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The Correlation Between the Price of Gold and Monetary Policy: A Case Study of The Chinese Market

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ABSTRACT

Currently, the global economy is confronted with an unstable situation, and due to gold's characteristics as a risk hedge, the gold market has once again garnered significant attention. Many investors are shifting their focus towards gold, particularly in China where it has sparked a gold rush. This study aims to evaluate the relationship between Chinese gold prices, net funding amount, securities amount, money supply, policy interest rates, and exchange rates. By examining the connection between gold and monetary policy, this paper explores the actual role of gold in China's economic landscape. Monthly data from January 2008 to December 2023 were utilized for VAR model analysis. These indicators' channels are interconnected and theoretically impact the country's monetary policy. The conclusion suggests that lowering monetary policy rates in response to easing measures can potentially stimulate inflation and consequently influence upward pressure on the price of gold. Additionally, securities amount negatively affects the price of gold as increasing it serves as China's strategy for curbing inflationary pressures which prevents driving up the price of gold through inflation alone. Other monetary policy indicators also indirectly or directly relate to changes in inflation with potential implications for fluctuations in gold prices. Through these conclusions drawn from our analysis, this research contributes twofold: firstly, by analyzing how changes in monetary policy affect China using its example; and secondly by establishing links between monetary policy decisions and their impact on variations in gold prices. These findings hold relevance for policymakers within central banks or financial institutions alike as well as academia and industry professionals involved with precious metals.

KEYWORDS

Gold Price; Monetary Policy; Decomposition Analysis; VAR Model; China

1. INTRODUCTION

In 2024, China's gold market experienced significant activity and garnered frequent media attention. The interplay of various domestic and international factors has propelled the global gold price to reach unprecedented highs, with the purchasing behavior of the Chinese central bank potentially serving as a crucial driving force. In just the first quarter of 2024, global central banks augmented their holdings by 290 tonnes of gold, marking the largest increase in the first quarter since 2000, with notable contributions from the People's Bank of China. The unwavering commitment of the Chinese government to stabilize financial markets and foster continued growth in gold reserves has demonstrated unparalleled dynamism within this sector.

According to the latest data, China currently plays a crucial role and serves as a driving force in the global gold market. Since 2007, China has consistently surpassed South Africa in gold production, establishing itself as the world's leading gold producer. In 2023, China's gold production reached an

impressive 375.155 tons, reflecting not only its formidable strength in this sector but also significant advancements in the development and utilization of gold resources. Simultaneously, China continues to exhibit sustained enthusiasm for gold consumption. Reported data indicates that Chinese consumers' demand for gold reached 1,089.69 tons in 2023—a notable increase of 8.78%. This demonstrates ongoing interest among investors and collectors alike towards acquiring and holding onto precious metal assets. Notably, last year (2024), the World Gold Council reported a further surge in China's investment demand for physical gold—an observation that has captured the attention of global central banks and other markets who recognize its influence as one of the primary drivers shaping industry trends. Presently, it can be asserted that there exists an interdependent and closely linked relationship between China and the global gold market. Through collaborative efforts on both production and consumption fronts—bolstered by domestic initiatives alongside external factors—it is evident that cooperation and exchanges between these two entities are deepening with mutual benefits fostering common growth.

The connection between China and the gold market has been steadily deepening, particularly with the government's gradual opening up of China's gold market prior to the pandemic. An increasing number of international investors have entered China's gold market, with Hong Kong serving as a gateway for mainland investors to access overseas gold markets. Furthermore, an analysis of the trend and volatility of the gold price spread between London and China revealed structural changes in China's gold market before and after the establishment of the International Board (Tsai, Wang & Li, 2019). This indicates a gradual integration of the Chinese gold market with international counterparts such as the London Gold Market, supported by concerted efforts from the Chinese government as evidenced in official policy documents available on China's official website. During the turbulent period in 2008, while emphasizing tight monetary policy requirements, policies directed financial institutions to maintain a cautious approach towards adjusting loan interest rates while simultaneously encouraging and tightening loans. It is important to recognize that China demonstrates proficiency in managing monetary policy within its economy.

In fact, due to its critical role in ensuring economic stability, monetary policy necessitates the attention of policy planners towards sensitive changes that align with their objectives. As the foremost trading metal commodity and a significant safe-haven asset for numerous countries, gold exerts a substantial influence on global economic price fluctuations and plays a pivotal role in international trade and the global economy. Given the magnitude of China's gold market and gold's significance as an essential element of portfolio diversification, robust demand for gold in China would correspond with the NYMEX global benchmark (Arouri, Lahiani & Nguyen, 2015). This paper aims to examine the relationship between gold prices and Chinese monetary policy since 2008 from the perspective of gold prices within China.

The variables relevant to the theme selected in this study are gold price and six monetary policy indicators (such as interest rate, exchange rate, etc.). These variables will be utilized for constructing econometric models and decomposing them using time-series correlation methods. Considering the potential interference effects caused by endogeneity problems, a VAR model is employed to capture the relationship between variables while selecting an appropriate model, and other models are used for assessing and correcting the time series data. This approach can effectively mitigate bias resulting from endogeneity problems and yield reliable and accurate conclusions.

The testing process begins with conducting seasonal processing and unit root tests on the data to confirm its stability at the same order. Subsequently, the results of the Granger causality test are consulted, and the impulse response of a VAR model is utilized to extract causal relationships. By combining these response results with causality analysis, we can establish a confirmed correlation between gold prices and monetary policy. Furthermore, an in-depth examination of China's monetary policy changes from 2008 to 2023 will be conducted through policy reports from different periods, which reflect both the country's judgment on current economic conditions and their decision-making regarding monetary policies during indicator fluctuations. Finally, by integrating inflation factors into

our understanding of internal relationships within monetary policy indicators and comparing them with fluctuations in gold prices, conclusive findings can be obtained.

2. LITERATURE REVIEW

Gold has long been a subject of discussion in economics, and the exploration of its full value has been a topic extensively studied throughout history. O'Connor et al. (2015) provided a comprehensive review of literature pertaining to the historical aspects of gold, highlighting that while its physical value was more prominent in the past, currently, its economic value has surpassed intrinsic worth and emerged as a novel research focus - specifically, gold's ability to serve as a hedge against risks.

