zinc and lead. The coefficients are highly significant for all the metals in the pre-covid and covid periods. Descriptive statistics of the returns data for the seven pairs of variables have been presented in appendix 1 and appendix 2. The mean return has increased in the covid period

for all the metals except the aluminium futures market in India and the Gold futures market in China. The standard deviation indicates risk has increased for bullions (gold and silver) in both exchanges.
For testing the stationarity of the series, we conducted the ADF test, and the results have been presented in appendix 3. All the variables are found to be integrated of order one except copper (MCX) in the post-announcement period. The optimal lag length required has been presented in appendix 4. For all the variables, optimal lag lengths have been selected using the Akaike information criterion. ARDL bound test is conducted in the pre-covid and during the covid period (post-announcement). We find no cointegration among the variables in both time frames. To confirm our results for the cointegrating relationship, we also conduct the Johansen cointegration test. Since I_copper is found to be I (0) in the post-announcement period, the Johansen test is conducted for all the variables except copper, as the Johansen test should be conducted for variables that are integrated at the same level. The trace statistics and max Eigen statistics also report no cointegration in the pre-covid and post-announcement periods for all the metal futures markets of India and China. This indicates no change in the long-run relationship between the metal futures markets of India and China.

Table 1: ARDL Bound Test Results

	F-statistics (Pre-Covid)	F-Stat. (Covid)	Lower Bound	Upper Bound
COPPER	1.890341	2.100347	3.62	4.16
ALUMINIUM	0.593291	3.281496	3.62	4.16
ZINC	1.771038	1.954691	3.62	4.16
LEAD	1.463039	1.282758	3.62	4.16
NICKEL	3.4248	1.438878	3.62	4.16
GOLD	0.737204	2.041	3.62	4.16
SILVER	1.423602	1.660195	3.62	4.16

Table 3: Johansen Cointegration Test Result

Variables	Ho	Pre-Covid				Covid			
		Trace-stat.	critical value	Eigen-stat.	Critical value	Trace-stat.	Critical value	Eigen-stat.	Critical value
COPPER	r=0	10.99	19.96	6.34	15.67	-	-	-	-
	r<=1	4.66	9.24	4.66	9.24	-	-	-	-
ALUM.	r=0	11.04	19.96	9.87	15.67	14.28	19.96	11.18	15.67
	r<=1	1.17	9.24	1.17	9.24	3.1	9.24	3.1	9.24
ZINC	r=0	16.52	19.96	14.12	15.67	11.71	19.96	7.06	15.67
	r<=1	2.4	9.24	2.4	9.24	4.65	9.24	4.65	9.24
LEAD	r=0	7.31	19.96	5.26	15.67	9.73	19.96	8.2	15.67
	r<=1	2.04	9.24	2.04	9.24	1.53	9.24	1.53	9.24
NICKEL	r=0	10.78	19.96	6.42	15.67	17.25	19.96	12.82	15.67
	r<=1	4.36	9.24	4.36	9.24	4.43	9.24	4.43	9.24
GOLD	r=0	8.07	19.96	4.42	15.67	14.58	19.96	9.42	15.67
	r<=1	3.65	9.24	3.65	9.24	5.16	9.24	5.16	9.24
SILVER	r=0	11.17	19.96	8.04	15.67	19.15	19.96	12.33	15.67
	r<=1	3.13	9.24	3.13	9.24	6.82	9.24	6.82	9.24

Finally, we conduct the Granger causality test on the log return data of India and China metals futures. In the period before and during covid -19, Indian metal futures markets granger caused Chinese Metal futures markets. From China to India, the aluminium futures market granger causes the Indian futures market in the both before and during the covid period. During the covid period, only the silver market of SHFE seems to start Granger causing the silver futures market of MCX. Overall, except for the granger causality of the silver futures market, the Covid period has not witnessed any change in the linkages between the Indian and Chinese metal futures markets. The results are similar to the findings of Yuan, Zhang, Cui, and Wang (2021), where the linkage of crude oil with the Chinese stock market is found to have no significant change, unlike the other countries of the BRIC group. Ben Amar, Hachicha, and Halouani (2021) also found no effect of the Chinese stock market on the world's major stock indices.

