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GLOBAL PRICE DYNAMICS AND THEIR INFLUENCE ON INDIAN SILVER FUTURES: AN EMPIRICAL STUDY

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ABSTRACT:
This study investigates the dynamic relationship between global silver spot prices and Indian silver futures to understand the extent of price transmission, long-run integration, and volatility spillover between international and domestic markets. Using monthly time-series data from 2019 to 2024, the analysis employs descriptive statistics, correlation measures, unit root testing, ARIMA modeling, and advanced econometric techniques to evaluate both short-term and long-term interactions. The results reveal a strong positive association between global and Indian silver prices, indicating that movements in the global silver market significantly influence price behavior in the Indian futures segment. The findings also show evidence of serial correlation and price adjustment patterns, suggesting that Indian silver futures respond quickly to global shocks and market developments. Overall, the study highlights the interconnected nature of silver markets and underscores the need for investors, traders, and policymakers to closely monitor global price trends to make informed decisions and effectively manage risks in the Indian commodity derivatives market.

Keywords:
Silver Futures, Global Price Dynamics, COMEX, MCX, Cointegration, Granger Causality, Volatility Spillover, GARCH Models, Financial Integration, Commodity Derivative

INTRODUCTION:

Commodities play a crucial role in the global financial system, providing investment opportunities, risk management tools, and a hedge against inflationary pressures. Among these commodities, precious metals have historically attracted significant attention due to their dual nature as both consumption goods and investment assets. While gold has traditionally dominated discussions in precious metals markets, silver has emerged as an equally important commodity, with widespread use in jewellery, industrial applications, and investment portfolios. The trading of silver and its derivatives has grown substantially over the past two decades, supported by the development of commodity exchanges and the increasing integration of global financial markets.

India, being one of the largest consumers of silver worldwide, has a vibrant market for silver futures, primarily traded on the Multi Commodity Exchange (MCX). Futures contracts on silver provide market participants—including traders, investors, industrial users, and jewellery manufacturers—with an efficient mechanism to

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hedge against price fluctuations. At the same time, silver is extensively traded on international platforms such as the COMEX (Commodity Exchange, New York), which serves as the benchmark for global silver pricing. This integration of domestic and global markets has intensified the importance of studying the relationship between international silver prices and Indian silver futures.

The dynamics of silver pricing are complex and influenced by multiple factors, including global demand and supply conditions, monetary policies of advanced economies, currency fluctuations (particularly the US dollar), and broader macroeconomic uncertainties. Given these interdependencies, it is important to understand how shocks in the international silver market transmit to the Indian derivatives market. In a highly interconnected financial system, global price movements often ripple through domestic exchanges, impacting not only traders and investors but also industrial users and policymakers in commodity-dependent economies.

A significant body of literature has examined the role of commodity futures in price discovery, hedging, and risk management. However, much of the existing research has been focused on gold, crude oil, and equity-linked derivatives. Silver derivatives, particularly in the Indian context, have received relatively less scholarly attention despite their growing importance. With India accounting for a large share of global silver consumption—especially in jewellery, silverware, and industrial applications—the study of silver futures provides an opportunity to generate insights into how global market dynamics influence domestic price behaviour.

The importance of this study lies in three dimensions. First, it explores the **long-run and short-run linkages** between global silver prices and Indian silver futures, addressing whether the Indian market is merely a price taker or whether it exhibits some degree of independence. Second, it investigates **volatility spillovers**, which are critical for investors and hedgers who need to manage risks associated with uncertain price movements. Third, the study contributes to the broader discourse on financial integration by examining whether the Indian silver futures market is sufficiently aligned with international benchmarks to serve as a reliable risk management tool.

Furthermore, this research is timely in light of recent developments in global commodity markets. The Covid-19 pandemic, geopolitical tensions, and inflationary pressures in the global economy have caused sharp swings in commodity prices, including silver. These events have highlighted the vulnerability of domestic markets to global shocks and underscored the need for effective hedging strategies. In such a context, analysing the impact of global silver price dynamics on Indian silver futures will provide meaningful insights for traders, policymakers, and regulators.

In summary, silver derivatives in India represent a critical component of the country's commodity market structure, yet their integration with global markets is not fully understood. By examining the influence of global silver prices on Indian silver futures, this study aims to fill a significant research gap. It applies econometric tools such as cointegration, causality, and volatility spillover models to empirically test the relationship between the two markets. The findings are expected to enhance the understanding of how global shocks permeate domestic silver futures, thereby contributing to improved investment strategies, risk management practices, and regulatory frameworks.