2.1. The Hedging Ability of Gold

The early research on gold hedging dates back to 1990, when Chua et al. published a paper demonstrating the lack of correlation between gold price movements and stock price movements based on monthly data from 1971 to 1988. Subsequent studies by Baur and Lucey (2010) revealed strong hedging abilities of gold in the United States, the United Kingdom, and Germany, while Baur and McDermott (2010) found limited impact in countries such as Australia, Canada, and Japan. A recent study by Beckmann et al. (2019) examined gold's dependence on stocks and bonds post-2008, casting doubt on its risk-hedging capabilities. These findings suggest that the effectiveness of gold as a market hedge is period-specific and varies across different countries (Beckmann et al. 2015; Gurgun et al. 2014).

While the correlation between stock markets and gold may vary from country to country, there is no definitive conclusion regarding gold's hedging capabilities. However, with the presence of the Shanghai Gold Exchange and the New York Gold Exchange, China and the United States possess mature stock and financial markets, rendering them influential countries. Therefore, literature focusing on these countries as primary research subjects can yield valuable insights applicable to most markets. For instance, Mei and McNown (2019) demonstrated a volatile conduction relationship between returns in the US stock market, Chinese stock market, and global gold market, highlighting their significant impact on the gold market. Additionally, Moussa et al. (2021) thoroughly examined the influence of gold prices on the American financial market. Furthermore, Ming et al. (2020) indicated that following China's capital market reform in 2005 and government exchange rate reform, gold could serve as a long-term hedging tool in China. Lai and Tseng (2010) also presented evidence supporting the Chinese stock market as a safe haven during times of financial turmoil, due to China's stable economic performance being considered for de-risking global investors' portfolios.

2.2. The Factors That Correlate with Gold

Due to the intrinsic properties of gold and its significant role in the economy, numerous economic factors are intricately linked with it. Apart from the aforementioned stock market hedging of gold, other influential factors affecting its price, such as oil and exchange rates, have become prominent subjects of research. Figure 1 below illustrates the integration of pertinent literature in this field.

Table 1. Literature on Gold as an Influential Factor

Key Factor	Author (period)	Variable	Methodology	Significant Result
Gold, Oil	Ewing et al. (2013)	Gold daily futures data Crude oil daily futures data	Univariate and Bivariate GARCH model	Gold to oil markets (transmission of volatility)
	Barunik et al. (2016)	Gold price Oil price Stock price	DCC GARCH model	Gold to oil and stock (after the financial crisis 2007-2009)
	Gil-Alana et al. (2017)	Gold price Oil price	Fractional cointegration techniques	Gold (past price) to Oil (current price)
Gold, Oil, Exchange Rate, Other Index	Aye et al. (2015)	Business cycle The nominal factor Interest rate The commodity factor Exchange rate Stock price	TVP model DMA model DMS model BMA model RW model	Exchange rates to gold returns (financial variables stronger than real economic variables)
	Sujit et al. (2011)	Gold price S&P 500 Index Exchange rate Oil price index (WTI) Oil price index (BRENT)	VAR model	Gold price to WTI index and exchange rate.
	Qian et al. (2019)	Gold price Dollar Index Federal funds rate CPI Exchange rate Oil price S&P500	Box–Behnken design (RSM)	Gold price to dollar Index, federal funds rate, exchange rate and S&P500 (negative)

Oil, similar to gold, is a significant internationally traded commodity with a substantial impact on the global economy. Early research has shown that there is a notable relationship between the two commodities: Ewing and Malik (2013) utilized the GARCH model to examine the volatility of gold and oil futures using single and dual variables, demonstrating significant correlation between them. Furthermore, Barunik et al. (2016) employed wavelet analysis to conduct time-frequency analysis on the correlation among gold, oil, and stocks, concluding that heterogeneity is a prominent feature of their interactions. Additionally, gill-alana et al. (2017) integrated fractional integration and cointegration concepts in their study utilizing advanced time series analysis techniques to analyze the relationship between oil prices and gold prices; they concluded that there exists a fractional cointegration relationship between these two variables. These studies provide empirical evidence for cross-market hedging of gold through various methods and support the notion that financial market participants share common information.

The existing literature on the relationship between gold prices and exchange rates often incorporates analysis of various economic indicators. Many economists argue that while the price of gold is primarily influenced by its supply and demand, its movements can also impact other economic indicators. For instance, aye et al. (2015) developed multiple models to identify factors influencing gold prices, identifying six predictive factors: business cycle, nominal interest rate, interest rate, commodity prices, exchange rates, and stock prices. Additionally, the Kansas City Fed's Financial Stress Index and the U.S. Economic Policy Uncertainty Index are considered as unpredictable

variables in this context. Among these factors, exchange rates have been found to exert a significant influence across all segments. Furthermore, Sujit and Kumar (2011) emphasized in their research that exchange rates play a crucial role in the dynamic relationship between gold prices, oil prices, exchange rates and stock market returns. Moreover, Qian et al. (2019) demonstrated through an integrated study using VAR model that the US dollar index, federal funds rate, oil price (WTI), exchange rate, and Standard & Poor's 500 index all have negative effects on gold price. Conclusively, the findings from this literature confirm a close association between oil prices and exchange rates with gold prices, resulting in mutual influential dynamics among them.

2.3. The Interaction Between Monetary Policy Indicators And Gold

With the evolution of monetary policy, there is a growing trend towards diversification and detailed analysis. The relationship between monetary policy and gold extends beyond just the exchange rate as a single indicator. As a result, in the past five years, an increasing body of literature has generated novel insights from the perspective of monetary policy. Figure 2 below illustrates the integration of pertinent research literature.

