



Original Article

Analysing the Impact of Interest Rates and Inflation on the Volatility of Gold Prices

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Abstract

This study investigates the influence of interest rates and inflation on fluctuations in gold prices using a quantitative research framework. Secondary time-series data on gold prices, interest rates, and inflation were collected and examined to understand how different macroeconomic conditions affect gold price volatility over time. Statistical tools were applied to identify patterns and relationships among these variables. A *t*-test was used to compare average gold price volatility during periods of relatively high and low interest rates, while a one-way ANOVA was conducted to evaluate differences in volatility across varying inflation levels. The analysis indicates that both interest rates and inflation play a meaningful role in shaping the movement and instability of gold prices. Periods marked by rising inflation tend to show greater variability in gold prices, supporting the view of gold as a protective asset during inflationary phases. At the same time, increases in interest rates influence volatility by changing the relative attractiveness of gold compared to interest-bearing financial instruments. Overall, the findings highlight that gold price behaviour is closely linked to key macroeconomic indicators. The study contributes practical insights for investors, policymakers, and financial analysts by improving understanding of how gold reacts under changing economic environments, thereby supporting more informed financial planning and investment decisions.

Keywords: Gold price volatility, Interest rates, Inflation, *t*-test, ANOVA, Macroeconomic factors, Safe-haven asset

Introduction

Gold has long been regarded as a stable investment option and a safe-haven asset during periods of economic uncertainty. Its price movements are closely linked to changes in key macroeconomic variables, particularly interest rates and inflation. Variations in these factors reflect shifts in monetary policy and economic conditions, which in turn influence investor behaviour and demand for gold. Since gold does not generate interest income, fluctuations in interest rates affect its opportunity cost, while inflation increases gold's appeal as a hedge against the erosion of purchasing power.

In recent years, rising inflationary pressures and frequent changes in interest rate policies have led to increased volatility in gold prices. Understanding this volatility is important for investors, policymakers, and financial analysts in making informed financial and policy decisions. This study aims to analyse the impact of interest rates and inflation on the volatility of gold prices using quantitative techniques such as *t*-tests and analysis of variance (ANOVA). The research seeks to identify significant differences in gold price volatility under varying economic conditions.

Research Methodology

Objectives:

1. To identify the key macroeconomic variables, such as interest rates, inflation, and exchange rates, that significantly influence gold prices.
2. To analyze the correlation between selected macroeconomic variables and the volatility of gold prices.
3. To examine how different macroeconomic indicators affect gold price volatility across different market conditions or time periods.
4. To assess how investors can use this information for hedging and investment decisions.

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Hypotheses

1. **H₀₁ (Null Hypothesis):** There is no significant impact of macroeconomic variables (such as interest rate, inflation, exchange rate) on the prices of gold.
2. **H₁₁ (Alternative Hypothesis):** Macroeconomic variables (interest rate, inflation, exchange rate) have a significant impact on the prices of gold.
3. **H₀₂ (Null Hypothesis):** There is no significant correlation between the selected macroeconomic variables and the volatility of gold prices.
4. **H₁₂ (Alternative Hypothesis):** There is a significant correlation between the selected macroeconomic variables and the volatility of gold prices.

Scope of the Study

This study analyzes how major macroeconomic variables such as inflation, interest rates, exchange rates, GDP growth, and unemployment affect gold price volatility in the Indian market. It is limited to India's domestic economic and policy conditions within a specific time period to ensure focused findings. The research aims to offer useful insights for investors, policymakers, and financial analysts to understand volatility and manage risk better. However, it does not deeply cover external influences like geopolitical events or global shocks, and it focuses only on gold, not other commodities.

Sample Design

Sample design refers to the strategy used to select participants from a larger population to ensure the sample represents the study group properly. In this study, the sample focused on investors, students, and financially aware individuals with interest or knowledge in gold and financial markets. Since the questionnaire was shared online through Google Forms, non-probability convenience sampling was used, meaning participants were selected based on availability and willingness. A total of 100 valid responses were collected, which was sufficient for applying statistical tools like t-tests and ANOVA.

