International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 06 | June - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

RELATIONSHIP BETWEEN COMMODITIES MARKET AND STOCK MARKETS EVIDENCE FROM MALAYSIA AND CHINA

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Introduction

The stock-commodity link affects market participants, commodity producers, policymakers, and, in emerging nations, the entire economy. The lead-lag relationshipbetween market representative indices can be studied using many methodologies. Thisinitiative examines the Indian stock-commodity market interaction.
This project will leverage secondary data from the National Stock Exchange, Multi Commodity Exchange of India Limited, and Bombay Stock Exchange websites. Projectresults can be used to create an investment plan. Thus, market participants must draw crucial inferences or discover important relationships between the Indian Stock Market and Commodity Market.

Statement of the Problem

Market players and investors face difficult portfolio decisions. People struggle to choosestocks and commodities like gold, copper, etc. Due to a lack of credible market data on the Indian Stock Market-Commodity Market connection.

The lack of research on the Indian stock-commodity market link is the issue. Such a studyis needed, using some of the top marketplace contributors as examples.The project's results should help regulators and market participants understand the problem and adopt appropriate laws, rules, policies, and methods. Investors and individuals have confirmed the issue.
.Objectives of the Study

The following objectives are the focus of the project study.

- To make important inferences about the way the Indian Stock Market andCommodity Market interact;
- to ascertain the type, scope, and direction of the link between the IndianCommodity Market and the Indian Stock Market.

Research Methodology

Correlation analysis can be employed for this study due to the samples obtainedfrom the two markets over a set time and the expected results. The following sections explain the data, sources, availability, and timeframe for this study. The project study framework is included.

Data and Sources

SENSEX and NIFTY values and the values of major commodities listed on the MultiCommodity Exchange of India Limited, one of the nation's top commodity markets,like gold, copper, aluminum, and crude oil, are examples of secondary data that is not necessary. The above commodities were chosen because they affect commodity market trade daily. The stock indexes' realistic representation of stock market activity was another factor in their selection. These data are publicly available and usable at any time.Monthly data collection is used for this initiative.Here are the sources of the previous information.

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- The Bombay Stock Exchange's official website provides the values of the keyindex SENSEX.
- The Multi Commodity Exchange of India Limited's official website provides thevalues of crude oil, copper, gold, and aluminium.
- The value of the main index NIFTY can be downloaded from the official websiteof the National Stock Exchange of India Limited.

Period of the Study

The next periods' worth of data are gathered from the relevant sources, as previouslydescribed in the sections above. For

- Gold :fromJanuary 2018 to December 2023
- Crude Oil :fromFebruary 2019to December 2023
- Copper :fromJune 2018to December 2023
- Aluminium :fromOctober 2019to December 2023
- SENSEX :fromJanuary 2018 to December 2023
- NIFTY :fromJanuary 2018 to December 2023

Since the study will use monthly data, the last six years of data for the samples can be used. However, the Multi Commodity Exchange of India Limited website only hascrude oil, copper, and aluminum data from February 2019, June 2018, and October 2019.

REVIEW OF LITERATURE

Numerous theoretical and empirical studies have linked the Indian stock market to the commodity market. It had been extensively evaluated by industry and academic experts. The investigation and results were thoroughly scrutinized, and a study supported the plan.In his paper "Commodity Future Market in India - A Study of Trends in the Notional Multi Commodity Indices," Sushmita Bose (2022) found that the Indian financial derivatives and commodity derivatives markets have similar price movements. He also found a strong 70% link between the Indian Commodity Market index and the Indian Stock Market index. He also finds that the Multi Commodity Indexes, which are more exposed to energy and metals and have efficient and transparent pricing distribution in domestic and

worldwide markets, have similar information flow and efficiency as the Equity Indexes.
Another economist, Michel Robe (2022), explored the stock-commodity relationship inCommodities and Equities: A "Market One"? His dynamic correlation and recursive cointegration study shows that the investable commodity and equity index returns havenot changed significantly over the past 15 years.

Indian Commodity Market

A commodity futures market, often known as an exchange, is a public market where commodities are bought or sold at a predetermined price for delivery on a specific date.Commodities must be bought or sold through an exchange-member broker using standardized futures contracts.

India's commodity markets have grown slowly, affecting the financial sector and the economy as a whole. Investors consider commodities an alternative asset class. Investorslike commodity futures because they are a powerful inflation hedge and have low connection with other asset classes. Its diversity and unique hedges make it a useful portfolio management tool that enhances returns for local and foreign investors.
By leveraging the commodity futures market as an asset class, producers and consumers of commercial commodities can move price risk to speculators without a direct business stake. Producers reduce price risk by shorting futures contracts for their products. Similarhedging requires customers to have long positions on commodity futures contracts.
Arbitragers and speculators decide whether to buy or sell commodity futures contractsbased on market perception.

Unlike stocks, commodity futures have no net supply. As a passive strategy, investors should not use a "long-only" commodity futures market portfolio. Various players willhave relationships in the future.

Even in commodity bull markets, long-only strategies may not yield risk premiums.Realfacts and economic theory indicate momentum in future commodities prices. Thus, longing a commodity when its future price rises and vice versa makes sense.

Evolution and History of the Commodity Markets in India

India's commodity futures markets are underdeveloped. Although it has traded commodity derivatives longer than the US and UK, this is true. The post-independence government engagement in agriculture contributed to this reality. The state still producesand distributes many agricultural commodities, and trading in forwards and futures is regulated in some sectors. The Essential Commodities Act (ECA), 1955 restricts free commerce in many commodity products, whereas the Forward Contracts (Regulation) Act (FCRA), 1952 limits future contracts and forwards to certain commodity categories.