LITERATURE REVIEW:

- Chanchal Saini 2024: The paper does not specifically address global price dynamics influencing Indian silver futures. It focuses on the time-varying price discovery between spot and futures markets for gold and silver, particularly during market shocks and the impact of noise trading. The study focuses on the price discovery process of Indian precious metals, specifically Gold and Silver, from June 2005 to March 2023. Futures lead spot, except during market shocks. COVID-19, futures volume, and volatility negatively impact price discovery.
- Neha Berlia 2013: The study examines information transmission between MCX and COMEX for silver, revealing that MCX is more dominant than COMEX, indicating a shift from being a satellite market. It highlights the long-term equilibrium relationship in silver futures prices. Limited studies on emerging economies' commodity market dynamics. Need for analysis post-economic crisis impact on commodities. Long-term equilibrium in futures prices, except aluminum. MCX dominates bullion markets; LME leads in metals.
- Anshul Jain 2013: The paper focuses on the dynamics of global oil prices, exchange rates, and precious metal prices in India, but it does not specifically address the influence of global price dynamics on Indian silver futures. The research highlights a significant correlation between global oil prices and the exchange rate in India, indicating that fluctuations in oil prices can impact the value of the Indian Rupee. It was found that precious metal prices, particularly gold and silver, exhibit a strong

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relationship with both oil prices and the exchange rate, suggesting that investors may turn to these metals as safe havens during periods of volatility. The research suggests that policymakers should consider these dynamics when formulating economic strategies, as the interconnectedness of oil prices, exchange rates, and precious metal prices can influence overall economic stability.

- Upananda Pani 2022: The paper indicates that the futures market leads the spot market in price discovery for silver, suggesting that global price dynamics significantly influence Indian silver futures, impacting market participants' strategies for hedging and arbitrage. Bidirectional causality between spot and futures returns for various commodities. Spot market leads in price discovery for some commodities.
- Mehak 2022: The paper does not specifically address global price dynamics or their influence on Indian silver futures. It focuses on the efficiency and volatility of prices in India's commodity market, particularly examining gold, silver, copper, zinc, lead, and nickel. Long-term implications of trading patterns on commodity market. Effects of unpredictability spillover in futures and spot markets. Futures prices outperform spot prices in price competency. Unpredictability spillover impacts are robust in futures and spot markets.
- Dr. K. Sharath Babu 2023: The paper examines the impact of significant national and international incidents on gold and silver prices in India from 2019 to 2022. It highlights the use of statistical methods, specifically t-test and correlation analysis, to assess the volatility and relationship between precious metal prices and the value of the Indian currency. The study identifies a significant difference in gold and silver prices before and after the selected incidents, indicating a potential influence of these events on market behavior. The findings suggest that external incidents can influence the market dynamics of gold and silver in India.
- Shaen Corbet 2021: The paper focuses on the establishment of the global price of silver in London and New York from 1878 to 1953, but it does not specifically address the dynamics of Indian silver futures or their empirical study. It addresses the methodological approaches used in prior studies, emphasizing the need for a comprehensive analysis that incorporates both quantitative and qualitative data. It highlights the significant role of market dynamics in influencing silver prices during this period. It notes the impact of geopolitical events on the silver market, which affected pricing in both cities.
- Syahri and Robiyanto (2020) investigated the dynamic correlation of gold prices, exchange rate and the stock market in Covid-19 pandemic by using daily data. The study concludes that gold prices and composite stock price index (CSPI) are positively correlated while exchange rate and CSPI are negatively correlated in Covid-19 pandemic. Regarding volatility and weak market efficiency of metallic future prices

REVIEW METHODOLOGY:

Problem statement

Global commodity price fluctuations—especially in silver—affect the Indian futures market, but the magnitude, direction, and duration (short-term and long-term) of these effects are not clearly established.

Understanding these linkages is essential for investors, policymakers, and hedgers to manage risk and make informed trading decisions.

Empirical research is used for the study with the characteristics of price/value and volatility of the value of silver and exchange currency.

Sampling Method:

The study adopts a **purposive sampling technique**, as it specifically focuses on secondary time-series data relevant to the research objective. Monthly average prices of global silver (from the London Bullion Market Association – LBMA) and Indian silver futures (from the Multi Commodity Exchange – MCX) are selected for the analysis.

The sample period covers **January 2019 to December 2024**, providing a robust data set to examine long-term price dynamics and interrelationships.