Table 2. Literature on Monetary Policy as Factor

Key Factor	Author (period)	Variable	Methodology	Significant Result
Gold, Exchange Rate, Monetary Policy Indicators	Zhu et al (2018)	Gold price Inflation expectations Exchange rates Stock market returns	GARCH model Dummy Variable model	Gold price to exchange rate Gold price to stock market returns (US market is negative/UK market is positive)
	Wong et al. (2019)	Foreign direct investment stock monetary policies Exchange rate	Fully modified OLS Dynamic OLS	Macroeconomic policy, exchange rate and FDI
	Depren et al. (2021)	Gold Prices MSCI Emerging Market Index Oil Prices VIX Index Monetary Policy Measures Indicators COVID-19 Indicators	Machine Learning Algorithms	Exchange rate to gold price (Before COVID-19 period) CBRT Monetary Policy Measures Indicators (Net funding amount, securities bought amount and WAC funding) to gold price (Before COVID-19 period)
	Muham mad, et al (2021)	Gold price Exchange rate Interest rate Oil prices	VAR model	Exchange rate (Pakistan) to gold price
	Shaikh and Vallabh (2022)	Gold price Exchange rate Sensex equity index Government’s 10 years G-sec bill VIX	Bai-Perron tests-based regression model	Exchange rate (India) to gold price (positive) Sensex equity index to gold price (negative)

For instance, Zhu et al. (2018) conducted a study on monetary policy focusing on the impact of inflation and the stock market on gold dynamics. Utilizing the GARCH model to analyze these influencing factors, they concluded that the US quantitative easing policy had a limited effect on gold.

However, there is insufficient evidence regarding the impact of British and Japanese monetary policies. This gap in the literature suggests a need for additional methodologies to explore this relationship further. In another perspective, Wong et al. (2019) performed panel unit root tests, panel co-integration tests, and dynamic ordinary least squares estimation analyses on fiscal and monetary policies, exchange rates, and FDI in ASEAN countries from 1995-2015. Their findings indicate a positive correlation between macroeconomic policy, exchange rates, and FDI. Similarly demonstrating strong correlation proof is Depren et al.'s recent study (2021), which utilized machine learning algorithms to verify the impact of monetary policy measures on gold prices in Turkey during the 2020 epidemic period by considering global factors, national factors, and monetary policy factors for research purposes. This novel scientific approach serves as an exemplary model worth emulating in future studies; scholars affirm its significance in highlighting the importance of monetary policy measures on gold prices.

In a separate study, Muhammad, Warda, and Zahid (2021) undertook an investigation into the monetary policy of Pakistan. Employing the VAR model to analyze variables such as gold price, oil price, exchange rate, and monetary policy interest rate, they concluded that a tight monetary policy would result in a decrease in gold prices. Furthermore, scholars Shaikh and Vallabh (2022) presented pertinent evidence regarding the correlation between India's monetary policy and gold price. One significant finding is that an increase in policy rates negatively impacts the gold market; this aligns with complementary research on the Indian exchange rate found in existing literature which underscores the significance of RBI announcements for the gold market. These studies demonstrate that conclusions drawn from literature analysis on various countries' monetary policies vary due to differences among these policies. The literature examining the impact of monetary policy on gold yields specific conclusions through case-specific analyses.

2.4. Conclusion

Overall, based on the aforementioned literature, it is evident that gold has exhibited a profound association with the stock market in previous studies, and its hedging characteristics have been extensively explored. However, given the evolving global economic conditions, there have been certain alterations in the relationship between these two variables – transitioning from partial non-correlation to partial correlation. Consequently, it becomes imperative to reassess the existence of gold's hedging performance. Furthermore, recent research has corroborated positive correlations between other factors such as oil prices and exchange rates as documented in prior literature. Therefore, future research endeavors should focus on conducting more comprehensive analyses regarding the impact of both conventional and unconventional monetary policies on gold prices.

A comprehensive review of recent literature reveals that, in addition to exchange rates and oil, there exists a potential relationship between monetary policy and gold. Therefore, this study employs Net Funding Amount, Securities Amount, Money Supply, and Monetary Policy Rate as endogenous variables to gauge changes in monetary policy. Furthermore, the impact of gold prices on these endogenous variables is examined to obtain response results.

The expectations of outcomes are inferred by referencing a study conducted in Turkey, a developing country facing similar circumstances. It is assumed that the loose monetary policy implemented during the initial stage of the Chinese market will lead to an increase in gold prices, while the subsequent tight monetary policy following the epidemic will result in a decline in gold prices. In other words, this study anticipates that there will be a positive correlation between the impact of gold shocks on variables promoting easy monetary policies and fluctuations influenced by underlying factors. Similarly, it assumes that there will be a negative correlation between monetary policy variables promoting tightening measures and their influence on gold prices, which also varies with certain underlying causes.

3. METHODOLOGY

3.1. Date Describe

Due to the limited availability of China's economic data and the global economic changes in 2008 as a dividing line, we have selected monthly economic data for 6 variables from January 2008 to December 2023. Gold prices are sourced from the International Gold Council and are denominated in RMB. In order to measure monetary policy, we have incorporated Money Supply into the Net Funding Amount and Securities Amount of the original basis, following the reaction effect index proposed by Depren, Kartal, and Karel Depren (2021). Additionally, Exchange Rate and Monetary Policy Rate have been included as new indicators. The official values of National Indicators for monetary policy can be found in the database of the Central Bank of China based on research conducted by Qian, Ralescu, and Zhang (2019). Specific sources and data abbreviations for each dataset are detailed in Table 3.

Table 3. Endogenous Variable of Study

Group	Variable	Code	Data
Global Indicators	Real Gold price per troy ounce (Unit:Yuan)	RGP	World Gold Council
National Indicators (China)	Net funding Amount (Unit:100 Million Yuan)	NFA	People's Bank of China official website
	Securities Amount (Unit:100 Million Yuan)	SA	People's Bank of China official website
	Money Supply (Unit:100 Million Yuan)	MS	People's Bank of China official website
	Exchange Rate (USD/CNY)	ER	China Currency official website
	Monetary policy rate (1year loan benchmark rate%)	MPR	China Currency official website

The Net funding Amount represents the unprocessed underlying data from China's central bank, as derived from the monetary authority's balance sheet. This encompasses currency issuance and deposit reserves, with the speed of currency issuance gradually increasing in line with the volume and economic requirements of China's development. The Chinese monetary system has consistently operated under a "partial reserve system", whereby commercial banks, policy banks, and other depository institutions are required to maintain a certain ratio of cash and deposits in the central bank as part of their deposit reserves. This index directly reflects the level of Chinese currency reserves at any given time, while also indirectly indicating the demand for cash within the Chinese market.

The Securities Amount, unlike the Net funding Amount, is derived from the asset column in the balance sheet of the monetary authority. It represents the quantity of government-issued bonds held by the central bank, indicating China's central bank purchasing power. The fluctuation in this amount serves as a reflection of the direction towards tightening or loosening control within China's monetary policy, thereby providing direct evidence for changes in China's monetary policy.