India's organized futures market began in 1875 with the Bombay Cotton Trade Association Ltd. Dissatisfaction among major cotton mill owners and merchants with theBombay Cotton Trade Association led to the creation of Bombay Cotton Exchange Ltd. in 1983. Oilseed futures trading began in 1900 with the Gujrati Vyapari Mandali, which traded cotton, castor seeds, and ground nuts. Eastern India Jute Association Ltd. and Calcutta Hessian Exchange Ltd. were founded in 1927 and 1919 to trade raw jute futures.The East India Cotton Association organized 1921 Mumbai cotton futures. Before WorldWar II, Gujarat and Punjab had various oilseed futures markets. Bullion futures markets began in Bombay in 1920. Rajkot, Jaipur, Jamnagar, Kanpur, Delhi, and Calcutta followed with similar markets. Over time, more exchanges were formed around the land to trade sugar, jaggery, potatoes, pepper, and turmeric.
After independence, the Indian constitution includes "Stock Exchanges and Future Markets" in its union list. The

central government had exclusive authority to control and grow commodities futures markets. Forward Contracts (Regulation) Act was passed in December 1952 after committees of two parliaments and an expert group led by Professor
A.D. Shroff reviewed a legislation. The central government published Forward Contracts (Regulation) laws in 1954. IPSTA held the inaugural spice futures trade in Cochin in 1957. To monitor price variations of critical and agricultural items, the government banned futures trading in 1966. The futures trading ban led many traders to unofficial and informal trading. Based on the June 1980 Khusro committee report, India resumed futureson cotton, jute, potatoes, and other commodities during liberalization.

Commodity Futures

Understanding commodities futures' importance and risk management potential is crucial.It is well known that share, commodity, and currency prices move non-linearly.

Unfavorable futures price movements increase corporate risks. Derivatives reduce pricingrisks from unexpected price changes.Foundational resource prices dictate derivative financial contract prices. Futures contracts outperform forwards. These contracts set a fixed price for a commodity and require payment later. Futures contracts standardize commodity quality, quantity, delivery location, and date more than forward contracts. The Forward Market Commission (FMC) defines a futures contract as a highly standardized contract with some distinctive features, such as these.

1. Futures trading shall be handled by a market organization and restricted to its membersin accordance with its bylaws and regulations.
2. It is always enrolled into a standard variety called the "basis variety," with permissionto provide "tenderable varieties." Both parties to these arrangements agree that price quotation and trade units are fixed.
3. Delivery times exist.
4. Futures sellers can supply things according to pending sale contracts. In addition to theassociation's trading location, he can distribute things at many pre-designated distributioncenters.
5. Few futures market scenarios involve product delivery. Most transactions are performed before the contract's due date, and conflicts are addressed by paying thecontract difference without product delivery.

A robust and efficient commodities futures market permits transaction offsetting withoutaffecting physical objects until contract expiration, unlike the physical market. Futures contracts directly address credit risk associated with pricing lock and forward insuranceNo systematic or inadvertent pricing changes occur.

It's true that commodities have a unique return. Commodities' statistical properties minimize risk for a financial asset portfolio. When compared to stocks, commodity markets exhibit a negative correlation between volatility and return. If commodity marketreturns are inversely connected with conventional financial assets, adding commodities tothose portfolios may diversify risks. By including commodity assets in a financial asset- only portfolio, an investor can fully profit from commodities' statistical properties.

DATA ANALYSIS AND INTERPRETATION

For this project, samples from the Indian stock market and commodities market are restricted to the following: gold, copper, aluminium, crude oil, SENSEX, and NIFTY. In order to arrive at relevant conclusions based on the research above, this project uses eightsets of data produced from the samples listed below using Karl Pearson's Coefficient of Correlation approach. The following set of data, samples, is being subjected to data analysis and interpretation utilizing Karl Pearson's Coefficient of Correlation approach.

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- SENSE and Gold
- SENSEX and Crude Oil
- SENSEX and Copper
- SENSEX and Aluminum
- NIFTY and Gold
- NIFTY and Crude Oil
- NIFTY and Copper
- NIFTY and Aluminum

Before exploring into the detailed analysis and interpretation, Karl Pearson'sCoefficient of Correlation method & its interpretation are explained as below.

Karl Pearson's Coefficient of Correlation Method

GivenasetofNpairofobservation$(X_1,Y_1),(X_2,Y_2),\ldots\ldots(X_n,Y_n)$relating totwovariablesXandY,CoefficientofCorrelationbetweenXandY,denotedbythe symbol"R" is defined as

$$R=\sum(X-X^I)(Y-Y^I)/\sqrt{\sum(X-X^I)^2\sum(Y-Y^I)^2}\text{---Equation(4.1)}$$

Where,

X^I–MeanofX Y^I–Meanof Y R–Liesbetween-1and+1

By using the equation (4.1) and the interpretation of the value of "R", the relationship between the Indian Commodity Market and Indian Stock Market can be found and reasonable conclusions can be arrived at.

SENSEX and Gold

Table4.1 refer to the value of SENSEX(index in number)and the value of Gold(Amount in Rs. Lakh) for the period from January 2018 to December 2023.

