



# Analysis of the Gold Price Correlation Between China and the United States and its Influencing Factors

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**Abstract.** Gold price volatility has a profound impact on the global economy and investment decisions, and is a typical safe-haven asset. This paper uses VAR model and Granger causality test to analyze the relationship between Chinese and U.S. gold prices, as well as how the dollar interest rate and the U.S. dollar index affect the Chinese and U.S. gold prices. The findings show that China's gold price volatility will be affected by the U.S. gold price volatility, and the U.S. dollar interest rate also presents a significant impact on the gold price. Investors and policy makers should strengthen their monitoring and understanding of the gold market in order to optimize their investment strategies and formulate more precise economic policies, so as to maintain national economic security and financial market stability.

**Keywords:** gold price, dollar interest rate, dollar index, VAR model

## 1 INTRODUCTION

Gold, as the first global hard currency, has always occupied an extraordinary position in the global economic market. As a traditional hedging tool and a means of storing wealth, the price movement of gold directly affects the operation of the global economy and the investment decisions of investors.

A series of international event shocks in recent years have had a notable impact on global gold prices, such as the adjustment of U.S. monetary policy, the global spread of the New Crown Epidemic and the tensions between Ukraine and Russia, all of which have made gold price volatility more complex and unpredictable. For example, from March 2018 to July 2019 the Federal Reserve conducted nine interest rate hikes, increasing short-term interest rates from 1.5% to 2.5%, leading to a reduction in the attractiveness of gold, and the price fell sharply; and because of the instability of the global economy caused by the New Crown Epidemic, there was a general increase in the demand for the purchase of safe-haven assets such as gold, which made the price of gold in 2020 reach a new all-time high. The price of gold reached an all-time high in 2020. Recently, the global financial market pattern has changed significantly. 2024 since China's domestic gold prices continue to rise, its volatility has attracted much

attention. At the same time, the international side, in the context of the Federal Reserve's monetary policy adjustment, superimposed on the recent intensification of geopolitical conflict, as well as the global central banks of many countries on the continued demand for gold, multiple factors together to promote the strong rise in international gold prices. Huge fluctuations in the price of gold for investors has brought great investment risk, but also triggered the majority of economists and policymakers for the complex factors behind the inquiry. These frequent fluctuations and complex interactions have triggered in-depth thinking about the driving forces behind gold price movements.

Therefore, in the complex and changing economic environment, research on the factors of gold price changes, understand and master the fluctuation law of gold price, can help investors understand and predict the trend of gold price changes, optimize their investment strategy, reduce investment risk, and at the same time, can assist the policy makers to understand the fluctuation mechanism of the price of gold, provide effective early warning information for the formulation of the corresponding macroeconomic policy, especially the monetary policy to provide a basis for maintaining national economic security and stabilizing the national financial market. Provide the basis for the formulation of corresponding macroeconomic policies, especially monetary policy, and at the same time for the maintenance of national economic security, stabilize the national financial market is of great significance.

This study employs the VAR model and Granger causality test in its research and analysis, which seeks to explore the impact of various domestic and international factors on gold prices and the correlation between them, with a view to providing theoretical support for answering this question. The following section is structured as follows, the second part is the literature review, the third part is the introduction of the data and models required for the empirical analysis, the fourth part is the analysis of the empirical results, and lastly, the conclusions and recommendations.

## 2 LITERATURE REVIEW

For the study of gold price volatility, a large number of scholars from the volatility prediction, influencing factors and correlation analysis with other markets to carry out a lot of research work.

There are many international researches in gold price volatility prediction, using econometric methods and machine learning methods to continuously improve the prediction accuracy of the exchange price volatility. Kyrtsov and Malliaris (2009) take the gold price, oil price, and the euro as samples, analyze the correlation between gold and oil and the euro by using the time series model and use the neural network model to make a prediction, and find that the correlation between oil price and gold price correlation is strong, the oil price on the gold price is greater than the gold price on the oil price[1]; DasTirath et.al. (2022) proposed a CQCSA optimization based Extreme Learning Machines Fuzzy Inference System (ELMFIS) for oil and gold price prediction, and the results show that the prediction model has a strong validity[2].