Money supply refers to the aggregate value of monetary assets at a specific point in time. It is a crucial determinant influencing market dynamics, supply and demand fluctuations, as well as exerting a direct impact on various macroeconomic variables such as inflation. As an essential gauge for measuring currency circulation levels, it effectively reflects economic activities across different countries and aids in assessing their current economic health. This study selects money supply as one of the key indicators in monetary policy analysis, providing valuable insights into monetary aspects for further research.

The Monetary policy rate refers to the annual benchmark lending rate set by China. The regulation of this interest rate aims to mobilize monetary liquidity, taking into account the country's price level, thereby indirectly reflecting its level of economic development. Therefore, this study aims to incorporate these two variables in order to facilitate the assessment of inflation and business cycle fluctuations in the currency.

Furthermore, given that exchange rates and monetary policy are influenced by the same factors, their close correlation will be utilized in general research to illustrate the fluctuations in the monetary policy of the country under investigation. Similarly, this paper also opts to utilize exchange rates as a means of elucidating the connection between currency value and monetary policy.

Subsequently, statistical analysis was conducted on the data. Despite adjusting for units, the Real Gold price, Net funding Amount, Securities Amount, and Money Supply variables still exhibit significant disparities compared to other variables. To mitigate this issue of heteroscedasticity and reduce absolute values in the data, a logarithmic transformation was applied to these four groups of data in empirical analysis resulting in RGP=Log (RGP), NFA=Log (NFA), SA=Log (SA), and MS=Log (MS). Consequently, these four variables were considered as growth rates for further investigation in this study.

Moreover, the data were observed to fluctuate slightly from quarter to quarter over the course of a year. Therefore, it is possible for all seven variables to be affected by seasonal fluctuations. In order to eliminate seasonal factors, we adopted CensusX-12 Season Adjustment for data processing, and obtained the adjusted data RGP_SA, VIX_SA, NFA_SA, SA_SA, MS_SA, ER_SA and MPR_SA.

3.2. VAR Model

Next, in order to explore the possible interaction between gold price and monetary policy, the VAR model will be established to analyze the 6 selected endogenous variables. Before establishing the model, we conducted unit root test on 6 groups of data, and Augmented Dickey-Fuller (ADF) test method was used to obtain that the variables were all first-order stationary. The sequential modified likelihood-ratio test (LR) was used to confirm that the VAR order was 3. With reference to the VAR model proposed by Sims (1980), the following VAR model formula is established:

$$A_0 z_t = \alpha_0 + \sum_{i=1}^{k} A_i z_{t-p} + \varepsilon_t \quad t = 1,2,\cdots,T$$

z_t is a set of endogenous variables, and is explained by the economic significance of 6 variables. There are no exogenous variables in the model. $z_{t-1}, i = 1,2\cdots,$ pis a lagging endogenous variable. A_0 represents the [6×6] synchronous matrix and A_i is the [6×6] autoregressive coefficient matrix. p is the order of lag. The error term ε_t is a sequence of structural innovation vectors that are unrelated to each other. In order to make the analysis easier to estimate, the conventional method is used to multiply A_0^{-1}both sides of the formula to transform the structural equation to get the simplified VAR model:

$$z_t = \beta_0 + \sum_{i=1}^{k} A_j z_{t-p} + e_t \quad t = 1,2,\cdots,T$$

Where; $\beta_0 = A_0^{-1}\alpha_0$; $A_j = A_0^{-1}A_i$; $e_t = A_0^{-1}\varepsilon_t$. Where e_t is the vectors for estimating residuals in the simplified VAR model.

Considering the structural disturbance, the correlation matrix is obtained by decomposing e_t as follows;

$$e_t = \begin{bmatrix} e_{1,t}^{D(RGP\_SA)} \\ e_{3,t}^{D(NFA\_SA)} \\ e_{4,t}^{D(SA\_SA)} \\ e_{5,t}^{D(MS\_SA)} \\ e_{6,t}^{D(ER\_SA)} \\ e_{7,t}^{D(MPR\_SA)} \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{bmatrix} \times \begin{bmatrix} \varepsilon_{1,t}^{D(RGP\_SA)} \\ \varepsilon_{3,t}^{D(NFA\_SA)} \\ \varepsilon_{4,t}^{D(SA\_SA)} \\ \varepsilon_{5,t}^{D(MS\_SA)} \\ \varepsilon_{6,t}^{D(ER\_SA)} \\ \varepsilon_{7,t}^{D(MPR\_SA)} \end{bmatrix}$$

The impact in the formula is defined as follows: $\varepsilon_{1,t}^{D(GGP\_SA)}$ is the global gold production shock, $\varepsilon_{4,t}^{D(NFA\_SA)}$ is the net funding amount shock, $\varepsilon_{5,t}^{D(SA\_SA)}$ is the securities amount shock, $\varepsilon_{6,t}^{D(MS\_SA)}$ is the money supply shock, $\varepsilon_{6,t}^{D(MS\_SA)}$ is the exchange rate shock, $\varepsilon_{8,t}^{D(MPR\_SA)}$ is the Monetary policy rate shock.

4. RESULT AND DISCUSSION

4.1. Test Result

4.1.1. Unit Root Test Results

Table 4. Unit Root Tests

Variable	In Level		In First Different	
	t-Statistic	Prob.*	t-Statistic	Prob.*
RGP_SA	-1.104677	0.9247	-11.19449	0.0000
VIX_SA	-4.066031	0.0083	-11.98208	0.0000
NFA_SA	-1.773368	0.7139	-13.26232	0.0000
SA_SA	-3.074417	0.1155	-15.02709	0.0000
MS_SA	-1.076439	0.9293	-18.14049	0.0000
ER_SA	-2.316839	0.4224	-8.749818	0.0000
MPR_SA	-2.804246	0.1976	-6.237462	0.0000
* Indicates lag order selected by the criterion				

4.1.2. Granger Causality Test Results

Based on the VAR 3-order model, test whether the parameters representing causality are significant, and get the results shown in table 5:

