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MACROECONOMIC DRIVERS OF COMMODITY (GOLD AND SILVER) PRICE VOLATILITY IN INDIA: AN EMPIRICAL INVESTIGATION

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ABSTRACT
The objective of present study is to analyse the impact of macro-economic drivers on commodity price (gold and silver) volatility. For this analysis the secondary data have been collected from world bank data indices and other relevant sources. The statistical tools like descriptive statistics, correlation and regression have been employed for analysis of collected data. The study finds that the chosen macro-economic variables have a statistically significant relationship with gold and silver prices. the results from the regression analysis show that the exchange rate is the most significant factor influencing the both gold and silver prices meanwhile inflation in influencing the gold prices and all other macro-economic factors are not statistically significant at 5 percent level. The study concludes that the exchange rate fluctuations play a major role in gold and silver prices and inflation rate also influencing the gold price changes in India
KEYWORDS: *Gold Price, Silver Price, Macroeconomic Variables, Commodity Market, Price volatility*

INTRODUCTION

In Indian economy Gold and silver is the important factor and is still the Indian, especially Indian women's holding nearly 11% of the world's total gold stock, it is showing gold is very popular asset to save and making investment in it. Gold is not only considered as a metal and also it represents the social standing and wealth. It is often used in religious rituals, marriages, and festivals and is regarded as a safe way to save for the future generations. According to the (World Gold Council, 2021) As India is one of the world's leading gold importers and consumers of the gold in both the domestic economic environment and global market. It makes the significant fluctuations and impact domestic gold prices (World Gold Council, 2021). Gold is considered a safe asset and an excellent investment hedge for times of urgent need. During periods of financial crisis or market volatility, investors typically shift their funds from high-risk assets into gold, which is viewed as having stable value. Gold prices frequently increase during periods of political and economic turmoil. Due to this characteristic, gold has become a key component of risk management and investment portfolio diversification strategies (Baur & Lucey, 2010). India's gold prices are very volatile, with regular and occasionally abrupt swings over time. Policymakers, jewellers, investors, and families are all impacted by this volatility. Changes in gold prices have an impact on consumers' saving and spending habits. Volatility offers investors both possibilities and hazards. Because India depends so heavily on imported gold, changes in gold prices have an influence on the country's import bill, current account deficit, and foreign exchange reserves from a macroeconomic standpoint (Reserve Bank of India, 2023). Gold price volatility is thought to be influenced by a number of macroeconomic factors. Given that gold is frequently employed as a hedge against price increases, inflation is one of the most significant factors. Investors frequently purchase gold to preserve their wealth's buying power as inflation rises (Ghosh et al., 2004). The gold is always top in the investors list than fixed income assets that gives low interest rates. Crude oil and stock markets are other options for investors and when stock market is fluctuates more the investors turn to investment in gold. When crude oil prices increase it can create the inflationary pressure and potentially increase the demand of gold. Furthermore, growth of gross domestic product (GDP) makes the impact of purchasing power and income levels of peoples; this may lead the investment and consumption of gold in India (Sailaija et., 2022). Likewise silver also occupies an important role among commodities: it is at once a valuable metallic, a store of value and an important engineering contribution. Its price is consequently fashioned by financial and economic forces as well as by real-sector mandate from electronics, solar sector and other manufacturing routines. This dual character makes silver more volatile than gold, and sharp price swings affect investors, jewellery and industrial users, and policymakers who monitor commodity markets (Hillier, Draper, & Faff, 2006; Batten, Ciner, & Lucey, 2010). The current study titled "Macroeconomic Drivers of Commodity (Gold and Silver) Price Volatility in India: An Empirical Investigation," examines how Gross Domestic Product (GDP), inflation, currency exchange rates, interest rates, and crude oil prices affect the volatility in gold and silver prices in India.