There are many international studies on the analysis of long-term and short-term factors affecting the price of gold, Smith (2001) found that the price of gold will be affected by the stock market of developed countries, when the stock price index of developed countries is rising, the international price of gold will be all the way down, and the two show a negative correlation[3]; Capie et.al. (2004) found that the price of gold will be affected by the changes in the exchange rate of major currencies, and shows a negative correlation, the strength of this relationship has a dynamic trend. study, it is concluded that gold price will be affected by the exchange rate changes of major currencies and shows a negative correlation, and the strength of this relationship has a tendency to change dynamically, and the role of gold in hedging against fluctuations in the foreign exchange value of the US dollar depends largely on unpredictable political attitudes and events[4]; Zhu et.al.(2023) use predictive modeling and STL decomposition to revisit the potential driving effect of climate risk on gold price volatility and to observe the utility benefits of such risk, finding that gold price volatility is negatively correlated with physical risk, and evidence of physical risk of climate change is found in the predictions of gold price volatility[5].

The analysis of the correlation of gold price with other commodities and financial assets is also a hot issue. Lawrence(2003) findings point out the strong correlation between commodity prices such as aluminum and oil and gold price[6]. Tang and Zhong(2023) mainly examine the performance of tail risk (TR) constructed from commodity price indices of 19 subcategories to predict gold futures market volatility[7]. The findings show that the inclusion of TR indicators significantly improves the predictive accuracy of the gold futures volatility model. Ergül Tuba and Karakaş (2024) analyze the characteristics of gold's hedging against inflation after 2013, and the findings suggest that in particular, the demand for gold exchange-traded funds (ETFs) and the U.S[8]. 10-year bond rate is effective for the period of the gold price effectively. The conclusion is reflected in the fact that, at least in the recent period, gold did provide a partial hedge against inflation as an investment vehicle.

From the existing literature combing can be found, for the gold price volatility research has been very rich, but fewer studies focus on the transmission mechanism of regional gold prices and the correlation between this transmission relationship and other key factors. Therefore, this paper will focus on examining the mutual influence mechanism of gold prices in China and the United States, and on this basis, further consider the impact of the dollar interest rate, the dollar index and other key factors, which is of certain reference significance for judging the price trend of China's gold market.

### 3 DATA AND MODELS

#### 3.1 Data and Variables

**Comparison of Chinese and American Gold Price Line Graphs.** The core variable of interest in this paper is the price of gold in China and the international market, using the daily data of the closing price of gold futures on the Shanghai Futures Exchange, the closing price of gold Au9999 on the Shanghai Gold Exchange, the closing price of gold on the COMEX, and the fixing price of gold in the London market from 2008 to

2024, with the source of data from the Choice database. As shown in Figure 1, which is a comparative chart of various types of gold prices, it can be found that the up and down trend of gold futures and spot prices in the Chinese and international markets are relatively consistent, but there are some differences in the magnitude of the phase fluctuations. Therefore, in the following analysis, focus on the Shanghai Futures Exchange gold futures and COMEX gold futures prices.

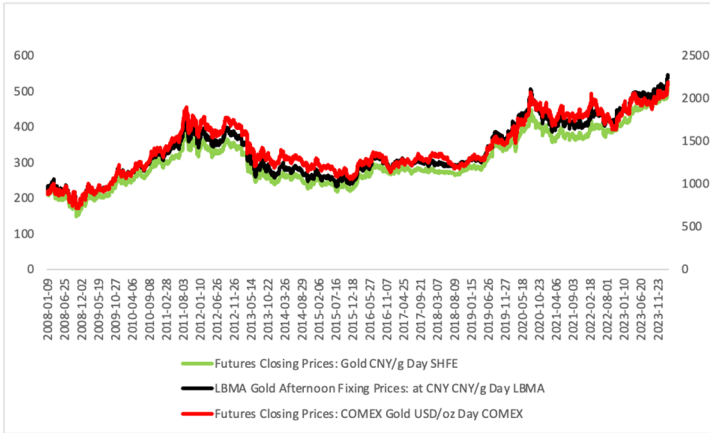


Fig. 1. The comparative chart of various types of gold prices

In the selection of other factor variables, this paper mainly considers the dollar interest rate and the dollar index, as shown in Figure 2, for the trend of the dollar interest rate and the dollar index comparison chart, it can be found that the dollar index as a whole shows a fluctuating upward trend, less volatility, while the dollar interest rate is more volatile, especially in recent years by the impact of the dollar interest rate hike, the interest rate shows a significant upward trend.