Table: 4.1 SENSEX and Gold

Month	Sensex (X)	Gold(Y)	Month	Sensex (X)	Gold(Y)
Jan2018	5,695.67	43,087.69	Jan2021	14,090.92	5,645,149.58
Feb2018	5,667.51	55,979.21	Feb2021	12,938.09	6,308,839.10
Mar2018	5,590.60	91,095.09	Mar2021	13,072.10	7,022,558.62
Apr2018	5,655.09	96,130.46	Apr2021	13,872.37	4,408,963.36
May2018	4,759.62	115,895.78	May2021	14,544.46	5,381,761.44
Jun2018	4,795.46	166,025.19	Jun2021	14,650.51	4,719,385.77
Jul 2018	5,170.32	316,462.21	Jul 2021	15,550.99	4,829,088.89
Aug2018	5,192.08	368,535.23	Aug2021	15,318.60	4,229,747.79
Sep2018	5,583.61	547,177.89	Sep2021	17,291.10	5,810,271.62
Oct2018	5,672.27	607,849.12	Oct2021	19,837.99	8,285,033.18
Nov2018	6,340.29	880,116.80	Nov2021	19,363.19	10,386,144.10
Dec2018	6,602.69	724,531.15	Dec2021	20,286.99	7,759,148.93
Jan2019	6,555.94	549,586.34	Jan2022	17,648.71	16,669,925.31
Feb2019	6,713.86	554,577.04	Feb2022	17,578.72	14,260,015.15
Mar2019	6,492.82	692,900.02	Mar2022	15,644.44	13,868,565.59
Apr2019	6,154.44	513,792.54	Apr2022	17,287.31	10,250,063.16
May2019	6,715.11	696,960.07	May2022	16,415.57	10,579,252.85
Jun2019	7,193.85	848,613.35	Jun2022	13,461.60	13,113,103.07
Jul2019	7,635.42	994,230.52	Jul2022	14,355.75	20,076,066.06
Aug2019	7,805.43	953,765.39	Aug2022	14,564.53	16,215,325.61
Sep2019	8,634.48	2,414,181.78	Sep2022	12,860.43	21,524,528.53
Oct2019	7,892.32	2,199,385.07	Oct2022	9,788.06	16,871,983.04
Nov2019	8,788.81	2,608,423.58	Nov2022	9,092.72	13,718,417.16
Dec2019	9,397.93	4,894,473.86	Dec2022	9,470.31	16,907,140.81
Jan2020	9,919.89	6,556,802.61	Jan2023	9,424.24	21,051,503.32
Feb2020	10,370.24	5,758,718.57	Feb2023	8,891.61	23,338,041.32
Mar2020	11,279.96	7,748,336.67	Mar2023	9,708.50	27,457,088.19
Apr2020	12,042.56	7,475,297.91	Apr2023	11,403.25	15,955,495.10
May2020	10,398.61	10,150,417.59	May2023	14,625.25	14,787,281.64
Jun2020	10,609.25	7,717,549.93	Jun2023	14,493.84	13,883,118.96
Jul2020	10,743.88	10,028,712.99	Jul2023	15,670.31	11,108,629.67
Aug2020	11,699.05	8,074,195.27	Aug2023	15,666.64	9,010,227.10
Sep2020	12,454.42	8,681,169.95	Sep2023	17,126.84	14,016,511.44
Oct2020	12,961.90	7,805,387.14	Oct2023	15,896.28	13,916,734.13
Nov2020	13,696.31	7,008,183.53	Nov2023	16,926.22	19,219,496.25
Dec2020	13,786.91	4,840,012.05	Dec2023	17,360.61	21,338,603.36

Data analysis Equation(4.1)can be used for data analysis. Reproducing the equation is as below.

$R=\sum(X-X^I)(Y-Y^I)/\sqrt{\sum(X-X^I)^2\sum(Y-Y^I)^2}$---Equation (4.1)

Using the basic mathematical calculations, the following values are arrived.

$\sum(X-X^I)(Y-Y^I)=1142296402022.18$

$\sum(X-X^I)^2= 1327526735.70$

$\sum(Y-Y^I)^2=3423152136717550.00$

By applying the values in Equation(4.1), R= +0.54

Interpretation" R" lies in the range of +0.50<=R<0.75. As per the Karl Pearson's Coefficient of Correlation method & its interpretation, there exists moderate positive correlation between the values of SENSEX and the values of Gold. That is if the SENSEX is in upward movement then the price of Gold also will be in the upward direction. In other terms it can be said that Indian Commodity Market closely follows the movement of Indian Stock Market

SENSEX and Crude Oil

Table 4.2 refer to the value of SENSEX (index in number) and the value ofCrude Oil (Amount in Rs. Lakh) for the period from February 2019 to December 2023.

Table: 4.2 SENSEX and Crude Oil

Month	Sensex (X)	CrudeOil(Y)	Month	Sensex (X)	CrudeOil(Y)
Feb2019	6,713.86	57,630.65	Aug2021	15,318.60	4,071,387.43
Mar2019	6,492.82	132,362.24	Sep2021	17,291.10	3,176,323.04
Apr2019	6,154.44	275,824.58	Oct2021	19,837.99	4,684,780.59
May2019	6,715.11	403,515.63	Nov2021	19,363.19	5,154,108.34
Jun2019	7,193.85	1,025,834.10	Dec2021	20,286.99	5,153,276.59
Jul 2019	7,635.42	1,955,893.08	Jan2022	17,648.71	4,671,822.02
Aug2019	7,805.43	2,740,941.84	Feb2022	17,578.72	4,468,044.92
Sep2019	8,634.48	2,688,590.89	Mar2022	15,644.44	5,275,426.22
Oct2019	7,892.32	2,010,215.72	Apr2022	17,287.31	5,446,577.38
Nov2019	8,788.81	1,450,380.75	May2022	16,415.57	9,230,304.00
Dec2019	9,397.93	1,029,696.14	Jun2022	13,461.60	11,287,930.81
Jan2020	9,919.89	948,291.30	Jul2022	14,355.75	10,822,279.05
Feb2020	10,370.24	1,194,250.92	Aug2022	14,564.53	7,502,891.61
Mar2020	11,279.96	1,330,380.32	Sep2022	12,860.43	8,953,858.65
Apr2020	12,042.56	738,551.33	Oct2022	9,788.06	6,138,823.07
May2020	10,398.61	651,179.87	Nov2022	9,092.72	5,377,674.75
Jun2020	10,609.25	424,607.95	Dec2022	9,470.31	6,771,616.16
Jul 2020	10,743.88	614,862.02	Jan2023	9,424.24	7,938,402.13
Aug2020	11,699.05	836,074.24	Feb2023	8,891.61	6,849,426.38
Sep2020	12,454.42	1,275,558.91	Mar2023	9,708.50	10,782,770.57
Oct2020	12,961.90	1,679,149.03	Apr2023	11,403.25	9,238,346.15

Nov2020	13,696.31	1,699,163.27	May2023	14,625.25	9,712,546.90
Dec2020	13,786.91	1,640,493.16	Jun2023	14,493.84	11,477,869.10
Jan2021	14,090.92	2,529,211.67	Jul2023	15,670.31	12,887,544.02
Feb2021	12,938.09	2,730,830.15	Aug2023	15,666.64	11,608,057.38
Mar2021	13,072.10	3,325,369.62	Sep2023	17,126.84	9,671,127.28
Apr2021	13,872.37	2,538,789.71	Oct2023	15,896.28	10,851,078.38
May2021	14,544.46	2,444,850.23	Nov2023	16,926.22	10,802,349.01
Jun2021	14,650.51	2,791,854.09	Dec2023	17,360.61	8,091,152.08
Jul2021	15,550.99	3,512,484.88			

Data analys is Equation(4.1)can be used for data analysis. Reproducing the equation is asbelow.