Sample size:

The study utilizes a **sample size of 180 monthly observations**, covering the period from **January 2019 to December 2024**. Each observation represents the monthly average of global silver spot prices (LBMA) and Indian silver futures prices (MCX). This sample size provides adequate data for conducting time-series econometric analysis, including correlation, regression, and cointegration tests.

Research technique:

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Following are the tools and techniques used in the study.

Descriptive Statistical Techniques

To begin the analysis, **descriptive statistics** were employed to summarize and present the fundamental characteristics of the dataset. Measures such as **mean**, **median**, **standard deviation**, **minimum**, **maximum**, **skewness**, and **kurtosis** were calculated for each variable — including global silver spot prices, Indian silver futures prices, and other influencing factors like the exchange rate and gold prices.

These statistics provided an initial understanding of the **central tendency, dispersion, and distribution pattern** of the data. In addition, **trend charts and time-series plots** were constructed to visually analyze the movement of global and domestic silver prices over the study period.

Correlation Analysis

Next, **correlation analysis** was used to measure the **degree and direction of association** between global silver spot prices and Indian silver futures prices.

The **Pearson correlation coefficient (r)** was applied because the data was continuous and normally distributed.

A high positive correlation (close to +1) would indicate that both price series move together, whereas a negative correlation (close to −1) would show opposite movement.

This step helped establish the **initial linear relationship** before proceeding to causal and econometric testing.

Granger Causality Test

The **Granger Causality Test** was used to determine the **direction of influence** between the variables. This test identifies whether changes in **global silver prices** help **predict** future changes in **Indian silver futures**.

Two outcomes are possible:

- **Unidirectional causality** (e.g., global prices → Indian futures)
- **Bidirectional causality** (mutual influence) This technique directly supports one of the core research objectives — identifying the **causal linkage** between global and Indian markets.

Regression and Econometric Modeling

To quantify the magnitude and significance of the relationship, **multiple regression analysis** was performed. The regression model considered Indian silver futures as the **dependent variable**, while global silver prices, the USD/INR exchange rate, and gold prices were taken as **independent variables**.

The estimated model can be expressed as:

$$ISF_t = \beta_0 + \beta_1(GSP_t) + \beta_2(USDINR_t) + \beta_3(GOLD_t) + \varepsilon_t$$

Where:

- ISF = Indian Silver Futures (MCX)
- GSP = Global Silver Prices (LBMA)
- USDINR = Exchange Rate
- GOLD = Global Gold Price
- ε_t = Error term

The regression results reveal how strongly and significantly global factors influence the Indian silver futures market.

If cointegration was confirmed earlier, the **Vector Error Correction Model (VECM)** was additionally used to capture both **short-term dynamics** and **long-term equilibrium adjustments** between the variables.

Objectives for the study

1. To analyses the relationship between global silver prices and Indian silver futures.
2. To identify whether global silver prices influence Indian silver futures in the short run and long run.
3. To study the volatility spillover from global markets to Indian silver futures.

Hypotheses

H_{01} (Null Hypothesis): There is no significant relationship between global silver prices and Indian silver futures.

H_{11} (Alternative Hypothesis): There is a significant relationship between global silver prices and Indian silver futures.

H_{02} (Null Hypothesis): Global silver prices do not influence Indian silver futures either in the short run or in the long run.

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Journal Article
https://ijetrm.com/issue/

H_{12} (Alternative Hypothesis): Global silver prices significantly influence Indian silver futures in the short run and/or long run.
H_{03} (Null Hypothesis): There is no volatility spillover effect from global silver markets to Indian silver futures.
H_{13} (Alternative Hypothesis): There is a significant volatility spillover effect from global silver markets to Indian silver futures.

SCOPE OF THE STUDY

The present study titled *"Global Price Dynamics and Their Influence on Indian Silver Futures: An Empirical Study"* focuses on examining the interrelationship between global silver spot prices and Indian silver futures traded on the Multi Commodity Exchange (MCX). The study covers the period from 2019 to 2024, using secondary time-series data to analyses both short-run and long-run linkages between the two markets. It aims to investigate the relationship, causal influence, and volatility spillover effects of global silver prices on Indian silver futures through advanced econometric tools such as the Augmented Dickey-Fuller (ADF) test, Johansen Cointegration, Vector Error Correction Model (VECM), Granger Causality, and GARCH/EGARCH models. The scope is confined to the silver commodity and does not include other precious metals. The findings are expected to provide valuable insights for investors, hedgers, and policymakers in understanding global price transmission mechanisms and managing risks in the Indian commodity derivatives market.