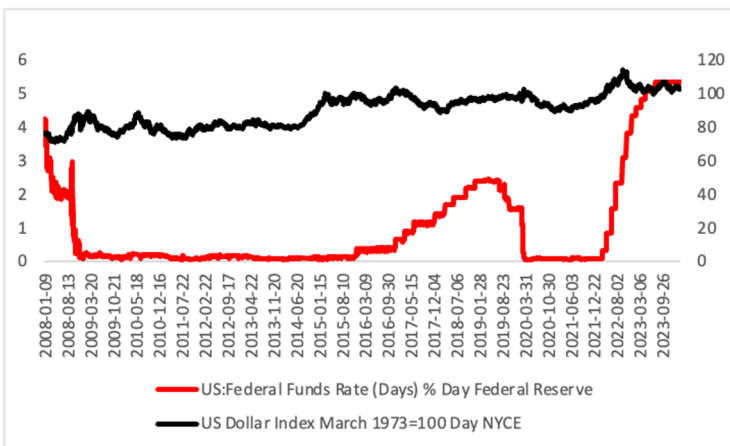


Fig. 2. The comparison chart of the dollar interest rate and the dollar index

**Data Pre-Processing.** The following analysis compares the U.S. Federal Funds Rate (RATE) with the U.S. Dollar Index (USD) using SHFE gold futures closing price data (denoted CNGOLD) and COMEX gold futures closing price data (denoted USGOLD).

In order to ensure the smoothness of the data, all the price data were processed using logarithmic first-order differencing to obtain the logarithmic yield data, which is calculated as follows:

$$R_t = \ln P_t - \ln P_{t-1} \quad (1)$$

Where  $P_t$  is the price data on day  $t$ , and  $R_t$  Then is the processed logarithmic yield data.

After the log difference treatment, ADF test is performed, as shown in Table 1, all data can pass the unit root test, which is smooth data and can be subjected to VAR modeling.

**Table 1.** Unit root test for variables

Test critical values	t-Statistic	Prob.*
CNGold	-62.71588	0.0001
USGold	-59.55286	0.0001
Rate	-52.38554	0.0001
USD	-61.92939	0.0001

**Descriptive Statistics and Correlation Analysis.** The descriptive statistics of the variables are shown in Table 2. Throughout the study interval, the average value of the logarithmic returns of Chinese and U.S. gold futures is greater than 0, and the return of U.S. gold price is slightly higher than that of China, but in terms of volatility, the volatility of U.S. gold price is slightly higher than that of China. From the point of view of the dollar interest rate and the dollar index, the volatility of the dollar interest rate is much larger than that of the dollar index, and the dollar index has the weakest volatility and the dollar interest rate has the strongest volatility among the four variables.

**Table 2.** The descriptive statistics of the variables

	CNGOLD	USGOLD	RATE	USD
Mean	0.000216	0.000241	5.93E-05	7.99E-05
Median	0.000245	0.000394	0.000000	9.57E-05
Maximum	0.056755	0.086250	1.417066	0.059531
Minimum	-0.078433	-0.094678	-1.481605	-0.030268
Std. Dev.	0.010683	0.011186	0.101193	0.005138
Skewness	-0.342726	-0.125847	0.533900	0.268148
Kurtosis	8.053415	8.730186	44.79170	9.892171
Jarque-Bera	4096.078	5181.494	275260.6	7526.868
Probability	0.000000	0.000000	0.000000	0.000000
Observations	3780	3780	3780	3780

The results of the correlation analysis of variables are shown in Table 3, the log returns of Chinese and U.S. gold prices show a significant positive correlation, with a correlation coefficient of 0.3021; the U.S. dollar interest rate and the log returns of Chinese and U.S. gold prices show a weak positive correlation, with the correlation coefficients of 0.0251 and 0.0165, respectively; and the U.S. dollar index and the log returns of Chinese and U.S. gold prices show a significant negative correlation, with the correlation coefficients of -0.1275 and -0.4067, especially the dollar index and the logarithmic return of U.S. gold futures show a strong negative relationship.

**Table 3.** The results of the correlation analysis of variables

	CNGOLD	USGOLD	RATE	USD
CNGOLD	1.0000	0.3021	0.0251	-0.1275
USGOLD	0.3021	1.0000	0.0165	-0.4067
RATE	0.0251	0.0165	1.0000	0.0238
USD	-0.1275	-0.4067	0.0238	1.0000

## 4 EMPIRICAL RESULTS

### 4.1 Analysis of the Results of the Fitting of the VAR Model

VAR (Vector Autoregression) model is an economic time series analysis method used to simulate and forecast the dynamic relationship between multiple related variables. The basic principle of VAR model is that the current value of each variable can be explained by its own lagged value and the lagged values of other variables, based on the assumption that there is interdependence and influence among variables. The VAR model describes the relationship between variables by introducing lag and error terms, and is mainly used to analyze the causal relationship between variables, shock transmission, and predicting future values.