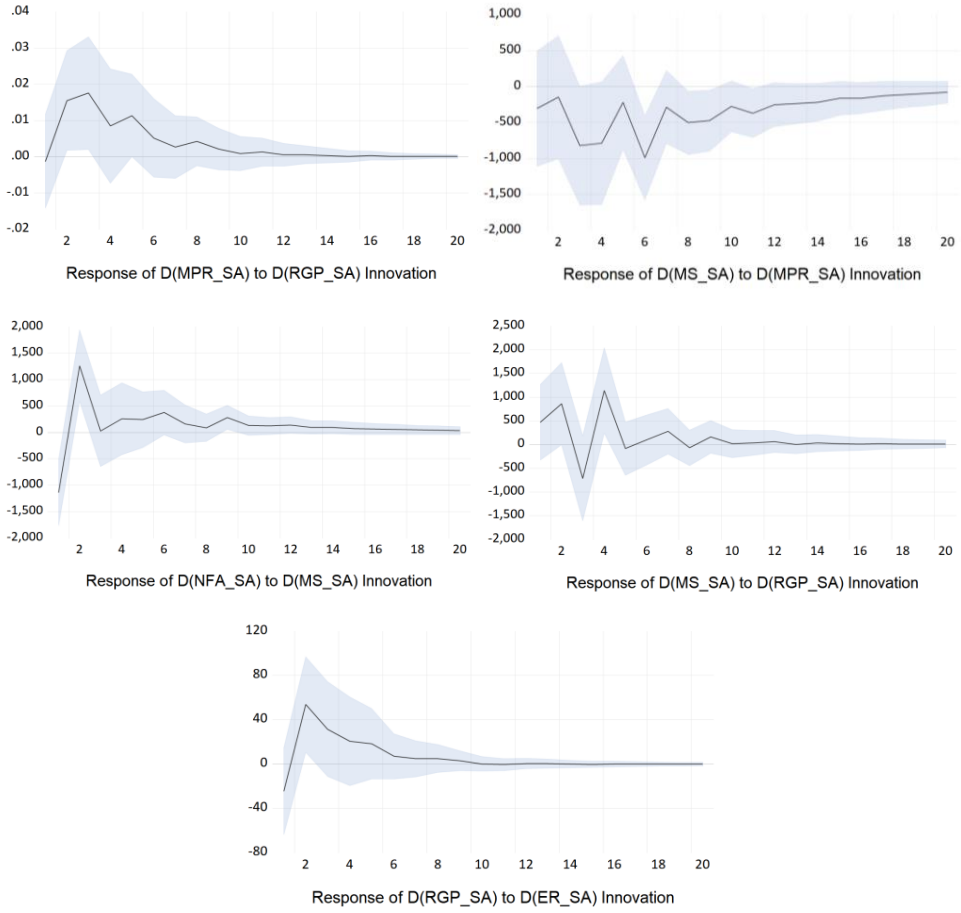
Table 5. VAR Granger Causality Test

		Depend Variable					
		D(RGP_SA)	D(NFA_SA)	D(SA_SA)	D(MS_SA)	D(ER_SA)	D(MPR_SA)
Excluded	df	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.
D(RGP_SA)	3	NA	0.6864	0.9239	0.0080	0.5758	0.0034
D(NFA_SA)	3	0.3937	NA	0.7565	0.0528	0.7109	0.7299
D(SA_SA)	3	0.2323	0.6260	NA	0.9574	0.8971	0.9020
D(MS_SA)	3	0.4783	0.0018	0.2583	NA	0.1738	0.8977
D(ER_SA)	3	0.0372	0.2141	0.9452	0.8936	NA	0.8670
D(MPR_SA)	3	0.1269	0.6861	0.8085	0.0245	0.6082	NA
All	24	0.1531	0.0006	0.9073	0.0235	0.1460	0.0001

4.2. VAR Model Impulse Response

4.2.1. The Impulse Response Conforms to Granger Causality

The previous Glen causality test revealed 5 distinct groups of causal relationships among the 6 variables. Specifically, we found that the exchange rate exerts a causal effect on the real gold price, money supply influences the CBOE volatility index and net funding amount, while the real gold price impacts the money supply. Additionally, monetary policy rate affects both money supply and real gold price, and CBOE volatility index has a causal effect on monetary policy rate. Notably, all variables exhibit causality except for ER (exchange rate) and SA (unknown variable). To further investigate these causal relationships, we conduct impulse response analysis by applying an independent variable with identified causality to impact its corresponding dependent variable.



Note: 95% CI using analytic asymptotic S.E.s. Horizon length is 20.

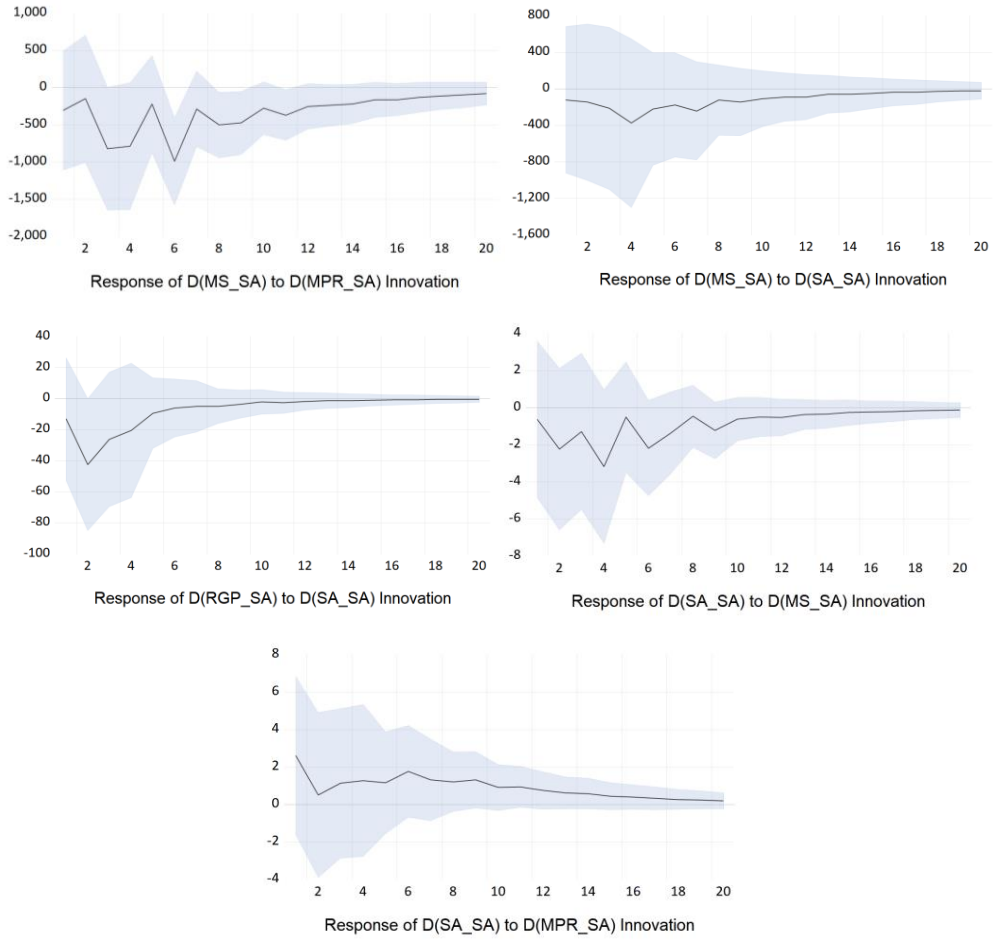
Figure 1. Impulse response diagram with Granger Causality

