

# write an academic research paper about macro-economic factors that affect gold price monthly return

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## summary

The relationship between macroeconomic factors and gold price monthly returns is a significant area of study in economics, as fluctuations in gold prices can have profound implications for investors, policymakers, and financial markets. Gold is often viewed as a safe-haven asset, whose price is influenced by a variety of macroeconomic indicators, including interest rates, inflation, economic growth, and unemployment rates. Understanding these dynamics is crucial for forecasting gold price movements and making informed investment decisions.

Interest rates play a pivotal role in shaping gold prices; higher rates increase the opportunity cost of holding non-yielding assets like gold, potentially leading to decreased demand. Conversely, lower interest rates typically enhance gold's appeal, resulting in price increases. Additionally, inflation is considered a key driver of gold prices, as rising inflation rates tend to lead investors to seek gold as a hedge against the declining purchasing power of currency. Empirical studies suggest that a one percent increase in inflation correlates with a rise in gold prices by approximately 1.32 percent<sup>[1]</sup>.

U.S. GDP growth and unemployment rates further complicate the interaction between economic health and gold prices. A robust economy usually diminishes the demand for gold, while increased unemployment—indicative of economic distress—often propels investors towards gold for security. This inverse relationship highlights gold's status as a barometer for economic stability. Notably, empirical research indicates that a one percent rise in unemployment can result in an approximate 0.89 percent increase in gold prices<sup>[2]</sup>.

Overall, the interplay between these macroeconomic factors illustrates the complexity of the gold market. Controversies arise regarding the extent to which these factors independently affect gold prices, as well as the potential influence of external variables like geopolitical events and changes in market sentiment. As such, the ongoing study of these dynamics remains crucial for understanding and predicting gold price movements in an ever-evolving economic landscape.

## Key Macroeconomic Factors

### Interest Rates

Interest rates are another crucial determinant of gold prices. Higher interest rates increase the opportunity cost of holding non-yielding assets like gold, making it less attractive to investors. Conversely, lower interest rates tend to bolster demand for gold, as the relative attractiveness of interest-bearing assets diminishes[3]. Studies indicate that an increase in interest rates by one percent can lead to a decrease in gold prices by approximately 0.39 percent[4].

## Inflation

Inflation is often viewed as a driving force behind gold price movements. Gold is traditionally considered a hedge against inflation; when inflation rates rise, the price of gold typically increases. Research shows that for every one percent increase in the inflation rate, gold prices can rise by approximately 1.32 percent[1]. This relationship underscores the perception of gold as a protective asset during inflationary periods.

## Introduction to Macroeconomic Influences

The price of gold is significantly influenced by various macroeconomic factors, which serve as critical indicators of economic health and investor behavior. Understanding these factors provides insights into the dynamics that affect gold price movements, particularly in relation to economic stability, inflation, and interest rates.

## U.S. GDP Growth

U.S. GDP growth is a primary factor influencing gold prices. It acts as a barometer for the overall economic health of the country, thereby affecting investor confidence. A growing GDP typically indicates a strong economy, which can lead to reduced demand for gold as a safe-haven asset. Conversely, during periods of economic uncertainty or contraction, investors tend to gravitate towards gold as a hedge against instability[5].

## Unemployment Rates

Unemployment rates also play a role in shaping gold prices. Higher unemployment is associated with economic distress, prompting investors to seek refuge in gold. Empirical findings suggest that a one percent increase in U.S. unemployment can lead to an increase in gold prices by about 0.89 percent[2]. This relationship highlights the inverse correlation between economic health and gold price movements.

## Correlation with Real Interest Rates

The correlation between gold prices and real interest rates is generally negative. When real yields decline, gold prices tend to rise, reinforcing the notion that inflation acts as a supportive factor for gold, while rate hikes pose a threat[6]. Recent data analysis indicates a strong inverse relationship, with a correlation coefficient of -0.82 between real interest rates and gold prices, suggesting that shifts in interest rates can lead to significant changes in gold valuation[3].