The following table selects the four variables treated in section 3.1.2 above and adopts the 4-variable VAR model, which was tested by the SC information criterion to determine the optimal lag order to be 2, i.e., to construct the 4-variable VAR(2) model.

The fitting results of the VAR model are shown in Table 4, and it can be found that, at the 5% significance level, the effects of the U.S. gold price, the U.S. dollar interest rate and the U.S. dollar index on China's gold price are significant, in which the U.S. gold price, the U.S. dollar interest rate and China's gold price are positively correlated, the U.S. dollar index is positively correlated with China's gold price on the previous day while the U.S. dollar index is negatively correlated with China's gold price on the next day; the effect of China's gold price, U.S. dollar interest rate and the dollar index are all significant to the U.S. gold price, in which the Chinese gold price, the dollar interest rate and the Chinese gold price are positively correlated, while the dollar index is negatively correlated with the U.S. gold price. And the regression coefficient of the US dollar interest rate to the US gold price is larger than that of the US dollar interest rate to the Chinese gold price.

**Table 4.** The fitting results of the VAR model

	CNGOLD	USGOLD	RATE	USD
CNGOLD(-1)	-0.457555 (0.01690) [-27.0771]	-0.003896 (0.02547) [-0.15299]	-0.343065 (0.22377) [-1.53309]	-0.021460 (0.01169) [-1.83541]
CNGOLD(-2)	-0.074510 (0.01251) [-5.95490]	-0.018249 (0.01886) [-0.96770]	-0.350695 (0.16569) [-2.11652]	-0.006475 (0.00866) [-0.74785]
USGOLD(-1)	0.755983 (0.01265) [ 59.7670]	0.024504 (0.01906) [ 1.28543]	0.483202 (0.16750) [ 2.88477]	-0.009245 (0.00875) [-1.05628]
USGOLD(-2)	0.313176 (0.01699) [ 18.4302]	-0.017076 (0.02561) [-0.66679]	0.108718 (0.22502) [ 0.48315]	-0.005629 (0.01176) [-0.47878]
RATE(-1)	0.000374 (0.00123) [ 0.30520]	0.001264 (0.00185) [ 0.68457]	-0.242056 (0.01623) [-14.9160]	-0.000506 (0.00085) [-0.59716]
RATE(-2)	-0.001206 (0.00122) [-0.98483]	0.003240 (0.00185) [ 1.75522]	-0.085792 (0.01622) [-5.29013]	-8.08E-05 (0.00085) [-0.09536]
USD(-1)	0.076048 (0.02578) [ 2.94931]	-0.042994 (0.03886) [-1.10634]	0.381946 (0.34145) [ 1.11859]	-0.022201 (0.01784) [-1.24437]
USD(-2)	0.091523 (0.02579) [ 3.54874]	-0.009804 (0.03887) [-0.25223]	0.029229 (0.34152) [ 0.08558]	-0.022141 (0.01785) [-1.24076]
C	7.74E-05 (0.00012) [ 0.63992]	0.000243 (0.00018) [ 1.33518]	6.09E-05 (0.00160) [ 0.03806]	9.50E-05 (8.4E-05) [ 1.13566]
R-squared	0.517083	0.002840	0.059682	0.003743
Adj. R-squared	0.516058	0.000723	0.057686	0.001629
F-statistic	504.4577	1.341757	29.90236	1.770188
Schwarz SC	-6.952071	-6.131677	-1.785226	-7.688614

## 4.2 Analysis of the Results of the Granger Causality Test

As shown in Table 5, it is the result of Granger causality test between variables, and it can be found that, at 5% significance level, U.S. gold price is the Granger cause of China's gold price, but vice versa, China's gold price is not the Granger cause of U.S. gold price. This indicates that the U.S. gold price and Chinese gold price are not causally related to each other, and the U.S. gold price affects the Chinese gold price more.