REVIEW OF LITERATURE

The several existing empirical studies has been conducted and analysed to check the association between macroeconomic factors and changes in gold and silver prices. These research studies having the result that the complex relationship of geopolitical factors, financial factors, and economic factors affects gold prices. Few studies that are different from mentioned in the introduction and especially relevant to the current study on gold and silver price volatility in India are highlighted in the following review of literatures. Robert Barsky and Lawrence H. Summers (1988) were in their study, the argued that the inflation is the only factor

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influencing gold prices and also showed that real interest rates and general macroeconomic prospects are important factors in determining the movement of gold prices. They opposed that the monetary policy, investors' expectations for future economic stability had a substantial impact on gold prices. According to Richard D. Jaffe's (1989) they studied when considering the role of gold and precious metals in investment portfolios, gold offers diversification benefits due to its relatively low correlation with conventional financial assets. The study concludes that financial instability and macroeconomic shocks make gold more attractive, while also increasing price volatility. Their findings suggest that volatility in interest rates, inflation, and currency rates can exacerbate changes in the price of gold. M. K. Suresh and R. V. Rajesh (2018) discovered that the most significant factors influencing domestic gold prices in India were inflation and depreciation of the currency rate. In a similar vein, R. K. Sharma and S. Mathur (2021) found statistically significant influences on gold returns in India from both stock market volatility and crude oil prices. Pindyck and Rotemberg (1990) demonstrated that the prices of unrelated commodities tend to move together more closely than can be explained by fundamental factors alone, pointing to common macroeconomic shocks. Furthermore, Sjaastad and Scaccia Villani (1996) found that exchange rate movements influence the dollar price of gold. Cappi, Mills, and Wood (2005) and Reboredo (2013) they stated that gold is inversely correlated with the US dollar, acts as a hedge and a safe haven during sharp declines in the dollar's value, and supports the currency-driven dynamics of precious metals. In studies concerning the relationship between gold and silver, Sener (2001) and Lucey & Tully (2006) found that the long-term connection between these two metals is unstable over time; Tully & Lucey (2007) identified that the US dollar has a significant impact on gold; and Sensoy (2013) documented that the interrelationships among precious metals vary over time. Furthermore, Bhatia, Das, Tiwari, Shahbaz, and Hashim (2018) demonstrated that the causal relationship between metal prices varies according to market conditions. All of this indicates that silver cannot be considered merely a simple substitute for, or a proxy of, gold. On hedge and safe-haven roles, Hillier, Draper, and Faff (2006) found diversification benefits in precious metals and noted that silver is more volatile than gold, Baur and Lucey (2010) and Baur and McDermott (2010) showed that gold acts as a hedge and, briefly, as a safe haven against equity declines, mainly in developed markets, Ciner, Gurdgiev, and Lucey (2013) found that these roles differ across countries and periods, and Beckmann and Czudaj (2013) found that gold's inflation hedging ability changes over time and across economies. Turning to volatility, Hammoudeh and Yuan (2008) reported that metal volatility responds to oil and interest rate shocks, Batten, Ciner, and Lucey (2010) found that monetary variables such as interest rates and inflation influence precious metal volatility, with silver's link to the business cycle differing from gold's, Sari, Hammoudeh, and Soytas (2010) found short- and long-run links among oil prices, precious metal prices and exchange rates, and Hammoudeh, Malik, and McAleer (2011) compared volatility behaviour and risk measures across the metals. Indian evidence is limited and focuses mainly on gold: Mishra, Das, and Mishra (2010) linked gold price volatility to stock market returns, and Sindhu (2013) examined factors such as exchange rates and inflation in gold prices. Most of this literature therefore concerns developed markets and gold, and few studies examine silver price volatility against several macroeconomic variables in India, which is the gap this study addresses.

OBJECTIVE AND METHODOLOGY

The objective of this research paper is to analyze the influence of macro-economic variables on the volatility of gold and silver prices in India. For this study, secondary data have been collected from World Bank data indices and other relevant published sources. The study covers a period of 25-years from 2000 to 2025. To fulfil the objective of the study, the following 'null hypothesis' is formulated: There is no significant relationship between macroeconomic factors and gold & silver prices in India. In this study, the price of gold and silver is treated as the dependent variable, while macroeconomic factors are considered independent variables. The independent variables include Gross Domestic Product (GDP), foreign exchange rates, real interest rates, inflation rates, and crude oil prices. Various statistical tools like descriptive statistics, correlation analysis, and multiple regression analysis were employed to analyze the relationships between gold and silver prices and macro-economic variables.