In Figure 1, the impact of MPR on MS is statistically significant, indicating a negative influence of MPR on MS. However, the other depicted impact effects in the figure are not statistically significant. Additional concerns arise regarding the impacts of ER on RGP, RGP on MPR, and MS on NFA. The fluctuation observed in these three shocks' influence is remarkably similar; all transition from negative to positive influences after the initial stage, with subsequent positive influences persisting thereafter. This observation further suggests a biased positive influence of monetary policy on other variables. The impact of RGP on MS does not provide conclusive judgment based solely on pulse pattern analysis following Granger causality testing.

4.2.2. The Result of Significant Impulse Response

Since the majority of impulse response results obtained from specific shocks in the initial stage lack statistical significance, we consider all seven variables as shock variables to conduct an extensive

impulse response analysis aiming to establish their relationships. After examining a total of 36 impulse responses, we observe a significant impulse response function graph as depicted in Figure 2.



Note: 95% CI using analytic asymptotic S.E.s. Horizon length is 20.

Figure 2. Impulse response diagram with Significant Result

According to the results obtained from analyzing the significance of the impulse response graph, we have identified five groups of variables that exhibit interrelationships. Specifically, an increase in Securities is found to exert a negative influence on the real gold price. Moreover, an increase in Securities also leads to a decrease in money supply, while changes in money supply negatively affect Securities amount as well. Additionally, there is evidence suggesting that Monetary policy rate has a detrimental impact on money supply; however, it positively affects the number of securities.

The impact of speculative shocks on China's monetary policy is limited, as depicted in the chart above. In practice, while gold can indirectly influence exchange rate fluctuations through external factors such as the Federal Reserve and subsequently affect China's currency, it does not exhibit a direct correlation with China's active currency regulation. This is attributed to China's adoption of a diversified foreign exchange reserve management strategy and its robust capital flow control capacity, which render the domestic market relatively independent from international market volatilities. Furthermore, policymakers prioritize making judgments based on actual conditions when formulating monetary policy. They consider domestic economic conditions, inflationary pressures, employment situations, trade environments, and conduct scientific analysis and assessment by incorporating relevant data and reports. Therefore, setting monetary policy does not solely rely on fluctuations caused by gold prices or speculation. Overall, although gold holds global significance as a safe haven asset; however, within the current operational framework of the Chinese economy, there is no conclusive evidence suggesting that it directly impacts monetary policy significantly. Conversely, China actively responds to various risks and challenges through advancing reform and opening up

measures, deepening financial system reforms, enhancing economic resilience, and maintaining a relatively stable and sustainable development trend.

4.3. The Relationship between China's Monetary Policy Changes And Gold Prices

Based on the aforementioned statistical results of impulse response, it is evident that the monetary policy rate and securities amount exhibit the strongest correlation with other variables in this study. The Gran causality test reveals six groups of variables containing MPR and SA that demonstrate a causal relationship, while significant results from the impulse response analysis indicate five groups containing MPR and SA variables. Consequently, this paper will delve into an in-depth discussion and analysis of factors associated with government's decision-making regarding monetary management and their subsequent impact.

4.3.1. Changes in China's Monetary Policy

The value of China's monetary policy rate primarily hinges on the government's comprehensive assessment of the overall economic landscape. According to a government report, on November 27, 2008, in order to implement an accommodative monetary policy, China reduced the interest rates for one-year yuan deposits and loans offered by financial institutions by 1.08 percentage points each. Both Figure 3's curve and actual data corroborate that the magnitude and intensity of the gradual adjustment in 2008 described in the report exceeded market expectations. This measure aimed at alleviating global inflationary pressures while fostering robust credit development. In the first half of 2011, driven by real estate regulation and foreign trade factors, policy interest rates were incrementally raised to reinstate a previously tight monetary policy stance. A significant shift in policy rates occurred again in mid-2015 when record-low levels were introduced with an aim to facilitate lending for small businesses and rural agriculture initiatives. Subsequently, the monetary policy interest rate has been maintained at this level consistently, perpetually propelling China's economic growth.

Furthermore, as evident from the monetary balance sheet, the quantity of securities primarily pertains to the volume of government-issued bonds held by the People's Bank of China (PBOC). The central bank's securities portfolio predominantly comprises special government bonds issued by these authorities. Specifically, commencing in 2007, the PBOC initiated substantial purchases of special Treasury bonds released that year by the Ministry of Finance, significantly augmenting its holdings and reaching a peak level of approximately 9.6%. In that same year, precise statistics indicate that China's Ministry of Finance issued a total sum of 1.55 trillion yuan worth of special Treasury bonds to financial institutions such as Agricultural Bank of China (ABC), thereby establishing a foundation for determining the quantum of securities held by PBOC. Subsequently, since 2008, there has been an annual decline in government bond issuance; nevertheless, due to limited transactions conducted on government bonds by the central bank itself and sustained possession of special Treasury bonds over time, the actual indebtedness towards governmental entities has remained relatively stable. As per December 2023 data, this "claims to the government" amounted to 1.5274 trillion yuan and accounted for roughly 3.33% out of total assets—a consistent trend also depicted in Figure 3.