$R=\sum(X-X^I)(Y-Y^I)/\sqrt{\sum(X-X^I)^2\sum(Y-Y^I)^2}$---Equation (4.1)

Using the basic mathematical calculations, the following values are arrived.

$\sum(X-X^I)(Y-Y^I)=365659472151.93$

$\sum(X-X^I)^2= 791248096.45$

$\sum(Y-Y^I)^2=832791532296900.00$

By applying the values in Equation(4.1), R= +0.45

Interpretation The value of "R" is between +0.25 and R<0.50. Karl Pearson's Coefficientof Correlation technique and interpretation show a low positive correlation between SENSEX and Crude Oil. If the SENSEX rises, Crude Oil will too, but not as much. In other words, Indian Commodity Market follows Indian Stock Market.

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SENSEX and Copper

Table4.3 refer to the value of SENSEX (index in number) and the value of Copper(Amount in Rs. Lakh) for the period from June 2018 to December 2023.

Table:4.3SENSEXandCopper

Month	Sensex (X)	Copper(Y)	Month	Sensex (X)	Copper(Y)
Jun2018	4,795.46	2,150.53	Jun2021	14650.51	4903241.7
Jul2018	5,170.32	30.49	Jul2021	15550.99	3906874.38
Aug2018	5,192.08	619.56	Aug2021	15318.6	4457745.89
Sep2018	5,583.61	245.51	Sep2021	17291.1	3075007.71
Oct2018	5,672.27	1,469.04	Oct2021	19837.99	3207586.78
Nov2018	6,340.29	504.10	Nov2021	19363.19	3175309.05
Dec2018	6,602.69	382.71	Dec2021	20286.99	2433187.29
Jan2019	6,555.94	1,719.90	Jan2022	17648.71	3576212.67
Feb2019	6,713.86	1,237.89	Feb2022	17578.72	4312334.88
Mar2019	6,492.82	5,103.32	Mar2022	15644.44	3387136.71

Apr2019	6,154.44	301.53	Apr2022	17287.31	3551766.88
May2019	6,715.11	7,540.22	May2022	16415.57	3098724.05
Jun2019	7,193.85	37,613.04	Jun2022	13461.6	2682307.89
Jul2019	7,635.42	30,283.46	Jul2022	14355.75	3236470.02
Aug2019	7,805.43	32,253.97	Aug2022	14564.53	2988559.79
Sep2019	8,634.48	24,070.30	Sep2022	12860.43	3291336.01
Oct2019	7,892.32	39,538.08	Oct2022	9788.06	4018916.43
Nov2019	8,788.81	72,325.26	Nov2022	9092.72	3495672.39
Dec2019	9,397.93	61,016.21	Dec2022	9470.31	2388655.89
Jan2020	9,919.89	70,036.80	Jan2023	9424.24	3479376.76
Feb2020	10,370.24	155,299.74	Feb2023	8891.61	3106711.55
Mar2020	11,279.96	263,915.16	Mar2023	9708.5	4247623.63
Apr2020	12,042.56	824,249.86	Apr2023	11403.25	6053344.65
May2020	10,398.61	1,908,015.18	May2023	14625.25	6042841.5
Jun2020	10,609.25	2,206,019.43	Jun2023	14493.84	7611567.1
Jul2020	10,743.88	1,816,113.62	Jul2023	15670.31	7502573.59
Aug2020	11,699.05	2,069,399.47	Aug2023	15666.64	9371733.53
Sep2020	12,454.42	1,741,533.62	Sep2023	17126.84	7741091.42
Oct2020	12,961.90	1,860,260.80	Oct2023	15896.28	6855829.36
Nov2020	13,696.31	2,759,647.39	Nov2023	16926.22	6687494.02
Dec2020	13786.91	1941184.81	Dec2023	17360.61	5160840.01
Jan2021	14090.92	3109797.36			
Feb2021	12938.09	3145448.63			
Mar2021	13072.1	3682018.39			
Apr2021	13872.37	5188834.3			
May2021	14544.46	5253177.05			

D**ataanalysis**Equation(4.1)canbeusedfordataanalysis.Reproducingtheequation is asbelow.

$R=\sum(X-X^I)(Y-Y^I)/\sqrt{\sum(X-X^I)^2\sum(Y-Y^I)^2}$---Equation (4.1)

Using the basic mathematical calculations, the following values are arrived.

$\sum(X-X^I)(Y-Y^I)=463402504969.27$

$\sum(X-X^I)^2= 1136357737.40$

$\sum(Y-Y^I)^2=377698121642356.00$

By applying the values in Equation(4.1), R= +0.71

Interpretation The value of "R" is between +0.50 and R<0.75. Karl Pearson's Coefficientof association technique and interpretation show a moderate positive association betweenSENSEX and Copper. Copper prices rise when the SENSEX does. The Indian Commodity Market closely tracks the Indian Stock Market.

SENSEX and Aluminium

Table 4.4 refer to the value of SENSEX (index in number) and the value ofAluminum (Amount in Rs. Lakh) for the period from October 2019 to December 2023.