ANALYSIS AND INTERPRETATION

Table 1
Descriptive Statistics Analysis of gold, silver prices and macro-economic determinants

Variables	N	Mean	Std. Deviation	Variance	Skewness	Kurtosis
Gold Price	25	4.321	0.41656	.174	-.256	-.829
Silver Price	25	1.492	0.389	.151	.009	-.101
GDP	25	0.782	0.206	.043	-2.430	7.534
Exchange Rate	25	1.760	0.107	.011	.329	-1.374
Real Interest Rate	25	0.609	0.323	.104	-2.010	4.774
Inflation Rate	25	0.737	0.182	.033	.080	-.210
Crude Oil Price	25	-0.136	0.277	.077	-1.084	.244

Source: Computed data

The above table 1 shows the descriptive statistics analysis of gold, silver and macro-economic variables. Gold prices showing the highest mean value of 4.321, followed by the exchange rate with the mean value of 1.760 and silver prices with the mean value of 1.492. The standard deviation indicates that the in macro-economic factors, the real interest rate 0.323 has the highest variability, whereas the exchange rate depicts the lowest variability with the value of 0.107. GDP has a mean value of 0.782, with a standard deviation of 0.206, indicating relatively low variation. The skewness data shows that the gold prices, GDP, real interest rate, and

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crude oil prices are negatively skewed, however silver prices, exchange rate, and inflation are positively skewed. The kurtosis values indicate that GDP (7.534) and real interest rate (4.774) have highly peaked distributions compared with the normal distribution. In contrast, gold, silver, exchange rate, and inflation have negative kurtosis, indicating relatively flatter distributions. Crude oil prices have a negative mean of -0.136 and slightly positive kurtosis of 0.244. Overall, the results indicate differences in the variability and distributional patterns of the selected variables, with the exchange rate being the most stable variable.

Table 2
Correlation analysis of gold, silver prices and macroeconomic variables

		Gold Price	Silver Price	GDP	Exchange Rate	Real Interest Rate	Inflation Rate	Crude Oil Prices
Gold Price	Pearson Correlation	1						
	Sig. (2-tailed)							
	N	26						
Silver Price	Pearson Correlation	1.000**	1					
	Sig. (2-tailed)	.000						
	N	26	26					
GDP	Pearson Correlation	.039	.039	1				
	Sig. (2-tailed)	.850	.850					
	N	26	26	26				
Exchange Rate	Pearson Correlation	.805**	.805**	.004	1			
	Sig. (2-tailed)	.000	.000	.984				
	N	26	26	26	26			
Real Interest Rate	Pearson Correlation	-.339	-.339	-.209	-.074	1		
	Sig. (2-tailed)	.090	.090	.306	.720			
	N	26	26	26	26	26		
Inflation Rate	Pearson Correlation	.068	.068	-.042	-.298	-.443*	1	
	Sig. (2-tailed)	.740	.740	.837	.139	.023		
	N	26	26	26	26	26	26	
Crude Oil Prices	Pearson Correlation	-.251	-.251	.262	-.523**	-.006	.206	1
	Sig. (2-tailed)	.216	.216	.196	.006	.975	.313	
	N	26	26	26	26	26	26	26
**. Correlation is significant at the 0.01 level (2-tailed).								
*. Correlation is significant at the 0.05 level (2-tailed).								

The correlation analysis from above table 2 examines the relationship between gold and silver prices and selected macroeconomic variables using Pearson's correlation coefficient. The results reveal a perfect positive and statistically significant relationship between gold and silver prices ($r = 1.000$, $p = 0.000$). Both gold and silver prices also have a strong positive and significant relationship with the exchange rate ($r = 0.805$, $p = 0.000$). However, their relationships with GDP ($r = 0.039$), inflation ($r = 0.068$), real interest rate ($r = -0.339$), and crude oil prices ($r = -0.251$) are statistically insignificant at the 5% level. Among the macroeconomic variables, GDP shows weak relationships with the other variables, and none of these relationships is statistically significant. The exchange rate has a moderate negative and significant relationship with crude oil prices ($r = -0.523$, $p = 0.006$). Similarly, the real interest rate has a moderate negative and significant relationship with inflation ($r = -0.443$, $p = 0.023$). The remaining relationships among macroeconomic variables are statistically insignificant. Overall, the findings suggest that the exchange rate has the strongest significant association with gold and silver prices among the selected macroeconomic variables. Thus, the correlation results indicate that exchange rate movements are closely associated with precious metal prices, although correlation does not establish causation.