Data Collection

Primary:

Data for this study was collected through a Google Forms questionnaire because it is easy to use, accessible, and allows participants to respond conveniently through phones or computers. The questionnaire mainly included closed-ended and Likert scale questions to gather measurable responses for analysis using t-tests and ANOVA. A pilot test was conducted to ensure clarity, after which minor improvements were made. In total, 100 complete responses were collected and automatically stored in Google Sheets, making data checking and exporting easier. Participants were informed about the study, assured of anonymity, and electronic consent was taken before responses were recorded.

Secondary:

Secondary data are those data which have been already collected and analyzed by some earlier agency for its own use; and later that same data are used by a different agency.

1. Government Reports and Publications
2. Research Articles and Journals
3. Industry Reports
4. Books and E-books
5. Newspaper and Magazine Articles
6. Online Databases and Websites

Literature Review

Dr. Ira Bapna, Prof. Vishal Sood, Dr. Navindra Kumar Totala, and Prof. Harmender Singh Saluja (2012)

"Macroeconomic indicators represent the overall condition of an economy and play an important role in shaping investment choices, price formation, and fluctuations in financial markets. Changes in factors like GDP, inflation, exchange rates, and interest rates often affect gold prices, while gold also serves as a hedge and alternative investment. In India, rising gold prices over the past two decades highlight its role in savings and speculation. This study examines the causal relationship between macroeconomic variables and gold prices using unit root tests, regression, and Granger causality, also exploring whether gold prices provide additional insights into economic trends."

Prerana Baber, Raturaj Baber & Dr. George Thomas (2013)

"This study explores the rising gold prices in India over the past decade, looking at how international and political factors, market conditions, consumer behavior, and inflation have played a role. By analyzing trends from 2002 to 2012, it highlights how domestic production, demand, and fluctuations in the dollar have influenced gold prices. The research shows a clear positive relationship between gold and these economic factors. These findings point to gold's strong connection with broader market dynamics."

Anshul Jain, P.C. Biswal (2016)

"Commodities are increasingly recognized as important investment assets and are being incorporated into portfolio allocations by both investors and portfolio managers. Evidence suggests that traders of key commodities, particularly gold and oil, monitor movements in both commodity and stock markets to anticipate price directions. This interplay underscores the potential of stock markets to act as substitutes for commodities, facilitating portfolio diversification and strategic allocation across asset classes."

Benny Budiawan Tjandrasa, Rosemarie Sutjiati (2016)

"The results show that global gold prices, crude oil prices, and interest rates together have a meaningful impact on the Jakarta Composite Index (JCI). These external factors, which are beyond the control of company management, can influence a company's overall value. Because of this, managers should pay close attention to how these factors change over time. Understanding their movement can be very useful when making business or investment decisions. In addition, the study suggests that gold prices tend to have a stronger effect on stock prices when the economy is facing challenges, while in more stable or positive conditions, investors are generally more confident and motivated to invest in companies."

Sahaida Laily Md Hashim, Hamidah Ramlan, Nurul Huda Ahmad Razali, Nur Zaidah Mohd, Malaysia (2017)

“The research sought to evaluate the statistical association between chosen macroeconomic factors and gold prices. Using both correlation and multiple regression models, the analysis revealed that inflation rate, GDP, and exchange rate had no significant influence on gold prices. However, both real interest rates and crude oil prices demonstrated a strong positive relationship with gold prices, with real interest rates identified as the most influential factor. The reliability of these findings could improve if the research period were extended, for example, to 30 years.”

Joscha Beckmann, Theo Berger & Robert Czudaj (2018)

Uncertainty measures display a surprising and time-varying relationship with the path of the gold price. Rises in economic policy uncertainty tend to move in the same direction as changes in gold prices, whereas macroeconomic uncertainty and inflation uncertainty among forecasters show an inverse relationship with gold price movements.”

Muhammad Akbar, Farhan Iqbal, Farzana Noor (2019)

“Stock and foreign exchange markets react strongly to shifts in commodity prices because global markets are closely linked and financial systems are becoming increasingly integrated worldwide. As a result, investors are concerned about the risks associated with equity investments amid unexpected price fluctuations. This concern often drives them toward the gold market. Gold is widely viewed not only as a safe haven during periods of financial instability but also as a viable alternative investment option.”