Table: 4.4 SENSEX and Aluminium

Month	Sensex (X)	Aluminium(Y)	Month	Sensex (X)	Aluminium(Y)
Oct2019	7,892.32	25.22	Oct2022	9,788.06	26,694.18
Nov2019	8,788.81	1,221.61	Nov2022	9,092.72	26,175.95
Dec2019	9,397.93	1,825.05	Dec2022	9,470.31	45,653.99
Jan2020	9,919.89	7,736.27	Jan2023	9,424.24	45,683.57
Feb2020	10,370.24	3,608.81	Feb2023	8,891.61	30,122.10
Mar2020	11,279.96	17,382.46	Mar2023	9,708.50	43,722.29
Apr2020	12,042.56	64,487.58	Apr2023	11,403.25	70,063.13
May2020	10,398.61	102,201.44	May2023	14,625.25	71,753.50
Jun2020	10,609.25	36,994.79	Jun2023	14,493.84	263,663.03
Jul 2020	10,743.88	35,066.32	Jul 2023	15,670.31	276,706.76
Aug2020	11,699.05	36,969.76	Aug2023	15,666.64	592,556.47
Sep2020	12,454.42	61,578.81	Sep2023	17,126.84	322,638.75
Oct2020	12,961.90	32,788.34	Oct2023	15,896.28	295,053.10
Nov2020	13,696.31	47,171.98	Nov2023	16,926.22	207,078.77
Dec2020	13,786.91	40,687.60	Dec2023	17,360.61	387,736.97
Jan2021	14,090.92	61,318.55			
Feb2021	12,938.09	76,538.01			
Mar2021	13,072.10	182,755.65			
Apr2021	13,872.37	66,965.75			
May2021	14,544.46	76,146.15			
Jun2021	14,650.51	54,846.55			
Jul 2021	15,550.99	33,742.68			
Aug2021	15,318.60	29,986.37			
Sep2021	17,291.10	43,924.32			
Oct2021	19,837.99	41,902.22			
Nov2021	19,363.19	28,000.56			
Dec2021	20,286.99	10,941.88			
Jan2022	17,648.71	46,541.11			
Feb2022	17,578.72	70,600.65			
Mar2022	15,644.44	84,508.59			
Apr2022	17,287.31	25,307.67			
May2022	16,415.57	42,332.85			
Jun2022	13,461.60	34,271.17			
Jul2022	14,355.75	105,884.06			
Aug2022	14,564.53	41,504.25			
Sep2022	12,860.43	38,458.58			

Data analysis Equation (4.1) can be used for data analysis. Reproducing the equationis as below.

$R=\sum(X-X^I)(Y-Y^I)/\sqrt{\sum(X-X^I)^2\sum(Y-Y^I)^2}$---Equation (4.1)

Using the basic mathematical calculations, the following values are arrived.

$\sum(X-X^I)(Y-Y^I)=5988340313.83$

$\sum(X-X^I)^2= 502904909.58$

$\sum(Y-Y^I)^2=644823821628.16$

By applying the values in Equation(4.1), R= +0.33

Interpretation The value of "R" is between +0.25 and R<0.50. Karl Pearson's Coefficientof association technique and interpretation show a low positive association between SENSEX and Aluminium. If the SENSEX rises, so will aluminum prices, but not as much. Indian Commodity Market follows Indian Stock Market.

NIFTYandGold

Table4.5 refer to the value of NIFTY (indexing number)and the value of Gold (Amountin Rs. Lakh) for the period from January 2018 to December 2023.

Table: 4.5 NIFTY and Gold

Month	Nifty(X)	Gold(Y)	Month	Nifty(X)	Gold(Y)
Jan2018	1,809.75	43,087.69	Jan2021	4,082.70	5,645,149.58
Feb2018	1,800.30	55,979.21	Feb2021	3,745.30	6,308,839.10
Mar2018	1,771.90	91,095.09	Mar2021	3,821.55	7,022,558.62
Apr2018	1,796.10	96,130.46	Apr2021	4,087.90	4,408,963.36
May2018	1,483.60	115,895.78	May2021	4,295.80	5,381,761.44
Jun2018	1,505.60	166,025.19	Jun2021	4,318.30	4,719,385.77
Jul2018	1,632.30	316,462.21	Jul2021	4,528.85	4,829,088.89
Aug2018	1,631.75	368,535.23	Aug2021	4,464.00	4,229,747.79
Sep2018	1,745.50	547,177.89	Sep2021	5,021.35	5,810,271.62
Oct2018	1,786.90	607,849.12	Oct2021	5,900.65	8,285,033.18
Nov2018	1,958.80	880,116.80	Nov2021	5,762.75	10,386,144.10
Dec2018	2,080.50	724,531.15	Dec2021	6,138.60	7,759,148.93
Jan2019	2,057.60	549,586.34	Jan2022	5,137.45	16,669,925.31
Feb2019	2,103.25	554,577.04	Feb2022	5,223.50	14,260,015.15
Mar2019	2,035.65	692,900.02	Mar2022	4,734.50	13,868,565.59
Apr2019	1,902.50	513,792.54	Apr2022	5,165.90	10,250,063.16
May2019	2,087.55	696,960.07	May2022	4,870.10	10,579,252.85
Jun2019	2,220.60	848,613.35	Jun2022	4,040.55	13,113,103.07
Jul2019	2,312.30	994,230.52	Jul2022	4,332.95	20,076,066.06
Aug2019	2,384.65	953,765.39	Aug2022	4,360.00	16,215,325.61
Sep2019	2,601.40	2,414,181.78	Sep2022	3,921.20	21,524,528.53
Oct2019	2,370.95	2,199,385.07	Oct 2022	2,885.60	16,871,983.04

Nov2019	2,652.25	2,608,423.58	Nov2022	2,755.10	13,718,417.16
Dec2019	2,836.55	4,894,473.86	Dec2022	2,959.15	16,907,140.81
Jan2020	3,001.10	6,556,802.61	Jan2023	2,874.80	21,051,503.32
Feb2020	3,074.70	5,758,718.57	Feb2023	2,763.65	23,338,041.32
Mar2020	3,402.55	7,748,336.67	Mar2023	3,020.95	27,457,088.19
Apr2020	3,557.60	7,475,297.91	Apr2023	3,473.95	15,955,495.10
May2020	3,071.05	10,150,417.59	May2023	4,448.95	14,787,281.64
Jun2020	3,128.20	7,717,549.93	Jun2023	4,291.10	13,883,118.96
Jul2020	3,143.20	10,028,712.99	Jul2023	4,636.45	11,108,629.67
Aug2020	3,413.90	8,074,195.27	Aug2023	4,662.10	9,010,227.10
Sep2020	3,588.40	8,681,169.95	Sep2023	5,083.95	14,016,511.44
Oct2020	3,744.10	7,805,387.14	Oct 2023	4,711.70	13,916,734.13
Nov2020	3,954.50	7,008,183.53	Nov2023	5,032.70	19,219,496.25
Dec2020	3,966.40	4,840,012.05	Dec2023	5,178.40	21,338,603.36

Data analysis Equation (4.1) can be used for data analysis. Reproducing the equationis as below.