# Theoretical Framework

## Introduction to Macroeconomic Factors

The relationship between macroeconomic factors and the price of gold has garnered significant attention in economic research. Gold is often perceived as a safe-haven asset during periods of economic instability, which suggests that its price is influenced by various macroeconomic indicators such as inflation, interest rates, and overall economic growth[\[7\]\[8\]](#). Understanding these relationships is crucial for investors and policymakers aiming to navigate the complexities of financial markets.

## Inflation and Gold Prices

Inflation is a primary macroeconomic factor that affects the demand for gold. As inflation rises, the purchasing power of currency decreases, leading investors to seek gold as a store of value. The scarcity of gold, coupled with increasing demand during inflationary periods, typically drives its price higher[\[9\]](#). Historical data reveals that gold has often outperformed other assets during inflationary environments, supporting the notion that investors gravitate towards gold to hedge against eroding currency value[\[10\]](#).

## Interest Rates and Gold Prices

Interest rates play a pivotal role in determining gold prices as well. Higher interest rates increase the opportunity cost of holding non-yielding assets like gold, potentially leading to a decrease in demand and consequently lower prices[\[10\]](#). Conversely, when interest rates are low, the appeal of gold increases, as the cost of holding it diminishes. This inverse relationship highlights the sensitivity of gold prices to monetary policy and economic conditions that influence interest rates[\[5\]\[11\]](#).

## Economic Growth and Gold Demand

Economic growth also impacts gold prices through changes in investor sentiment and demand dynamics. During periods of robust economic growth, the demand for gold may decline as investors prefer assets that yield higher returns, such as stocks or bonds. However, during economic downturns or crises, investors typically shift their focus towards gold, viewing it as a safer investment alternative[\[8\]](#). This behavioral aspect reinforces gold's status as a hedge against uncertainty, illustrating the cyclical nature of its demand[\[9\]](#).

## Liquidity Preference and Gold

The concept of liquidity preference, as discussed by Keynes, provides additional insight into how economic conditions can influence gold prices. In times of financial uncertainty, individuals may prioritize liquidity and opt to hold cash, impacting de-

mand for gold. Keynes suggested that when confidence in economic stability wanes, even an increase in the money supply might not effectively stimulate the economy if liquidity preferences remain high[12]. Thus, fluctuations in liquidity preference can lead to volatility in gold prices, reflecting broader economic sentiments.

## Supply Constraints and Market Dynamics

Finally, supply constraints further complicate the relationship between macro-economic factors and gold prices. The finite nature of gold reserves means that supply cannot easily adjust to meet sudden changes in demand, especially during inflationary periods or economic crises. As mining costs rise and accessible reserves diminish, the supply-side dynamics become increasingly relevant in determining gold prices[9][10]. This interplay between supply and demand underscores the importance of monitoring both economic indicators and market conditions in gold price analysis.

## Methodology

### Data Collection and Quality Assessment

In the preliminary phase of this research, a thorough quality assessment of the dataset was conducted, focusing on the integrity and accuracy of the data collected from reliable sources such as the Federal Reserve Bank of St. Louis, Yahoo Finance, and Macrotrends[5]. The dataset encompasses historical monthly returns of gold prices alongside various macroeconomic indicators, ensuring a robust foundation for analysis. A missing value test confirmed the dataset's completeness, as no missing values were detected. Additionally, an outlier detection procedure was employed using the quartile method, which identified any values outside the range of  $[Q1 - 1.5 * (Q3 - Q1), Q3 + 1.5 * (Q3 - Q1)]$ . This meticulous review found no outliers, further indicating the high level of accuracy within the dataset[7].

### Model Specification

To optimize the model's performance, several information criterion methods were utilized to determine the lag order of the Vector Autoregression (VAR) model. These criteria include the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Final Prediction Error (FPE), and Hannan-Quinn Information Criterion (HQIC). A lag order of 2 was ultimately selected after careful analysis, balancing the values of the information criteria to enhance model fitting performance while mitigating the risk of overfitting[7].