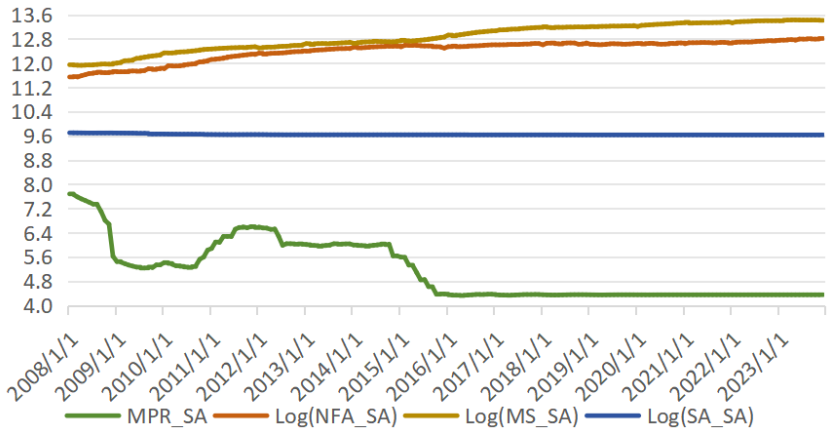


Figure 3. MPR_SA, Log (NFA_SA), Log (MS_SA) And Log (SA_SA) Data Plots from 2008 to 2023

4.3.2. The Comparison Between China's Monetary Policy and The Gold Price

In fact, China's monetary policy has undergone a transition from loose to tight and back to loose over the studied time frame. This shift is evident in the adjustments made by the country in its monetary policy interest rate to achieve control. Since 2008, global inflation has significantly impacted China's economic development. One of the current measures implemented by the government involves reducing the monetary policy interest rate, resulting in an increase in money supply that is inversely affected by interest rates. Consequently, this expansion of money supply diminishes purchasing power and renders a given amount of money insufficient for purchasing corresponding goods. In light of this situation, gold prices tend to decline during periods of severe inflation while exhibiting less fluctuation during moderate inflationary periods. The reverse changes observed between MS (money supply) and MPR (monetary policy interest rate) curves depicted in Figure 4 are closely linked with national decision-making.

This demonstrates the influence of China's monetary policy on gold prices, which is primarily manifested through the regulation of money supply and purchasing power in accordance with economic principles. Specifically, China's implementation of corresponding monetary policies can impact money supply by increasing the deposit reserve ratio, raising the rediscount rate, and policy interest rate. When the reserve requirement ratio increases, commercial banks are required to hold more reserves, resulting in a reduced amount of money available for circulation and limiting its availability in the market.

Consequently, individuals hold less cash and exhibit an increased demand for alternative investment instruments such as gold. Additionally, these specific measures also exert a certain degree of influence on the overall economic environment. For instance, when rediscount rates and policy interest rates rise, borrowing costs increase making it more challenging for businesses and individuals to secure funds. This may lead to decreased investment willingness among enterprises and suppressed consumption levels. In such scenarios, some investors may turn towards safe-haven commodities like gold to preserve and enhance their value. Therefore, following China's implementation of corresponding monetary policies that alter money supply dynamics alongside purchasing power effects; fluctuations in gold prices frequently occur. Gold is often considered a safe and stable choice as a hedge tool when markets anticipate inflation risks or economic instability; further bolstering its upward price trend.

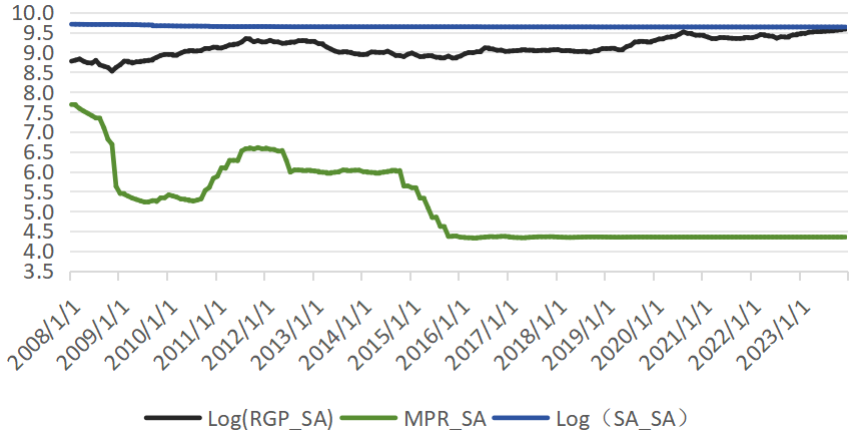


Figure 4. Log (RGP_SA), MPR_SA, And Log (SA_SA) Data Plots from 2008 to 2023

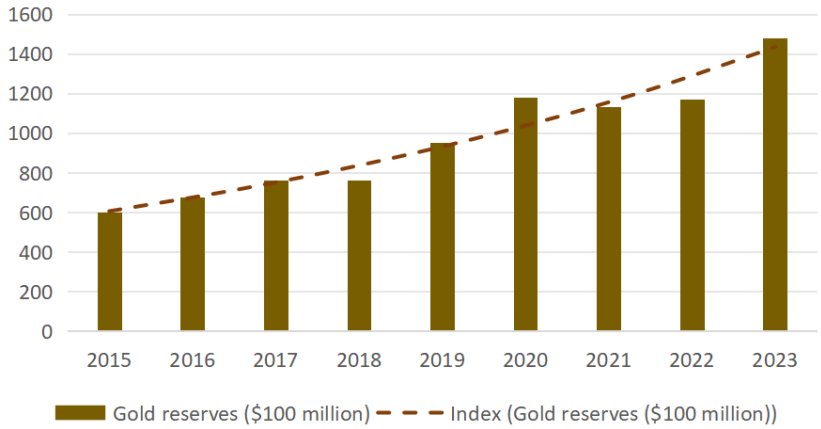
Moreover, there exists an inherent correlation between gold prices and inflation. During periods of economic uncertainty and recession, the preservative attributes of gold have prompted individuals to shift their investments from the stock market to the gold market. Consequently, due to alterations in supply and demand dynamics, there has been a significant surge in investor demand for the gold market, leading to an increase in the price of gold. Therefore, over the long term, gold can serve as a hedge against inflation risk, with inflation emerging as a primary determinant influencing its price trends. This also reflects China's monetary policy direction; loose monetary policies tend to induce some level of inflation while austerity measures have the opposite effect. Additionally, Figure 8 illustrates that during loose monetary policy periods from 2011 to 2015, inflation accelerated the upward trajectory of gold prices whereas tight monetary policies resulted in a downward trend.