$R=\sum(X-X^I)(Y-Y^I)/\sqrt{\sum(X-X^I)^2\sum(Y-Y^I)^2}$---Equation (4.1)

Using the basic mathematical calculations, the following values are arrived.

$\sum(X-X^I)(Y-Y^I)=337157679340.11$

$\sum(X-X^I)^2= 109993643.19$

$\sum(Y-Y^I)^2=3423152136717550.00$

By applying the values in Equation(4.1), R= +0.55

Interpretation The value of "R" is between +0.50 and R<0.75. The Karl Pearson's Coefficient of association method and interpretation show a moderate positive associationbetween NIFTY and Gold.Gold prices rise when the NIFTY does. The Indian Commodity Market closely tracks the Indian Stock Market.

NIFTY and Crude Oil

Table 4.6 refer to the value of NIFTY (index in number) and the value of CrudeOil (Amount in Rs. Lakh) for the period from February 2019 to December 2023.

Table: 4.6 NIFTY and Crude Oil

Month	Nifty (X)	CrudeOil(Y)	Month	Nifty (X)	CrudeOil(Y)
Feb2019	2,103.25	57,630.65	Aug2021	4,464.00	4071387.43
Mar2019	2,035.65	132,362.24	Sep2021	5,021.35	3176323.04
Apr2019	1,902.50	275,824.58	Oct2021	5,900.65	4684780.59
May2019	2,087.55	403,515.63	Nov2021	5,762.75	5154108.34
Jun2019	2,220.60	1,025,834.10	Dec2021	6,138.60	5153276.59
Jul 2019	2,312.30	1,955,893.08	Jan2022	5,137.45	4671822.02
Aug2019	2,384.65	2,740,941.84	Feb2022	5,223.50	4468044.92
Sep2019	2,601.40	2,688,590.89	Mar2022	4,734.50	5275426.22

Oct2019	2,370.95	2,010,215.72	Apr2022	5,165.90	5446577.38
Nov2019	2,652.25	1,450,380.75	May2022	4,870.10	9230304
Dec2019	2,836.55	1,029,696.14	Jun2022	4,040.55	11287930.81
Jan2020	3,001.10	948,291.30	Jul2022	4,332.95	10822279.05
Feb2020	3,074.70	1,194,250.92	Aug2022	4,360.00	7502891.61
Mar2020	3,402.55	1,330,380.32	Sep2022	3,921.20	8953858.65
Apr2020	3,557.60	738,551.33	Oct 2022	2,885.60	6138823.07
May2020	3,071.05	651,179.87	Nov2022	2,755.10	5377674.75
Jun2020	3,128.20	424,607.95	Dec2022	2,959.15	6771616.16
Jul2020	3,143.20	614,862.02	Jan2023	2,874.80	7938402.13
Aug2020	3,413.90	836,074.24	Feb2023	2,763.65	6849426.38
Sep2020	3,588.40	1,275,558.91	Mar2023	3,020.95	10782770.57
Oct 2020	3,744.10	1,679,149.03	Apr2023	3,473.95	9238346.15
Nov2020	3,954.50	1,699,163.27	May2023	4,448.95	9712546.9
Dec2020	3,966.40	1,640,493.16	Jun2023	4,291.10	11477869.1
Jan2021	4,082.70	2,529,211.67	Jul2023	4,636.45	12887544.02
Feb2021	3,745.30	2,730,830.15	Aug2023	4,662.10	11608057.38
Mar2021	3,821.55	3,325,369.62	Sep2023	5,083.95	9671127.28
Apr2021	4,087.90	2,538,789.71	Oct2023	4,711.70	10851078.38
May2021	4,295.80	2,444,850.23	Nov2023	5,032.70	10802349.01
Jun2021	4,318.30	2,791,854.09	Dec2023	5,178.40	8091152.08
Jul 2021	4,528.85	3,512,484.88			

Data analysis Equation (4.1) can be used for data analysis. Reproducing the equationis as below.

$R=\sum(X-X^I)(Y-Y^I)/\sqrt{\sum(X-X^I)^2\sum(Y-Y^I)^2}$---Equation (4.1)

Using the basic mathematical calculations, the following values are arrived.

$\sum(X-X^I)(Y-Y^I)=112432369238.30$

$\sum(X-X^I)^2= 66520462.02$

$\sum(Y-Y^I)^2=832791532296900.00$

By applying the values in Equation(4.1), R= +0.48

Interpretation The value of "R" is between +0.25 and R<0.50. Karl Pearson's Coefficientof Correlation technique and interpretation show a low positive correlation between NIFTY and Crude Oil. If the NIFTY rises, Crude Oil will too, but not as much. In other words, Indian Commodity Market follows Indian Stock Market.

NIFTY and Copper

Table4.7refertothevalueofNIFTY(index in number)and the value of Copper(Amount in Rs. Lakh) for the period from June 2018 to December 2023.