### Parameter Estimation and Testing for Stationarity

In the establishment of the VAR model, Augmented Dickey-Fuller (ADF) tests were conducted to evaluate the stationarity of the time series variables. Initial tests revealed non-stationarity in the original data levels, necessitating the computation of first-order differences to fulfill the stationarity requirements essential for constructing

the VAR model. Following the differencing process, the ADF test indicated that all variables had transformed into stationary time series, addressing the potential for spurious regression issues that can arise with non-stationary data[\[7\]\[13\]](#).

## Causality and Cointegration Analysis

To further refine the VAR model, causality matrices were constructed using Granger causality tests, while Johansen cointegration tests were performed to identify long-term relationships among the variables. Durbin-Watson statistics tests were also employed to assess the independence of residuals, ensuring the reliability of the VAR model prior to its finalization[\[7\]](#).

## Evaluation of Model Stability and Predictive Ability

The stability and predictive ability of the VAR model were evaluated through various diagnostic tests, including tests for autocorrelation and heteroskedasticity. This comprehensive evaluation is essential to ascertain that the model reliably captures the dynamic relationships among the macroeconomic factors influencing gold price monthly returns. By employing robust statistical techniques, the study aims to develop a reliable framework that enhances understanding of the factors impacting gold prices, ultimately informing investment decisions and economic policy-making[\[7\]\[14\]\[15\]](#).

## Limitations and Future Research Directions

This study acknowledges limitations related to the temporal scope of the data (2010-2024) and the potential exclusion of influential variables such as other precious metals and crude oil. Future research is encouraged to expand the variable scope, incorporate a broader time series, and utilize advanced prediction methods, including machine learning algorithms, to enhance model accuracy and sensitivity to market dynamics[\[7\]\[13\]](#).

## Empirical Analysis

### Sensitivity Analysis and Correlation

Sensitivity analysis plays a crucial role in understanding how fluctuations in economic variables impact the price of gold. This analytical approach is vital for assessing potential economic shocks or changes in monetary policy, which can significantly influence the gold market[\[15\]](#). By identifying the most influential variables, researchers can adjust forecasting models to better predict gold price movements.

Correlation analysis is an essential tool in price forecasting that evaluates the relationships between different economic variables. The correlation coefficients, which range from -1 to 1, help determine whether two variables move together or independently. A positive correlation indicates that as one variable increases, the other does as well, while a negative correlation suggests an inverse relationship[\[15\]](#). For example, a correlation coefficient of 0.7 indicates a strong positive relationship,



which can guide companies in adjusting their pricing strategies based on consumer behavior[15][7].

## Granger Causality Tests

Granger causality tests are employed to ascertain whether changes in one variable can predict changes in another. This is particularly relevant in understanding the relationship between macroeconomic factors, such as interest rates, and the price of gold. For instance, research has shown that factors like the US exchange rate, silver prices, and oil prices have significant correlations with gold prices[4][1]. Through these tests, researchers can determine the direction and strength of these causal relationships, enhancing the understanding of how economic indicators affect gold pricing.

## Data Visualization and Preliminary Analysis

Various visualization techniques are used to gain insights into the relationships among variables influencing gold prices. Initial analyses, including line charts depicting the closing prices of gold futures alongside Brent crude oil and silver futures, reveal trends and potential correlations over time. These visual representations facilitate a preliminary understanding of data characteristics and variable interactions[7].

## Unit Root Test and Cointegration Analysis

In the analysis of time series data, ensuring the stability and reliability of data is paramount. The Augmented Dickey-Fuller (ADF) test is commonly applied to assess the stationarity of the dataset. Results from the ADF test indicate that the variables of interest may exhibit non-stationarity at their original levels, implying that their statistical properties change over time. This non-stationarity can lead to pseudo-regression problems in economic modeling, necessitating careful handling of the data before proceeding with further analysis[7].

## Impact of Economic Indicators

Empirical studies reveal that various macroeconomic indicators, such as the Dow Jones Index, inflation rates, and consumer spending, significantly influence gold prices. For instance, a negative correlation has been found between gold prices and the US exchange rate, while a positive correlation exists between gold prices and silver and oil prices[4][1][2]. Understanding these relationships allows analysts to anticipate market trends and adjust investment strategies accordingly.

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