IMPACT OF INFLATION ON GOLD PRICES: EVIDENCE FROM TIME-SERIES ANALYSIS IN INDIA

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Abstract- Gold is said to be one of the important investments. It is popularity known as a safe investment when the economy is in an unstable condition. Cost of gold is affected with large number of economic factors including inflation, interest rate and currency etc. This study examines how gold value is influenced by key macroeconomic factor including Consumer Price Index (CPI), borrowing rate and USD/INR [3],[8]. Data analysis tool which is implemented in Python-based tools are used to collect, process and study the data. The dataset is first preprocessed and the analysed using exploratory data analysis techniques. Connection and graphs are used to understand the patterns and trend between gold price and macroeconomic factor. Also, interesting results of the project are the effect of interest rates of how investor decides to invest in the gold.

Keywords- ***Gold price, Economic factor, Inflation, Exchange rate, Interest rate, Time Series analysis***

I. INTRODUCTION

Gold has always been considered a secure investment option, particularly in times of economic turmoil and financial crises [1]. One of the main reasons investors prefer gold is their ability to retain value and act as a safeguard against inflation [8], [16]. Compared to many financial assets, gold generally shows more stable long-term behaviour, making it a preferred choice during uncertain economic conditions [1].

The prices of gold are influenced by several economic factors, which include inflation, interest rates, and exchange rates. An increase in inflation always results in an increase in the prices of gold, as investors try to hedge against it [8]. An increase in interest rates always results in a decline in the prices of gold, as investors tend to invest in other financial instruments that provide interest [9]. The value of the US dollar also influences the prices of gold [3].

In recent times, the availability of financial information has helped in a more systematic study.

II. LITERATURE SURVEY

It has been acknowledged that gold acts as a financial asset and is considered a safe haven during uncertain economic conditions and financial volatility [1], [2]. It has been found that during the times of volatility in the financial market, investors invest in gold investments to maintain stability and avoid financial risks [1]. In addition to this, it has been found that gold acts as an effective tool to diversify the investment portfolio during uncertain economic conditions [2].

Inflation is one of the major macroeconomic factors that affects the price of gold. In general, an increase in inflation leads to a reduction in the value of currency. Hence, during times of inflation, investments in gold act as a safe investment. It has been found through various studies that investments in gold help to maintain wealth over a period of time [8]. In addition to this, according to macroeconomic theories, inflation affects the movement of commodity prices.

In addition, the interest rates also play an important role in the gold price market. Since the gold market does not promise any interest or dividend, the interest rates may affect the gold market. The inverse relationship between the interest rates and the gold

price has been identified by the research. This affects the market trends [9].

Another major factor that affects the gold price market is the exchange rates. The gold price is traded worldwide in dollars, and the fluctuations in the exchange rates affect the gold price in the local market. It has been identified that the fluctuations in the exchange rates affect the gold price, resulting in market volatility [3]. In addition, the relationship between the gold and the dollar has been identified, and the gold price is used to hedge the depreciation of the dollar [7].

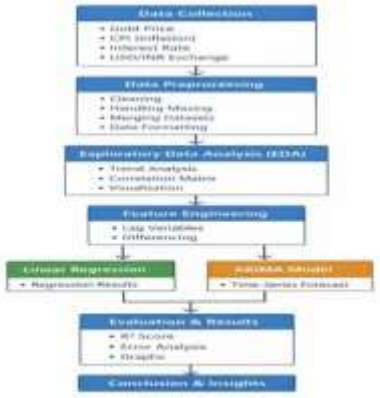
In addition to this, the price of gold is also influenced by the overall commodity market and the economic conditions prevailing globally. The research conducted regarding this issue has indicated that the price of gold is correlated with the price of other commodities under the influence of economic factors and the demand prevailing globally [5]. The interrelation between the gold market and other financial markets, like the oil market, clearly indicates the complexity involved.

The recent reports and data provided by various international agencies have helped in a better understanding of the trends prevailing in the gold price market. The reports regarding market analysis have indicated that the overall demand and supply, along with economic factors, have a major influence on the price dynamics of gold [11]. In addition, the overall economic factors provided by various agencies have helped in a better understanding of the interrelation between the price of gold and other macroeconomic factors by using statistical and computational techniques.