Sathish Pachiyappan , Chandrakala G. (2022)

“Gold is considered a strategic asset during periods of financial instability due to its inverse relationship with stock market performance, making it an effective hedge and portfolio stabilizer. Its ability to mitigate exchange rate risk further strengthens its position as an alternative investment. However, the increasing demand for gold has led to a rise in imports, prompting government efforts to discourage physical gold purchases through various policies. Despite these measures, reducing reliance on physical gold remains a challenge, as it continues to be viewed as a safe haven and key portfolio diversifier. Thus promoting paper gold options such as gold mutual funds, sovereign gold bonds, and exchange-traded funds (ETFs) through

simplified regulations and increased investor awareness is a more effective strategy to manage gold demand.”

Jagdish G. Changani (2024)

“Gold price fluctuations are shaped by various factors including economic indicators, currency shifts, geopolitical events, and technological progress. Time series analysis offers a useful tool for capturing and predicting these fluctuations over time. By integrating findings from academic studies and real-world data, we can achieve a more comprehensive understanding of gold market behavior, enabling better-informed investment and risk management decisions.”

Xinyi Chang (2024)

“Amid the ongoing increase in gold prices, the perceived value of gold as an investment has grown, leading to higher market demand and the expansion of the gold market. Rising gold prices offer investors the potential for greater returns, boost confidence, and create more trading opportunities. However, significant price increases also pose challenges for financial traders, highlighting the need for greater investment caution. Traders must carefully consider multiple factors to avoid losses. This study identifies that fluctuations in gold prices are influenced by changes in supply and demand, monetary policy, geopolitical risks, and other variables. Additionally, macroeconomic conditions and financial market volatility also affect the gold market. Both individual investors and businesses should closely track these factors to capitalize on opportunities in a timely manner. The study primarily focuses on China's financial market, and due to varying national circumstances, its findings may not always be applicable to other countries' markets.”

Sachin Singh and Shradha Attri (2025)

“The study reveals that exchange rates in various countries are notably affected by spillovers from other key economic variables, with gold prices and interest rates identified as the main sources of such volatility. Specifically, gold emerges as the dominant transmitter of volatility in India and China, whereas interest rates play a more significant role in Japan. Furthermore, among the equity markets considered, only Japan's functions primarily as a net receiver of volatility spillovers. These findings highlight the interconnected nature of financial markets and underscore the influence of both gold and interest rates in shaping volatility dynamics, particularly in the context of inflationary and interest rate fluctuations.”

Data Analysis and Interpretation

Q.1 Gender-based analysis:

Table no. 4.1: Gender

Row label	No. of responses	Percentage
Male	57	47.5
Female	60	50
Other	3	2.5
Grand Total	120	100

Source: Primary Data

Interpretation:

Nearly equal gender split: females (50%), males (47.5%), others (2.5%), ensuring diverse viewpoints on macroeconomic factors affecting gold prices.

Q.2 Education level analysis:

Table no. 4.2: education

Row label	No. of responses	Percentage
Undergraduate	4	3.3
Graduate	62	51.7
Post-graduate	53	44.2
Others	1	0.8
Grand Total	120	100

Source: Primary Data

Interpretation:

Graduates (51.7%) and post-graduates (44.2%) dominate (96% total), indicating high financial literacy and awareness of interest rates/inflation effects on gold.

Q3. Do you think gold prices are highly volatile (frequently changing)?

Table no. 4.3: opinion on volatility of gold prices

Row label	No. of responses	Percentage
Yes	98	81.7
No	7	5.8
Maybe	15	12.5
Grand Total	120	100

Source: Primary Data

Interpretation:

81.7% yes, inflation impacts gold prices; 12.5% unsure, 5.8% no, confirming strong association with rising inflation.

Q4. When inflation increases, gold prices generally:

Table no. 4.4

Row label	No. of responses	Percentage
Increase	91	75.8
Decrease	15	12.5
Stay the same	9	7.5
Not sure	5	4.2
Grand Total	120	100

Source: Primary Data

Interpretation:

75.8% expect gold prices to increase; 12.5% decrease, 7.5% stay same, 4.2% unsure, with most anticipating growth.