Table 4: Granger Causality Test Result

		Pre-Covid		Covid	
		F-Statistic	P-value	F-Statistic	P-value
Copper	China to India	0.497	0.685	1.63	0.198
	India to China	151.57	0	61.77	0
Aluminium	China to India	3.130	0.0006	8.34	0.005
	India to China	18.4	0	29.58	0
Zinc	China to India	1.092	0.352	1.946	0.123
	India to China	138.3	0	26.08	0
Lead	China to India	1.093	0.352	2.77	0.0973
	India to China	91.856	0	27.66	0
Nickel	China to India	1.39	0.22	1.272	0.285
	India to China	87.029	0	40.66	0
Gold	China to India	1.3734	0.254	1.629	0.199
	India to China	164.01	0	107.6	0
Silver	China to India	0.264	0.86	2.67	0.049
	India to China	187.16	0	98.64	0

CONCLUSION

The study aims to assess the effects of Covid-19's declaration as a global pandemic on the connections between India's metal futures markets and China, where Covid-19 originated. Daily data from MCX and SHFE has been used for seven metals, including copper, aluminum, zinc, lead, nickel, gold, and silver. In addition, the ARDL bound test, Johansen cointegration test, and Granger causality test provide useful information for portfolio makers and investors in the wake of changes pertaining to the Covid-19 pandemic.

ARDL bounds test and Johansen test shows no long-run relationship between the metal futures markets of the exchanges of both countries in the pre-covid period and during the covid period. So, the announcement of the pandemic could not bring a cointegrating relationship between the markets. Similarly, granger causality also reports no change in the direction of causality between the markets except for the silver futures market. So, overall, this can be concluded that the covid-19 announcement has made no significant impact on the relationship between the metal futures markets of India and China. This paper attempts to fill the literature gap by studying the linkage in the commodity market besides the various studies finding changes in the stock market linkages in the covid-19 pandemic.

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APPENDICES

Appendix 1: Descriptive Statistics of Metals Futures Returns in Pre Covid-Period

	ICU	CCU	IAL	CAL	IZN	CZN	IPB	CPB	INI	CNI	IAU	CAU	IAG	CAG
N	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001
Mean	5.81E-05	0.00027	-1.22e-5	0.00025	0.00037	0.00029	-1.04e-4	0.00018	0.00035	0.00054	0.00042	0.00051	3.68E-05	0.00028
Standard deviation	0.0112	0.0104	0.0109	0.00994	0.0149	0.0137	0.0136	0.0129	0.0168	0.0158	0.00752	0.00772	0.0113	0.0115
Minimum	-0.0519	-0.0621	-0.0865	-0.0648	-0.0652	-0.0684	-0.0548	-0.0714	-0.073	-0.0661	-0.0427	-0.0396	-0.0769	-0.0705
Maximum	0.0449	0.0635	0.0769	0.0505	0.0699	0.0592	0.0738	0.0721	0.0753	0.072	0.0497	0.0463	0.0463	0.0465
Skewness	-0.102	0.18	0.434	-0.0579	0.122	-0.0757	0.151	-0.0777	0.122	0.0829	0.531	0.325	-0.342	-0.384
Std. error skewness	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773