Table: 4.7 NIFTY and Copper

Month	Nifty (X)	Copper(Y)	Month	Nifty (X)	Copper(Y)
Jun2018	1,505.60	2,150.53	Jun2021	4,318.30	4903241.7
Jul 2018	1,632.30	30.49	Jul 2021	4,528.85	3906874.38
Aug2018	1,631.75	619.56	Aug2021	4,464.00	4457745.89
Sep2018	1,745.50	245.51	Sep2021	5,021.35	3075007.71
Oct2018	1,786.90	1,469.04	Oct2021	5,900.65	3207586.78
Nov2018	1,958.80	504.1	Nov2021	5,762.75	3175309.05
Dec2018	2,080.50	382.71	Dec2021	6,138.60	2433187.29
Jan2019	2,057.60	1,719.90	Jan2022	5,137.45	3576212.67
Feb2019	2,103.25	1,237.89	Feb2022	5,223.50	4312334.88
Mar2019	2,035.65	5,103.32	Mar2022	4,734.50	3387136.71
Apr2019	1,902.50	301.53	Apr2022	5,165.90	3551766.88
May2019	2,087.55	7,540.22	May2022	4,870.10	3098724.05
Jun2019	2,220.60	37,613.04	Jun2022	4,040.55	2682307.89
Jul 2019	2,312.30	30,283.46	Jul 2022	4,332.95	3236470.02
Aug2019	2,384.65	32,253.97	Aug2022	4,360.00	2988559.79
Sep2019	2,601.40	24,070.30	Sep2022	3,921.20	3291336.01
Oct2019	2,370.95	39,538.08	Oct2022	2,885.60	4018916.43
Nov2019	2,652.25	72,325.26	Nov2022	2,755.10	3495672.39
Dec2019	2,836.55	61,016.21	Dec2022	2,959.15	2388655.89
Jan2020	3,001.10	70,036.80	Jan2023	2,874.80	3479376.76
Feb2020	3,074.70	155,299.74	Feb2023	2,763.65	3106711.55
Mar2020	3,402.55	263,915.16	Mar2023	3,020.95	4247623.63
Apr2020	3,557.60	824,249.86	Apr2023	3,473.95	6053344.65
May2020	3,071.05	1,908,015.18	May2023	4,448.95	6042841.5
Jun2020	3,128.20	2,206,019.43	Jun2023	4,291.10	7611567.1
Jul 2020	3,143.20	1,816,113.62	Jul 2023	4,636.45	7502573.59
Aug2020	3,413.90	2,069,399.47	Aug2023	4,662.10	9371733.53
Sep2020	3,588.40	1,741,533.62	Sep2023	5,083.95	7741091.42
Oct2020	3,744.10	1,860,260.80	Oct2023	4,711.70	6855829.36
Nov2020	3,954.50	2,759,647.39	Nov2023	5,032.70	6687494.02
Dec2020	3,966.40	1941184.81	Dec2023	5,178.40	5160840.01
Jan2021	4,082.70	3109797.36			
Feb2021	3,745.30	3145448.63			
Mar2021	3,821.55	3682018.39			
Apr2021	4,087.90	5188834.3			
May2021	4,295.80	5253177.05			

Data analysis Equation (4.1) can be used for data analysis. Reproducing the equationis as below.

$R=\sum(X-X^I)(Y-Y^I)/\sqrt{\sum(X-X^I)^2\sum(Y-Y^I)^2}$---Equation (4.1)

Using the basic mathematical calculations, the following values are arrived.

$\sum(X-X^{I})(Y-Y^{I})=134151072109.54$

$\sum(X-X^{I})^{2}= 94584794.92$

$\sum(Y-Y^{I})^{2}=377698121642356.00$

By applying the values in Equation(4.1), R= +0.71

Interpretation The value of "R" is between +0.50 and R<0.75. Karl Pearson's Coefficient of link technique and interpretation show a moderate positive link between NIFTY and Copper. Copper prices rise when the NIFTY does. The Indian Commodity Market closelytracks the Indian Stock Market.

NIFTYand Aluminium

Table 4.8 refer to the value of NIFTY (index in number) and the value ofAluminium (Amount in Rs. Lakh) for the period from October 2019 to December 2023.

Table: 4.8 NIFTY and Aluminium

Month	Nifty(X)	Aluminum(Y)	Month	Nifty(X)	Aluminum(Y)
Oct2019	2,370.95	25.22	Oct2022	2,885.60	26,694.18
Nov2019	2,652.25	1,221.61	Nov2022	2,755.10	26,175.95
Dec2019	2,836.55	1,825.05	Dec2022	2,959.15	45,653.99
Jan2020	3,001.10	7,736.27	Jan2023	2,874.80	45,683.57
Feb2020	3,074.70	3,608.81	Feb2023	2,763.65	30,122.10
Mar2020	3,402.55	17,382.46	Mar2023	3,020.95	43,722.29
Apr2020	3,557.60	64,487.58	Apr2023	3,473.95	70,063.13
May2020	3,071.05	102,201.44	May2023	4,448.95	71,753.50
Jun2020	3,128.20	36,994.79	Jun2023	4,291.10	263,663.03
Jul2020	3,143.20	35,066.32	Jul 2023	4,636.45	276,706.76
Aug2020	3,413.90	36,969.76	Aug2023	4,662.10	592,556.47
Sep2020	3,588.40	61,578.81	Sep2023	5,083.95	322,638.75
Oct2020	3,744.10	32,788.34	Oct2023	4,711.70	295,053.10
Nov2020	3,954.50	47,171.98	Nov2023	5,032.70	207,078.77
Dec2020	3,966.40	40,687.60	Dec2023	5,178.40	387,736.97
Jan2021	4,082.70	61,318.55			
Feb2021	3,745.30	76,538.01			
Mar2021	3,821.55	182,755.65			
Apr2021	4,087.90	66,965.75			
May2021	4,295.80	76,146.15			
Jun2021	4,318.30	54,846.55			
Jul2021	4,528.85	33,742.68			
Aug2021	4,464.00	29,986.37			
Sep2021	5,021.35	43,924.32			
Oct2021	5,900.65	41,902.22			
Nov2021	5,762.75	28,000.56			

Dec2021	6,138.60	10,941.88			
Jan2022	5,137.45	46,541.11			
Feb2022	5,223.50	70,600.65			
Mar2022	4,734.50	84,508.59			
Apr2022	5,165.90	25,307.67			
May2022	4,870.10	42,332.85			
Jun2022	4,040.55	34,271.17			
Jul2022	4,332.95	105,884.06			
Aug2022	4,360.00	41,504.25			
Sep2022	3,921.20	38,458.58			

Data analysis Equation (4.1)can be used for data analysis .Reproducing the equation isasbelow.

$R=\sum(X-X^I)(Y-Y^I)/\sqrt{\sum(X-X^I)^2\sum(Y-Y^I)^2}$---Equation (4.1)

Using the basic mathematical calculations, the following values are arrived.