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Table 3

Multiple Regression Analysis of Gold & Silver Prices and Macro-Economic Variables

H_{01} = There is no significant relationship between gold, silver prices and macro-economic variables in India.

Model summary results of Gold Price		**Model summary results of Gold Price**	
Model	1	Model	1
R	.938[a]	R	.897[a]
R Square	.880	R Square	.805
Adjusted R Square	.849	Adjusted R Square	.756
Std. Error of the Estimate	.16203	Std. Error of the Estimate	.19224
R Square Change	.880	R Square Change	.805
F Change	27.925	F Change	16.491
df1	5	df1	5
df2	19	df2	20
Sig. F Change	.000	Sig. F Change	.000
Dependent Variable: Gold Prices		**Dependent Variable: Gold Prices**	

a. Predictors: (Constant), GDP, Exchange Rate, Real Interest Rate, Inflation Rate, Crude Oil Prices

Table 3 explains the multiple regression analysis of select macroeconomic variables, namely GDP, exchange rate, real interest rate, inflation rate, and crude oil prices, and gold and silver prices in India. The results indicate that the R-value for gold prices is 0.938, while for silver prices it is 0.897, suggesting a very strong positive relationship between the selected macroeconomic variables and both precious metals. The R-square value of 0.880 for gold indicates that 88% of the variation in gold prices is explained by the selected macroeconomic variables, whereas the R-square value of 0.805 for silver indicates that 80.5% of the variation in silver prices is explained by these variables. The adjusted R-square values are 0.849 for gold and 0.756 for silver, demonstrating the good explanatory power of both regression models. Furthermore, the F-statistic values are 27.925 for gold and 16.491 for silver, with a significance value of 0.000 in both cases, which is below the 0.05 level of significance. This confirms that both regression models are statistically significant. Therefore, the null hypothesis, stating that there is no significant relationship between macroeconomic variables and gold & silver prices in India, and null hypothesis for gold &silver prices are rejected. It can therefore be concluded that the selected macroeconomic variables have a statistically significant combined relationship with both gold and silver prices in India, with the model showing comparatively greater explanatory power for gold prices than for silver prices.

Table 4

ANOVA table of gold, silver prices and macro-economic variables

	Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Dependent Variable: Gold Price		Regression	3.666	5	.733	27.925	.000[b]
		Residual	.499	19	.026		
		Total	4.165	24			
Dependent Variable: Silver Price		Regression	3.047	5	.609	16.491	.000[b]
		Residual	.739	20	.037		
		Total	3.786	25			

b. Predictors: (Constant), GDP, Exchange Rate, Real Interest Rate, Inflation Rate, Crude Oil Prices

The table 4 examines the ANOVA results and evaluate the null hypothesis, stating that the macroeconomic variables like GDP, Exchange Rate, Real Interest Rate, Inflation Rate, and Crude Oil Prices have no combined significant effect on gold and silver prices. For the gold price model, the regression results show the F statistic value of 27.925 with significance value of 0.000. This indicates to the rejection of the null hypothesis for gold, explains that these macroeconomic factors collectively provide a strong, statistically significant for predicting gold price fluctuations. Likewise, the silver price model produces an F statistic of 16.491 with significant value of 0.000. Hence, the null hypothesis is rejected for silver, indicating that the selected macro-economic variables significantly explain variance in silver prices as well. Comparatively, both models demonstrate strong statistical validity, with the higher F-value for gold and silver prices suggests that these macroeconomic indicators collectively account for price variations more strongly in gold than in silver. In summary, empirical evidence from both ANOVA tests strongly supports the rejection of null hypotheses, concluding that the macroeconomic variables are most important determinants of gold and silver market prices.

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Table 5
Coefficients table of gold prices and macro-economic variables
H_{01} = There is no significant relationship between macro-economic variables and gold prices in India.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-3.300	.796		-4.149	.001	-4.965	-1.635
	GDP	.058	.108	.049	.537	.598	-.168	.284
	Exchange Rate	3.927	.502	.951	7.827	.000*	2.877	4.977
	Real Interest rate	-.042	.097	-.045	-.427	.674	-.246	.162
	Inflation Rate	.980	.258	.388	3.797	.001*	.440	1.519
	Crude Oil Prices	.088	.198	.061	.442	.663	-.327	.503

a. Dependent Variable: gold price
b. Predictors: (Constant), GDP, Exchange Rate, Real Interest Rate, Inflation Rate, Crude Oil Prices
c. * Indicates the 5% level of significance