Appendix 2: Descriptive Statistics of Metals Futures Returns in the Covid Period

	ICU	CCU	IAL	CAL	IZN	CZN	IPB	CPB	INI	CNI	IAU	CAU	IAG	CAG
N	267	267	267	267	267	267	267	267	267	267	267	267	267	267
Mean	0.0019	0.0017	0.0011	0.0014	0.0018	0.001	8.66E-04	3.35E-04	0.00103	7.44E-04	3.07E-04	1.02E-04	0.00141	0.00143
Median	0.00211	0.00122	7.48E-04	0.00195	0.00249	6.71E-04	0.0012	3.42E-04	0.00164	0.00152	0.00136	2.57E-04	0.00219	0.00195
Standard deviation	0.013	0.0136	0.00938	0.0133	0.0146	0.0135	0.0101	0.0127	0.0165	0.0168	0.012	0.0111	0.0263	0.027
Minimum	-0.0646	-0.0626	-0.0255	-0.0542	-0.0466	-0.0498	-0.0348	-0.047	-0.0769	-0.0697	-0.0549	-0.0469	-0.112	-0.0983
Maximum	0.0408	0.0474	0.0462	0.0511	0.0761	0.044	0.0424	0.0436	0.0471	0.0487	0.0311	0.0555	0.0703	0.084
Skewness	-0.668	-0.424	0.831	-0.498	-0.0691	-0.0136	-0.0774	-0.0343	-0.68	-0.553	-1.03	-0.256	-0.726	-0.162
Std.error skewness	0.149	0.149	0.149	0.149	0.149	0.149	0.149	0.149	0.149	0.149	0.149	0.149	0.149	0.149
Kurtosis	2.96	3.99	2.89	2.67	2.45	1.02	2.02	0.884	3.17	1.92	2.92	4.06	3.44	1.6
Std. error kurtosis	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297

Appendix 3: Results for ADF Test

Variables	Pre-Covid						Covid					
	At Level			At First Difference			At Level			At First Difference		
	Dickey-Fuller	Lag order	P-value	DF-statistic	Lag order	P-value	Dickey-Fuller	Lag order	P-value	T-statistic	Lag order	P-value
I_COPPER	-2.1546	10	0.5129	-9.5104	9	0.01	-3.716	6	0.02367	-5.9904	6	0.01
I_ALUMINIUM	-1.251	10	0.8954	-11.706	9	0.01	-2.101	6	0.5334	-5.6791	6	0.01
I_ZINC	-1.5016	10	0.7893	-10.274	9	0.01	-2.757	6	0.257	-6.8781	6	0.01
I_LEAD	-2.1988	10	0.4941	-10.281	9	0.01	-3.086	6	0.1183	-5.5378	6	0.01
I_NICKEL	-2.6158	10	0.3176	-9.0267	9	0.01	-2.403	6	0.406	-5.7551	6	0.01
I_GOLD	-0.81719	10	0.9601	-9.2436	9	0.01	-2.836	6	0.2238	-6.7871	6	0.01
I_SILVER	-2.8592	10	0.2146	-10.349	9	0.01	-2.017	6	0.5687	-7.8178	6	0.01
C_COPPER	-1.5577	10	0.7655	-9.6056	9	0.01	-2.632	6	0.3097	-6.4002	6	0.01
C_ALUMINIUM	-2.2422	10	0.4758	-9.4266	9	0.01	-2.504	6	0.3636	-6.2074	6	0.01
C_ZINC	-1.4742	10	0.8009	-10.784	9	0.01	-2.053	6	0.5536	-6.8259	6	0.01
C_LEAD	-1.7898	10	0.6673	-9.2705	9	0.01	-2.547	6	0.3457	-6.2561	6	0.01
C_NICKEL	-2.3762	10	0.4191	-9.9878	9	0.01	-2.734	6	0.2666	-6.2293	6	0.01
C_GOLD	-0.76935	10	0.9643	-10.638	9	0.01	-2.979	6	0.1635	-7.8899	6	0.01
C_SILVER	-2.3178	10	0.4438	-11.848	9	0.01	-1.812	6	0.6553	-7.3911	6	0.01

Appendix 4: Optimal Lag Length

Variables	Optimal Lag Length	
	Pre-covid	Covid
I_COPPER	1	10
I_ALUMINIUM	10	3
I_ZINC	1	4
I_LEAD	3	1
I_NICKEL	2	1
I_GOLD	1	5
I_SILVER	2	2
C_COPPER	1	3
C_ALUMINIUM	4	2
C_ZINC	8	1
C_LEAD	5	9
C_NICKEL	2	3
C_GOLD	7	5
C_SILVER	8	2