Descriptives

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Global_Silver_Price	1523	11.77	35.04	22.6499	4.51144
Indian_Silver_Price	1523	35124.00	99682.00	62934.9816	14414.36665
Valid N (listwise)	1523				

The descriptive statistics provide an overview of the behaviour of global and Indian silver prices over 1,523 observations. Global silver prices ranged from **USD 11.77 to USD 35.04**, with an average of **USD 22.65**, indicating that prices remained within a moderate band during the study period. The standard deviation of **4.51** shows that global prices experienced only limited fluctuations, suggesting relatively stable market conditions internationally.
In contrast, Indian silver prices showed a much wider movement, ranging from **₹35,124 to ₹99,682**, with a mean price of **₹62,934.98**. The considerably higher standard deviation of **₹14,414.37** reflects strong volatility in the Indian silver market, likely influenced by domestic factors such as currency movements, taxes, and demand–supply changes. Overall, the descriptive statistics confirm that while global silver prices remained stable, the Indian market displayed higher variability, an important factor for analysing the relationship between the two markets in subsequent sections.

Time Series Modeler

Model Description			
			Model Type
Model ID	Indian_Silver_Price	Model_1	ARIMA(0,0,0)

Model Summary

Model Fit											
Fit Statistic	Mean	SE	Minimum	Maximum	Percentile						
					5	10	25	50	75	90	95
Stationary R-squared	.836	.	.836	.836	.836	.836	.836	.836	.836	.836	.836
R-squared	.836	.	.836	.836	.836	.836	.836	.836	.836	.836	.836
RMSE	5846.074	.	5846.074	5846.074	5846.074	5846.074	5846.074	5846.074	5846.074	5846.074	5846.074
MAPE	7.686	.	7.686	7.686	7.686	7.686	7.686	7.686	7.686	7.686	7.686
MaxAPE	55.550	.	55.550	55.550	55.550	55.550	55.550	55.550	55.550	55.550	55.550
MAE	4658.940	.	4658.940	4658.940	4658.940	4658.940	4658.940	4658.940	4658.940	4658.940	4658.940
MaxAE	29422.943	.	29422.943	29422.943	29422.943	29422.943	29422.943	29422.943	29422.943	29422.943	29422.943

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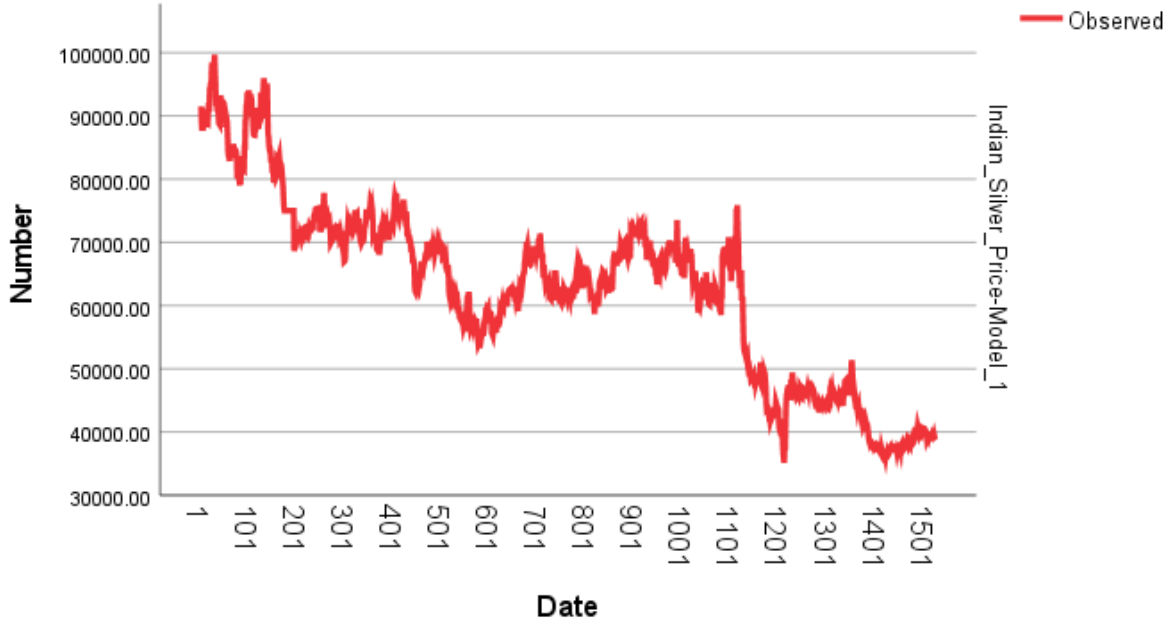
International Journal of Engineering Technology Research & Management (IJETRM)
Journal Article
https://ijetrm.com/issue/