III. PROPOSED METHODOLOGY

The present study adopts a systematic and data-centric approach to investigate the impact of macroeconomic factors on gold prices. As existing studies emphasize the need to consider parameters like inflation, interest rates, and exchange rates while analyzing gold prices [4], [9], this study aims to focus on the investigation of these parameters. The proposed methodology includes data collection from reliable sources. Historical data with regards to gold prices and other parameters like Consumer Price Index (CPI), interest rates, and exchange rates in USD/INR are collected from reliable sources like economic data and financial reports [11], [12]. Such data forms a comprehensive basis to understand historical trends and fluctuations in gold prices. After collecting data from reliable sources, data preprocessing is done to ensure accuracy in data. Data preprocessing includes steps to ensure data accuracy and consistency among different datasets based on time period. Inconsistency in data can create confusion in data interpretations. Then exploratory data analysis (EDA) is done on the data. EDA provides an idea about the data. During EDA, trends, patterns, and changes in gold prices are identified. The analysis of the variables is done using visualization techniques, such as line plots and distribution plots, as confirmed by earlier analysis techniques, as discussed in financial literature [10]. Correlation analysis is the major part of this methodology, which is used to analyze the correlation between gold prices and macroeconomic variables. Earlier literature has confirmed that gold prices are correlated with economic indicators [3], [8]. So, a correlation matrix is created between the variables because gold prices are correlated with economic indicators. Along with the application of statistical analysis techniques, visualization techniques are also used to present the results in a more understandable form. The results will be presented in a more understandable form using visualization techniques, which will help in understanding the influence of factors on gold prices. The entire process is done with the help of Python programming tools. These tools are very efficient in handling data and visualizing it in a meaningful way. Libraries like Pandas, NumPy, Matplotlib, and Seaborn are used to carry out the entire process.

IV. ARCHITECTURE DIAGRAM



V. VARIOUS METHODOLOGY

This study uses a practical way of approach to analyse how gold prices respond to changes in other important economic factors. Firstly, in the analysis, gold prices, inflation (CPI), interest rates and exchange rates are collected, the data are cleaned and merged for the analysis.

After the preprocessing of the data, exploratory data analysis is used to understand the trends present in the data, how variables move overtime. Simple statistical visualization techniques are used to gain knowledge, to better capture the behaviour of the data. Then, finally Linear Regression is applied to examine relationships between variables. ARIMA is used to forecast future gold prices. the model outputs are then evaluated to understand the effectiveness in answering the price movements.

VI. INPUT

The input to the proposed study includes time-series data with respect to gold prices and some macroeconomic parameters that are identified to impact financial markets. In this regard, historical data with respect to gold prices are considered as input data. In addition to this, some important macroeconomic parameters like inflation (using the Consumer Price Index), interest rates, and exchange rates (in terms of USD/INR) are considered as input data.
The input data are acquired from credible sources in the form of publicly available financial data and economic reports [11], [12]. The input data are identified to impact gold prices in prior studies [3], [8], [9]. The data are made uniform with respect to a common timeframe to ensure effective analysis.

VII. PSEUDOCODE AND IMPLEMENTATION

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Input: Gold price data (G), CPI, Interest Rate (IR), Exchange Rate (EX) Output: Correlation results, Regression model, Forecasts, Insights

Begin

1.  Load datasets G, CPI, IR, EX

2.  Preprocess data:
Format dates, merge datasets into D, handle missing values

3.  Perform exploratory data analysis:
Plot trends and compute summary statistics

4.  Compute correlation matrix: Corr ← correlation(D)

5.  Perform feature engineering:
Generate lag and differenced variables

6.  Test stationarity:
Apply ADF test and transform data if required

7.  Build regression model: Fit Y ~ {CPI, IR, EX}

8.  Apply ARIMA model:
Identify (p, d, q) and forecast gold prices

9.  Evaluate models and compare results

10.  Interpret findings and derive insights

End
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The implementation of this study was carried out by utilizing data analytics techniques via the use of Python. The datasets regarding the prices of gold, as well as other factors, were first preprocessed by merging the data based on a common index that was retrieved from FRED datasets [12]. Then, correlation analysis was carried out to determine the relationship between the variables. Furthermore, a Multiple Linear Regression model was developed to determine the effect of inflation rates, interest rates, and exchange rates on the prices of gold. Additionally, time series analysis via the use of the ARIMA model was carried out after verifying the stationarity of the data via differencing and the ADF test. This methodology is consistent with the existing methodologies that are utilized to analyse the macroeconomic environment of countries [6].

VIII. OUTPUT

The results obtained from this analysis are graphical representations, statistical results, and results from predictive models. The trend plot will show the trends of gold prices as well as inflation. The correlation matrix will show various relationships. From the regression analysis, coefficients will be obtained to show the degree of influence of each macroeconomic factor. Moreover, results will be obtained on the predicted gold prices using the ARIMA model, which shows trends over time. This shows that descriptive as well as predictive results are obtained, as shown by various empirical studies [4], [9].

IX. RESULTS AND DISCUSSION

The output of the analysis consists of graphical visualizations, statistical summaries, and results from the predictive model. The trend plot shows the trend in which the gold prices and inflation are changing over time. The correlation matrix shows the correlation between different variables. The result from the regression model shows the coefficients, which indicate the extent to which each macroeconomic factor is driving the gold prices. Additionally, the result from the ARIMA model shows the forecasted values of the gold prices, which show the trend in which the gold prices are changing over time. The results show a positive correlation between inflation and gold prices, which is in line with the fact that gold acts as a hedge against inflation [8]. The impact of exchange rate changes is also observed in the analysis, which is in line with the fact that gold prices are influenced by exchange rate changes [3], [7]. However, the extent to which these factors influence the gold prices varies over time, which is observed in the correlation analysis. Moreover, the results of the regression analysis indicate that the macroeconomic variables have a joint effect on the movement of the gold price, although their individual effects vary. The above results are consistent with earlier studies which have emphasized the importance of various economic factors in influencing the gold price [1], [2].