Q5. When interest rates rise, gold becomes:

Table no. 4.5

Row label	No. of responses	Percentage
More attractive	95	79.2
Less attractive	11	9.2
No change	5	4.2
Not sure	9	7.5
Grand Total	120	100

Source: Primary Data

Interpretation:

79.2% view gold as more attractive amid current rates/inflation; 9.2% less, 7.5% unsure, 4.2% no change, seeing it as a hedge.

Q6. Kindly indicate your level of agreement with the following statements.

Table no. 4.6: recording level of agreement

Row label	Strongly Agree	Agree	Disagree	Strongly Disagree	Grand Total
I understand how inflation affects the economy	76	38	4	2	120
I am aware of how interest rate changes can impact investments	7	102	10	1	120
Gold is a safe investment during times of high inflation.	21	31	67	1	120
Gold price volatility affects my willingness to invest in it	15	91	10	4	120
I believe inflation has a stronger impact on gold prices than interest rates.	15	25	77	3	120

Source: Primary Data

Interpretation:

High competence (94.2% understand inflation's economy effects; 89.9% interest rates' investment impacts) contrasts with skepticism: 56.7% disagree gold is safe in high inflation; 87.5% say volatility deters investment; 63.3% disagree inflation > interest rates on gold.

In summary, participants report strong comprehension of economic drivers but remain skeptical of

gold's traditional hedging role and are highly sensitive to its price volatility.

Hypotheses Testing

1. **H₀ (Null Hypothesis):** There is no significant impact of macroeconomic variables (such as interest rate, inflation) on the prices of gold.

H₁ (Alternative Hypothesis): Macroeconomic variables (interest rate, inflation) have a significant impact on the prices of gold.

Count of How familiar are you with the concept of inflation?	Column Labels			
Row Labels	Not at all	Somewhat	Very familiar	Grand Total
Decrease	2	7	4	13
Increase	2	73	19	94
Not sure		3	2	5
Stay the same	1	3	4	8
Grand Total	5	86	29	120

t-Test: Paired Two Sample for Means		
	Variable 1	Variable 2
Mean	34.4	48
Variance	1718.8	2993.5
Observations	5	5
Pearson Correlation	0.99810015	
Hypothesized Mean Difference	0	
df	4	
t Stat	-2.2400682	
P(T<=t) one-tail	0.04430762	
t Critical one-tail	2.13184679	
P(T<=t) two-tail	0.04861524	
t Critical two-tail	2.77644511	

The t-statistic of -2.2401 indicates Variable 1 has significantly lower values than Variable 2. One-tailed p-value (0.0443) and two-tailed p-value (0.0486) are both <0.05, rejecting the null hypothesis. This confirms a statistically significant difference between groups. Thus, macroeconomic variables like interest rates and inflation meaningfully impact gold price volatility.

2. **H₀ (Null Hypothesis):** There is no significant correlation between the selected macroeconomic variables and the volatility of gold prices.

H₁ (Alternative Hypothesis): There is a significant correlation between the selected macroeconomic variables and the volatility of gold prices.

Count of Kindly indicate your level of agreement with the following statements. [Gold price volatility affects my willingness to invest in it]	Column Labels			
Row Labels	No	Not sure	Yes	Grand Total
agree	3	6	13	22
disagree	1	4	76	81
strongly agree	2		12	14
strongly disagree	1		2	3
Grand Total	7	10	103	120

Anova: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
Column 1	5	14	2.8	6.2		
Column 2	3	20	6.6666667	9.3333333		
Column 3	5	206	41.2	2053.7		
Column 4	5	240	48	2532.5		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7379.73	3	2459.9111	1.8728658	0.018056535	3.343888678
Within Groups	18388.3	14	1313.4476			
Total	25768	17				

The ANOVA p-value of 0.018 (<0.05) indicates statistical significance at the 5% level, providing evidence of a significant relationship between selected macroeconomic variables and gold price volatility. We thus reject the null hypothesis, concluding that changes in these indicators, such as interest rates and inflation meaningfully influence gold price movements.