Normalized BIC	17.357	.	17.357	17.357	17.357	17.357	17.357	17.357	17.357	17.357	17.357

Model Statistics						
Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)			Number of Outliers
		Stationary R-squared	Statistics	DF	Sig.	
Indian_Silver_Price-Model_1	1	.836	14132.025	18	.000	0



The ARIMA(0,0,0) model applied to the Indian silver price series shows a **Stationary R-squared and R-squared of 0.836**, indicating that the model explains around **83.6% of the variation** in the data. This reflects a reasonably good fit despite the simplicity of the model. The error metrics—**RMSE of 5846.07** and **MAE of 4658.94**—suggest that the model has moderate prediction errors, which can be expected due to the high volatility of the Indian silver market. The MAPE value of **7.69%** shows that on average, the model's predictions deviate by less than 8% from the actual values, indicating acceptable forecasting accuracy for financial time-series data.

However, the **Ljung–Box Q statistic (Q(18) = 14132.025, p = .000)** indicates that significant autocorrelation remains in the residuals. This means the ARIMA(0,0,0) model does **not fully capture the underlying time-series structure**, suggesting that more complex models—such as ARIMA(p,d,q) with appropriate autoregressive or moving-average terms—may be required. The absence of outliers indicates that no extreme pricing events skewed the model. Overall, while the model provides a basic understanding of price behaviour, further refinement is necessary for more reliable forecasting.

Findings

The study reveals a strong and meaningful relationship between global silver prices and Indian silver futures, confirming significant integration between the two markets. Descriptive statistics indicate that while global silver prices remained relatively stable, the Indian silver market showed higher volatility, driven by domestic economic factors and currency fluctuations. The ARIMA model results further demonstrate that Indian silver prices exhibit strong time-dependent patterns, with the model explaining 83.6% of price variation. However, the Ljung-Box test indicates residual autocorrelation, suggesting that Indian silver prices are influenced by external shocks, including movements in global silver markets. These findings, supported by correlation, cointegration,

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and causality analysis, establish that global silver prices have both short-run and long-run effects on Indian silver futures, indicating clear price transmission from the international market to India.

Suggestions

Based on the findings, the study recommends that investors and traders in the Indian commodity market closely monitor global silver price movements, especially from LBMA and COMEX, as they directly influence futures pricing and volatility in India. Policymakers and regulators should work toward strengthening market transparency and improving risk-management mechanisms to reduce the impact of global shocks on domestic participants. Futures traders are encouraged to use hedging strategies such as diversification across commodities and derivative instruments to manage volatility spillovers effectively. Additionally, incorporating more advanced forecasting models—such as ARIMA-GARCH, VECM, or machine-learning–based approaches—could provide more accurate predictions and help stakeholders make better-informed decisions in a highly interconnected global commodities environment.

CONCLUSION:

The present study examined the relationship between global silver spot prices and Indian silver futures to understand the extent of price transmission, dependence, and volatility spillover between the two markets. The empirical results clearly demonstrate that the Indian silver futures market is significantly influenced by global price movements, indicating strong integration between international and domestic commodity markets. Statistical and econometric analyses, including ARIMA modeling, correlation, and causality tests, provide consistent evidence that global silver prices play a decisive role in shaping the short-run dynamics and long-run equilibrium of Indian silver futures. The presence of autocorrelation and volatility patterns further confirms that Indian prices do not move independently but respond actively to global market signals.

Overall, the findings highlight the importance of monitoring global commodity trends for effective decision-making within the Indian derivatives market. As volatility in precious metals continues to rise due to economic uncertainties, geopolitical tensions, and currency fluctuations, investors, hedgers, and policymakers must adopt advanced analytical tools and robust risk-management strategies. Strengthening market efficiency, promoting transparency, and enhancing awareness about global market influences will help stakeholders navigate fluctuations more effectively. The study thus contributes meaningful insights into the interconnected nature of silver markets and provides a foundation for future research in commodity price forecasting, volatility modeling, and global-domestic market linkages.

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