In terms of Granger causality test of dollar interest rate, dollar index and Chinese gold price, at 5% significance level, dollar index and Chinese gold price are Granger causality to each other, and there is no Granger causality between dollar interest rate and Chinese gold price; in terms of Granger causality test of dollar interest rate, dollar index and U.S. gold price, it can be seen that neither the dollar interest rate nor the dollar index is the Granger cause of the U.S. gold price, on the contrary, the U.S. gold price is the Granger cause of the U.S. dollar interest rate and the U.S. dollar index.

**Table 5.** The results of the Granger causality test for VAR

Null Hypothesis:	Obs	F-Statistic	Prob.
USGOLD does not Granger Cause CNGOLD	3778	1994.20	0.0000
CNGOLD does not Granger Cause USGOLD		0.40587	0.6664
RATE does not Granger Cause CNGOLD	3778	1.00957	0.3645
CNGOLD does not Granger Cause RATE		2.76305	0.0632
USD does not Granger Cause CNGOLD	3778	109.587	5.E-47
CNGOLD does not Granger Cause USD		6.15456	0.0021
RATE does not Granger Cause USGOLD	3778	1.54807	0.2128
USGOLD does not Granger Cause RATE		3.52084	0.0297
USD does not Granger Cause USGOLD	3778	0.55877	0.5720
USGOLD does not Granger Cause USD		5.07113	0.0063
USD does not Granger Cause RATE	3778	0.16100	0.8513
RATE does not Granger Cause USD		0.27649	0.7585

### 4.3 Impulse Response Analysis

This paper uses impulse response functions to analyze the short-term impact of each variable. Figure 3 shows the impulse response function images of the four variables: the gold price in China and the United States, the US dollar index, and the US dollar interest rate. It can be seen that when the price of gold in the United States changes, it will have a relatively strong positive impact on the price of gold in China, and then gradually converge to zero. Although the impact is relatively short-term, the positive impact is relatively strong. At the same time, the impulse response function of the price of gold in China to the price of gold in the United States shows that the price of gold in China will also have a short-term positive impact on the price of gold in the United States, but compared to the impact of the price of gold in the United States on the price of gold in China, the impact is relatively small, and converges to 0 more quickly; from the impulse response of the US dollar interest rate and the US dollar index to the gold prices in China and the US, the impact is relatively weak. The US dollar interest rate will have a weak positive impact on the gold prices in China and the US in the short term; the US dollar index will have a weak positive impact on the gold prices in China in the short term, but it will then converge to 0, and the impact of the US dollar index on the gold prices in the US is not significant. Conversely, the US-China gold price has no significant impact on the US interest rate, but the US gold price has a significant negative impact on the US dollar index in the short term.