The above table 5 reveals the coefficients of gold prices and macro-economic variables. The Exchange Rate and inflation rate are showing the statistically significant at the 5% level. Hence, the null hypothesis is rejected for exchange rate and inflation rate, it indicates these are key drivers of gold prices. the GDP, Real Interest Rate, and Crude Oil Prices show the not significant and 5%level. Therefore, for GDP, real interest rate, and crude oil prices, the null hypothesis is accepted and it indicating these variables do not statistically significant influence on gold prices in this model. Overall, the standardized coefficients indicate that the exchange rate is the strongest predictor, followed by inflation, while the remaining variables show minimal explanatory power. Therefore, is partially rejected, as gold prices in India are significantly driven by currency fluctuations and domestic inflation rather than GDP growth, real interest rates, or crude oil prices.

Table 6
Coefficients table of silver prices and macro-economic variables
H_{01} = There is no significant relationship between macro-economic variables and silver prices in India.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-4.942	.894		-5.527	.000	-6.807	-3.076
	GDP	-.093	.204	-.049	-.457	.653	-.518	.332
	Exchange Rate	3.581	.448	.981	7.994	.000*	2.647	4.515
	Real Interest Rate	-.205	.142	-.170	-1.445	.164	-.502	.091
	Inflation Rate	.506	.258	.237	1.958	.064	-.033	1.044
	Crude Oil Prices	.315	.172	.225	1.835	.081	-.043	.674

a. Dependent Variable: Silver Price
b. Predictors: (Constant), GDP, Exchange Rate, Real Interest Rate, Inflation Rate, Crude Oil Prices
c. * Indicates the 5% level of significance

The above table 6 shows the coefficients of silver prices and macro-economic variables. The Exchange Rate is showing the statistically significant at the 5% level. Hence, the null hypothesis is rejected for exchange rate, it indicates this is the key driver of silver prices. The GDP, Real Interest Rate, inflation rate and Crude Oil Prices show the not significant and 5%level. Therefore, for GDP, real interest rate, inflation rate and crude oil prices, the null hypothesis is accepted and it indicating these variables do not statistically significant influence on silver prices in this model. Overall, the standardized coefficients indicate that the exchange rate is the strongest predictor, while the remaining variables show minimal explanatory power. Therefore, is partially rejected, as silver prices in India are significantly driven by currency fluctuations rather than GDP growth, real interest rates, inflation rate or crude oil prices.

CONCLUSION

The present study examines the macroeconomic drivers of gold and silver price volatility in India over the period 2000–2025. The study analyses the impact of five major macroeconomic variables, namely GDP, exchange rate, real interest rate, inflation rate, and crude oil prices, on gold and silver prices. The findings reveal that macroeconomic factors collectively have a significant relationship with both gold and silver prices in India. The regression results indicate that the selected variables explain 88% of the variation in gold prices and 80.5% of the variation in silver prices. The correlation analysis also identifies a strong positive and statistically significant relationship between gold and silver prices. Among all the selected macroeconomic variables, the exchange rate emerges as the most important determinant of both precious metal prices. The regression results show that exchange rate has a significant positive influence on gold as well as silver prices. Inflation also has a significant positive influence on gold prices, whereas its

individual effect on silver prices is statistically insignificant. Similarly, GDP, real interest rates, and crude oil prices do not show statistically significant individual effects on either gold or silver prices in the respective regression models. However, the combined influence of all five macroeconomic variables is statistically significant for both metals. The study therefore rejects the overall null hypothesis that macroeconomic variables have no significant relationship with gold and silver prices in India. It can be concluded that currency fluctuations play a major role in determining precious metal prices in the Indian market. The findings also suggest that gold prices are relatively more strongly explained by the selected macroeconomic variables than silver prices. Since gold and silver are important investment and consumption assets in India, their price movements have considerable implications for investors, households, jewellery businesses, and policymakers. Therefore, investors should carefully monitor exchange rate movements and inflation while making investment decisions in precious metals. Policymakers should also consider the impact of currency fluctuations and global economic conditions while formulating economic and financial policies. Overall, the study highlights the importance of understanding macroeconomic factors for analysing gold and silver price movements and managing investment risks in the Indian commodity market.

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