X. SCREENSHOTS

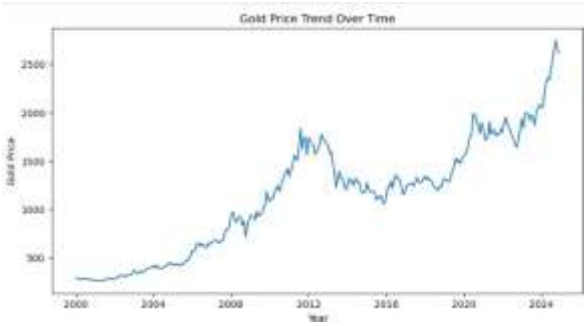

Figure: Gold Price Trend Over Time

The above figure shows how the value of the asset has changed; a general upward movement is seen with some short-term variations. This pattern suggests that it has gained importance as a store value, over changing marketing conditions and time period.

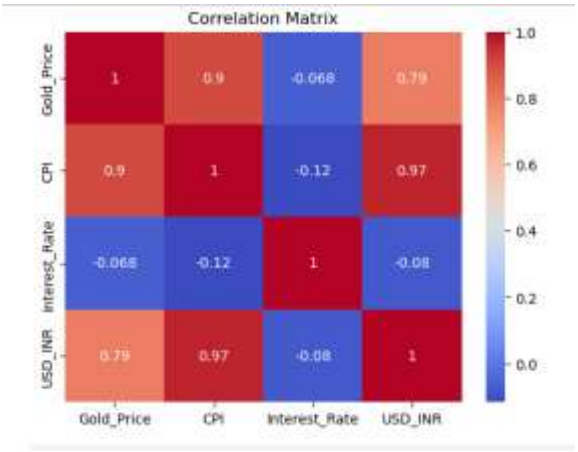

Figure: Correlation Matrix

It provides an overview of how the variable are related to each other, it shows whether they move in the same direction or in the opposite behavior. This tells us that changes in price level tend to align positively with the movement of the asset [8], [3], [9].

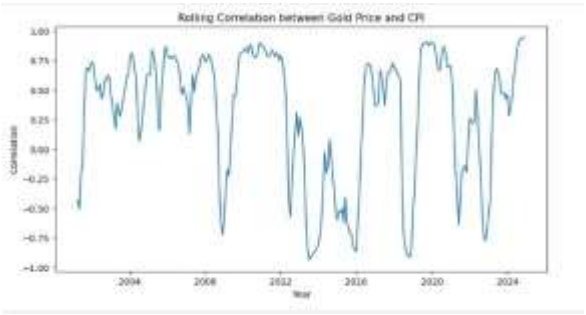

Figure: Rolling Correlation

It is a summary of how the variables are related to one another. This method captures how their interaction strengthens or weakens; we can also see that the association is not consistent throughout the entire period. The additional factors may also influence its behavior.

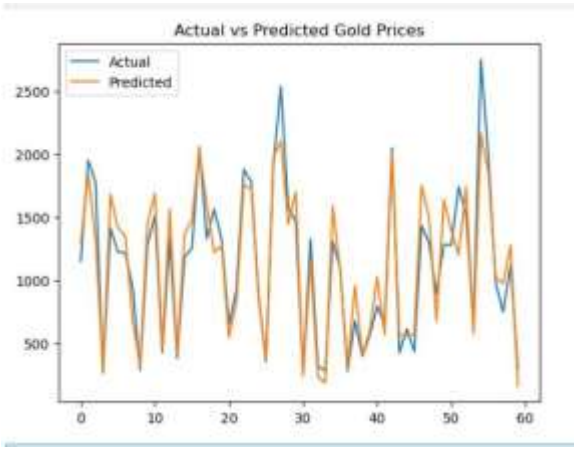

Figure: Actual vs Predicted Gold Prices

The figure displays the actual gold prices and the predicted values by the regression model during the test period. The predicted values show a similar trend to the actual values, which indicates that the model is able to predict the relationship between the gold prices and the chosen macroeconomic variables. Some variations in the actual and predicted values can be noticed, which indicates the existence of volatility in the market and the effect of external factors on the prices of gold. The similarity between the actual and predicted values indicates that the model is able to predict the values of the gold prices and can be utilized for the interpretation of the values.

XI. CONCLUSION

The study ends with how certain economic factors influence the operations of a major investment asset over time, it indicates that the changes in price levels & currency movements play an important role in determining its value.

Overall, the analysis provides useful insights into how different factors interact, helping investors, policy makers make better decision in changing economic environments.

XII. REFERENCES

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