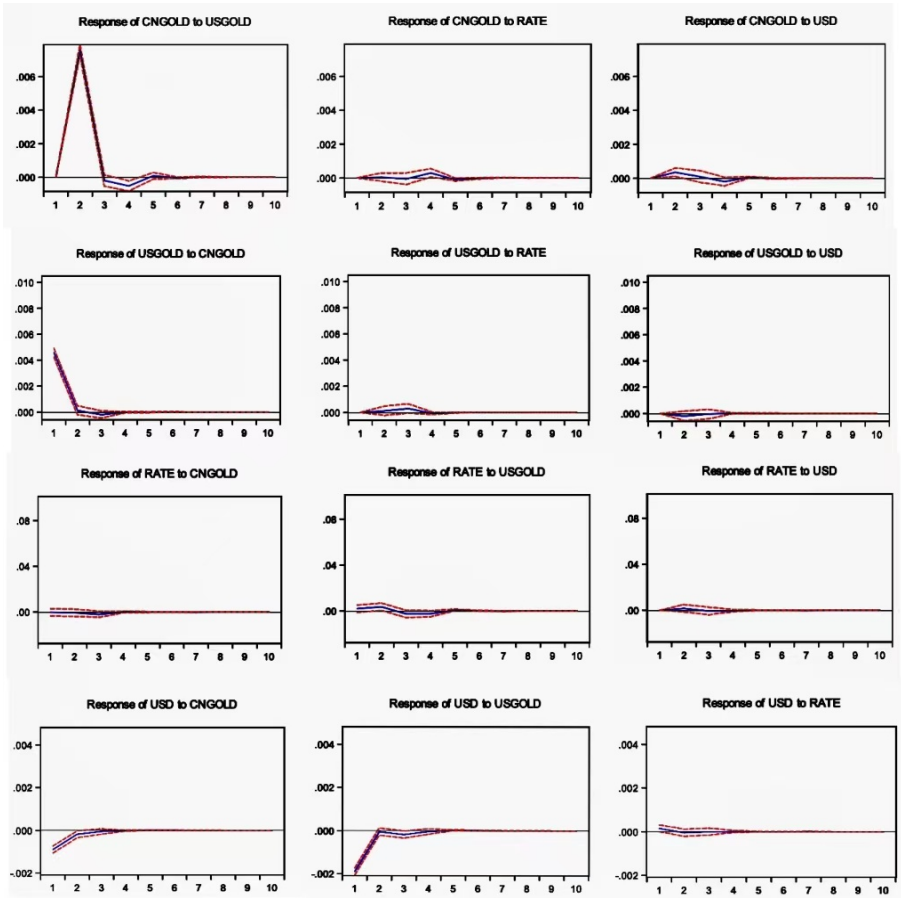


Fig. 3. impulse response function

#### 4.4 Analysis of Variance Decomposition

The results of the variance decomposition are shown in Figure 4, for the Chinese gold price, the U.S. gold price is an important factor in explaining the volatility of the Chinese gold price, but for the U.S. gold price, the strength of its own explanation is much greater than that of the other three variables. For Chinese and U.S. gold prices, the proportion that can be explained by the U.S. interest rate and the U.S. exchange rate are both smaller.

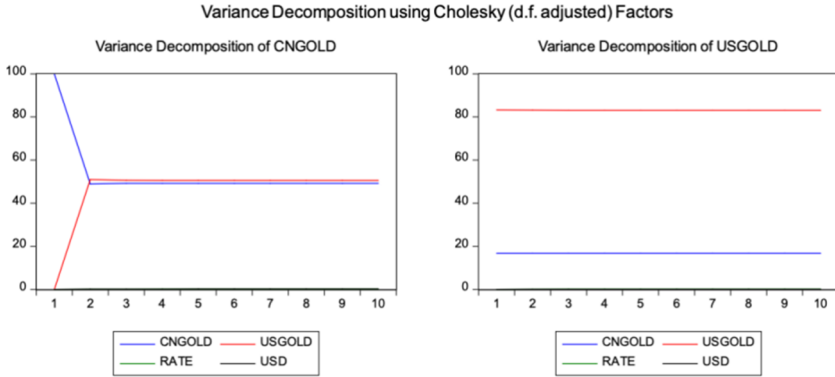


Fig. 4. Variance Decomposition

## 5 CONCLUSION

This paper uses the data of Chinese gold price, U.S. gold price, as well as the U.S. dollar exchange rate and the U.S. dollar index from 2008 to 2024, and conducts descriptive statistics and correlation analysis on the data, and the results show that the volatility of U.S. gold price is higher than that of China, the U.S. dollar interest rate and the logarithmic return on U.S.-Chinese gold price show a weak positive relationship, the U.S. dollar index and the logarithmic return on U.S.-Chinese gold price show a significant negative relationship,. And the dollar index and the log return on U.S. gold futures show a strong negative relationship. Through the VAR model fitting part and Granger causality test part, from the point of view of the impact of the dollar interest rate, the dollar index on the fluctuation of the gold price, these indices and the gold price is the existence of long-term cointegration relationship, and the U.S. gold price on China's gold price is the existence of Granger causality, that is, the U.S. gold price changes unidirectionally lead to the change of China's gold prices, which indicates that there is a certain correlation between gold prices of different countries, and there is a significant negative correlation between gold prices of the U.S. and China. This shows that there is a certain correlation between the gold prices of different countries. Through the impulse response analysis, variance decomposition and model setting, this paper finds that the U.S. gold price can strongly affect the volatility of Chinese gold price, and the U.S. dollar index also has a certain impact on it, which is the same as the conclusion of the previous Granger causality test.

According to the empirical part above, China's gold price is more significantly affected by the U.S. gold price and also affected by the U.S. dollar index, therefore, when forecasting the gold price or including it as a safe-haven asset in the portfolio, it is necessary to pay close attention to the fluctuations of the international gold market and the currency market in order to avoid the excess loss of the portfolio due to the dramatic fluctuations of the U.S. gold price or the U.S. dollar interest rate. At the same time, investors can use the international gold market and currency market fluctuations. At the

same time, investors can use international gold futures, exchange rate futures and other derivative financial instruments for risk hedging to effectively manage the risk exposure of the asset portfolio.

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