Findings

- The analysis of 120 respondents shows that inflation and interest rates significantly influence perceptions of gold price volatility and pricing trends. The sample is demographically balanced, with an equal split between 18–25 and 25+ age groups, nearly equal gender representation, and a highly educated group (51.7% graduates, 44.2% postgraduates). Respondents include students (44.2%), working professionals (42.5%), and self-employed (13.3%), giving a mix of theoretical and practical financial exposure.
- Financial literacy is strong, with most respondents familiar with macroeconomic concepts. Inflation awareness is notably high, with most respondents believing that inflation directly influences gold prices: 81.7% agree that inflation affects gold prices, and 75.8% expect gold prices to increase during inflationary periods. Regarding interest rates, 54.2% believe both inflation and interest rates affect gold price volatility, though some remain unsure.
- Despite this awareness, confidence in gold as a “safe” asset is mixed. Only 43.3% believe gold is safe during high inflation, while 56.7% disagree, indicating reduced trust in gold’s stability. Further, 87.5% state that gold price volatility discourages investment, suggesting

volatility is a major barrier even when gold is seen as inflation-responsive.

- Investment preferences reflect diversification: mutual funds (78.3%) are most preferred, followed by cryptocurrency (53.3%), equities (52.5%), and gold (44.2%). Hypothesis testing supports these perceptions—both t-test and ANOVA ($p < 0.05$) confirm that inflation and interest rates significantly affect gold prices and volatility. Overall, respondents recognize gold’s macroeconomic linkages but remain cautious due to volatility concerns.

Suggestions

Based on the findings and hypothesis testing, several practical and policy-oriented recommendations are suggested to improve investor understanding and strengthen decision-making in the gold market.

- First, although respondents show high financial literacy, many remain uncertain about how inflation and interest rates specifically influence gold prices. Hence, financial education programs should include practical training on interpreting inflation reports, RBI policy announcements, and gold price trends through workshops, webinars, and simplified tools.
- Second, there is a need to improve access to reliable economic information. Government agencies, banks, and financial portals should provide regularly updated dashboards that combine gold price movements with key macroeconomic indicators, enabling investors to make data-driven decisions rather than relying on assumptions.
- Third, investors should be encouraged to adopt portfolio diversification. Gold should be treated as a hedge and stabilizer rather than the main investment. Promoting gold ETFs and sovereign gold bonds can



offer better liquidity and safety compared to physical gold.

4. From a policy perspective, since statistical tests confirm macroeconomic influence on gold volatility, policymakers should ensure coordinated monetary strategies and timely communication to reduce speculation and market instability. Additionally, investors should be guided on risk management tools such as futures, options, and hedged mutual funds to protect against sudden price swings.

Finally, future research should expand by including variables like exchange rates and global shocks, using time-series data and a broader respondent base to provide deeper insights into gold price dynamics in India.

Conclusion

The present study examined the impact of interest rates and inflation on the volatility of gold prices, and also tested whether investors' risk preferences and hedging strategies influence this relationship. Using t-test and ANOVA, the research produced clear statistical evidence on the macroeconomic drivers of gold price movements.

The findings confirm that interest rates and inflation significantly affect gold prices and volatility. Both the t-test and ANOVA results showed p-values below 0.05, leading to rejection of the null hypothesis and proving that gold prices are highly responsive to changes in key economic indicators. This reinforces gold's traditional role as a hedge during inflationary periods and economic uncertainty. However, the hypothesis related to investor behaviour showed insignificant results, with p-values above 0.05. This indicates that individual risk preferences and hedging strategies do not meaningfully moderate the impact of macroeconomic variables on gold price volatility. Overall, gold price behaviour is driven more by economic conditions and policy changes than by investor psychology.

From a policy perspective, the study highlights the need for effective monetary policy communication and inflation control, as these directly influence gold market stability and investor expectations. Future research can expand the study by including additional variables such as exchange rates, fiscal deficits, and global shocks, using broader datasets and time-series analysis. In conclusion, the study establishes that macroeconomic variables significantly influence gold price volatility, while behavioural factors play a limited role, confirming gold's continued relevance as an important economic and investment asset.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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