$\sum(X-X^I)(Y-Y^I)=1762872696.82$

$\sum(X-X^I)^2= 43114369.22$

$\sum(Y-Y^I)^2=644823821628.16$

Byapplyingthe valuesin Equation(4.1), R= +0.33

Interpretation The value of "R" is between +0.25 and R<0.50. Karl Pearson's Coefficientof association technique and interpretation show a low positive association between NIFTY and Aluminum. That is, if the NIFTY is rising, so will aluminum prices, but not as much. The Indian Commodity Market closely tracks the Indian Stock Market.

An Overview– Data Analysis and Interpretation

In the previous sections, data analysis and interpretation had been carried out using the Karl Pearson's Coefficient of Correlation method for the eight pair of datadrawn from the samples of Indian Commodity Market and Indian Stock Market. Table
4.9 as shown below depicts an overview of the findings of the above.

Table: 4.9 An overview– Data Analysis and Interpretation

SamplesfromStock market	**Samplesfrom Commodity market**	**"R" value**	**Interpretation**
Sensex	Gold	+0.54	Moderatepositivecorrelation
Sensex	Crude oil	+0.45	Lowpositivecorrelation
Sensex	Copper	+0.71	Moderatepositivecorrelation
Sensex	Aluminium	+0.33	Lowpositivecorrelation
Nifty	Gold	+0.55	Moderatepositivecorrelation
Nifty	Crude oil	+0.48	Moderatepositivecorrelation

Nifty	Copper	+0.71	Lowpositivecorrelation
Nifty	Aluminium	+0.33	Lowpositivecorrelation

The range of "R" for the SENSEX and Gold is +0.50 to R<0.75. Karl Pearson's Coefficient of association and interpretation show a moderately positive association between SENSEX and Gold. Thus, higher SENSEX means rising gold prices. It may besaid that the Indian Commodity Market follows the Indian Stock Market.

For the SENSEX and Crude Oil, "R" is between +0.25 and R<0.50. Karl Pearson's coefficient of correlation and interpretation show a weak positive correlation between Crude Oil and SENSEX. Thus, if the SENSEX rises, crude oil prices will rise, howeverslightly. Essentially, the Indian Commodity Market tracks the Indian Stock Market.

The range of "R" for the SENSEX and Copper is +0.50 to R<0.75. Per Karl Pearson'scoefficient of correlation interpretation,

Copper levels are moderately positively correlated with SENSEX. Thus, copper prices will climb with the SENSEX. It may be said that the Indian Commodity Market followsthe Indian Stock Market.
The range of "R" for SENSEX and aluminum is +0.25 to R<0.50. Karl Pearson's

coefficient of correlation approach and interpretation show a weak positive association between aluminum and SENSEX. Thus, if the SENSEX rises, aluminum prices will rise,though not as much. The Indian Commodity Market follows the Indian Stock Market.

The range of "R" for NIFTY and Gold is +0.50 to R<0.75. Karl Pearson's Coefficient ofassociation and interpretation show a moderately positive association between NIFTY and Gold. Thus, higher NIFTY means rising gold prices. It may be said that the Indian Commodity Market follows the Indian Stock Market.
The range of "R" for NIFTY and crude oil is +0.25 to R<0.50. Karl Pearson's Coefficientof link technique and interpretation show a weak positive relationship between NIFTY and crude oil. If the NIFTY rises, crude oil prices will too, but not as much. Essentially, the Indian Commodity Market tracks the Indian Stock Market.

The range of "R" for NIFTY and Copper is +0.50 to R<0.75.Karl Pearson's Coefficient of association and interpretation show a fairly favorable association between NIFTY and Copper. Thus, rising NIFTY means increased copper prices. It may be said that the IndianCommodity Market follows the Indian Stock Market.

For NIFTY and Aluminium, “R” is between +0.25 and R<0.50.According to Karl Pearson's Coefficient of association, NIFTY and Aluminium have a low positive association. If the NIFTY rises, aluminum prices will rise, but not as much. The IndianCommodity Market closely tracks the Indian Stock Market.

SUMMARY OF FINDINGS ,SUGGESTIONS AND CONCLUSION

Findings

The main conclusions of this project research are listed below.

- There is a correlation between the Bombay Stock Exchange's SENSEX index andthe listed commodities of gold, crude oil, copper, and aluminum on the Multi Commodity Exchange of India Limited.
- The National Stock Exchange of India Limited's NIFTY index and the listed commodities of gold, crude oil, copper, and aluminum on the Multi Commodity Exchange of India Limited are related.The relationships are moving in a constructive manner. Samples listed on the Multi Commodity Exchange of IndiaLimited, including gold, crude oil, copper, and aluminum, closely track the movements of the SENSEX and NIFTY.
- It suggests that the direction of the Indian Stock Market is closely followed bythe Indian Commodity Market.

•Both the Indian Stock Market and the Indian Commodity Market constantly movein the same direction. The Indian Commodity Market moves increasing in tandem with the growth of the Indian Stock Market. The Indian Commodity Market swingsdownward in tandem with the declining Indian Stock Market.

Suggestions

Based on the analysis and conclusions of this project study, some recommendations areprovided below.

- The project analysis can help regulators and market participants create effectivepolicies, rules, laws, and strategies.
- Stock and commodities markets can be chosen using personalized investment programs.
- Both markets have the same liquidity because the Indian Commodity Market closesafter the Stock Market. to make good decisions.
- This project analysis can inform Indian stock and commodity market policies.
- Although their returns differ, the Indian stock and commodity markets have the samedirection. Thus, this project study suggests initiating further research using its findings.

Conclusion

This research study followed MultiCommodity Exchange of India Limited's website advise.The Indian stock-commodity market connection was the project'smain focus. For this project study, samples were taken from Multi Commodity Exchange of India Limited's values of Gold, Copper, Aluminium, and Crude Oiland major Indian stock market indices like SENSEX and NIFTY for the relevantperiod. Karl Pearson's Coefficient of Correlation examined the Indian Stock Market-Commodity Market Relationship.

The project analysis found a strong correlation between the Indian stock marketand commodity market. This link is good since the Indian Commodity Market follows the Indian Stock Market. The conclusions and recommendations in the previous sections should benefit all stakeholders, including regulators.