4.3.3. The Comparison with Previous Literature

Previous literature has consistently confirmed the correlation between gold prices and exchange rates, with studies by Aye et al. (2015), Sujit et al. (2011), and Qian et al. (2019) all demonstrating the impact of gold prices on exchange rates. Considering gold's historical attributes as a form of currency, it competes with paper money, particularly in a global monetary system dominated by the US dollar. Consequently, there exists a strong association between gold and the US dollar, positioning gold as an indicator for paper money value. Therefore, fluctuations in gold prices are inherently linked to movements within the global monetary system.

However, contrary to the past, there is currently no statistically significant correlation observed between China's exchange rate and the price of gold. This could be attributed to the increasing globalization and enhancement of the global monetary system, which make it challenging to associate the strength of gold with a single exchange rate indicator. In recent years, there has been a gradual divergence in the global monetary system as central banks allocate foreign exchange reserves considering the growing risk correlation between foreign currency assets and international relations. The shift towards stable investment in gold assets has resulted in a diminished influence of US fundamentals on gold prices and a weakened correlation with exchange rates.

Moreover, previous literature has chosen Turkey as the research context to compare the relationship between monetary policy and gold price (Depren et al., 2021). This choice aligns with our study's background since Turkey witnessed the largest increase in gold reserves after China post-2019, growing from 293.81 tons in 2019 to 766.376 tons in 2024. Similar to Figure 5 depicting China's consistent growth of gold reserves not only during the pandemic but also over an extended period, it is evident that both Turkey and China experienced a comparable demand for gold storage at certain intervals. Therefore, the findings of prior studies hold valuable reference significance for our current investigation.



Source from: China Gold Association

Figure 5. China's gold reserves and their growth index trend chart from 2015 to 2023

The paper demonstrates that the price of gold in Turkey is influenced by indicators such as net financing, securities purchases, and WAC financing in their monetary policy after the 2019 epidemic. This implies that significant adjustments in a country's gold reserves have a modest impact on its price. Given China's faster-growing reserves compared to Turkey, it may exert greater control over the price of gold due to its substantial holdings. Consequently, China's extensive gold reserves position it strongly to manage fluctuations in this precious metal. These findings align with previous analyses on the relationship between China's monetary policy and the price of gold, where indicators like net financing amount and securities purchase amount are shown to affect its value.

5. CONCLUSION

This study commences with a concise introduction highlighting the significance of the Chinese market in the global economy and elucidating the fundamental characteristics of gold. Furthermore, it proposes an imperative examination of the correlation between China's monetary policy and gold prices. To address endogeneity concerns, a VAR model is employed to test 6 variables, encompassing root testing and Glen causality analysis. Based on these aforementioned tests, discussions, and analyses, this study also draws the following conclusions:

In the Granger causality test, it has been observed that a causal relationship exists between the exchange rate, monetary policy interest rate, money supply, and gold price. Furthermore, the money supply within the internal indicators of monetary policy demonstrates a causal relationship with both the monetary policy interest rate and net funding amount. Based on the test results, it is evident that compared to other variables, the money supply index in monetary policy exhibits a broader correlation degree.

After conducting further VAR testing, more specific findings have been obtained: Firstly, the exchange rate between China and the United States does not exert a significant impact on gold prices from 2008 to 2023. This implies that there is no evidence of interaction between these two factors within the chosen time frame for this study. Secondly, the Central Bank of China's securities amount index exhibits a negative influence on real gold prices during the period spanning from 2008 to 2023. This relationship establishes a connection between gold prices and other indicators of monetary policy. Lastly, in the Chinese market, there exists interdependence among China's monetary policy interest rate, money supply, and securities amount. The presence of these three relationships plays an interconnected role in government monetary regulation and control while also highlighting the necessity for multiple means to achieve balanced monetary policy.

The primary contribution of this study lies in expanding the conceptual framework that underpins the relationship between monetary policy and gold. Particularly during periods of monetary easing or

tightening adjustments, changes in the gold price generally align with the prevailing conditions. Building upon this foundation, this study provides additional evidence from China's monetary policy that economic fluctuations have an impact on gold prices, specifically related to variations in the monetary policy rate and securities holdings. These findings assist policymakers in considering multiple facets of the interplay between indicators within monetary policy and broaden connections with other relevant indicators associated with gold.

The limitation of this study lies in the testing process employed within the research setting. The results obtained from the causality test conducted in Glen cannot be directly extrapolated to yield significant outcomes in subsequent VAR model analysis. Simultaneously, the causal relationship cannot be demonstrated through significant impulse response results. These conflicting findings render the conclusions of this study inconclusive and fail to provide a clear confirmation of causality. To address these contradictions, it is necessary to conduct direct theoretical analysis on specific monetary policy indicators' causality and establish a connection with significant empirical results. The lack of quantitative empirical evidence in this study, coupled with an inclination towards practical considerations and explanations, may compromise the accuracy of its final conclusion. Furthermore, another limitation lies in the measurement model and methodology employed; it fails to capture relationships between interconnected indicators effectively. Therefore, there is a need for updating and improving both the model itself as well as exploring innovative research methods.

In addition, for future research, it is recommended to expand the time span of the study in order to encompass multiple economic cycles. The 15-year period examined in this paper primarily reflects China's monetary policy during a phase of economic development. However, prior to 2008, China had already formulated long-term plans for monetary policy and achieved corresponding outcomes. Analyzing the dynamic relationship between monetary policy and gold prices over a longer term would provide better insights into the forward-looking and sustainable nature of China's monetary policy. Furthermore, it is essential to broaden the scope of analysis by incorporating other markets such as commodities, stocks, and bonds when examining their linkage with gold prices. By integrating findings from various market entry studies, a more comprehensive understanding can be gained regarding how monetary policy effects are transmitted to gold prices. This approach will facilitate an explanation of complex market interactions and exploration of interrelationships among different markets through diverse methodologies aimed at uncovering the reaction mechanism within the gold market.

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