Correlation Analysis Between Crude Oil and Gold

Yiran Chen*

School of Public Finance and Taxation, Capital University of Economics and Business, Fengtai District, Beijing, China

*b10727034@office365.npust.edu.tw

Abstract. The current market has a close link between CL/GC, with a possible correlation. The fluctuations in crude oil prices may somewhat affect the gold prices. This study utilises SPSSPRO to perform DLS regression analysis on crude oil, gold, and other variables to derive correlation results. The research collected data of crude oil, gold and related macroeconomic factors in the past 10 years for analysis and research and obtained the average value and other relevant data. Finally, the path chart of relevant variables was obtained to see the correlation between dependent variables, independent variables and control variables more clearly. The study finds a positive correlation between crude oil and gold prices, meaning that when crude oil prices rise, gold prices also rise, and when crude oil prices fall, gold prices fall. Other macroeconomic factors also correlate with gold prices, such as rate of inflation, US federal interest rate and exchange rate (US), these macroeconomic factors all have a high or low impact on gold, but the degree of correlation varies.

Keywords: Crude oil; Gold; Macro environment; Regression analyze

1 Introduction

In recent years, gold has gained increasing prominence in global markets. Its purchase has become a trend, and its price has attracted greater attention from investors and the general public. Gold is widely used as a precious metal in various fields due to its exceptional ductility and corrosion resistance. Moreover, gold is a significant asset that can be readily converted into currency at any time and place, making it highly valued by individuals and institutions. Given its crucial characteristics, gold is vital as a store of value and a hedging asset in the international financial market. Today, gold continues to hold a pivotal position worldwide, attracting sustained investment interest.

Gold is considered a safe-haven asset, meaning it helps mitigate significant losses incurred by investors during periods of market volatility. When stock markets decline or currencies depreciate, investors often turn to gold as a hedge asset, preserving assets during crises. This research explores the intricate link between gold resource and crude oil prices, shedding light on how these critical commodities interact in the global market.

© The Author(s) 2025
B. Siuta-Tokarska et al. (eds.), *Proceedings of the 2025 3rd International Academic Conference on Management Innovation and Economic Development (MIED 2025)*, Advances in Economics, Business and Management Research 348,
https://doi.org/10.2991/978-94-6463-835-6_49

Crude oil, a non-renewable fossil fuel, is the most fundamental material for modern industry and is used extensively in various manufacturing sectors. Numerous factors influence its price, including technological advancements, supply and demand dynamics, and geopolitical events. The significant fluctuations in crude oil prices and its widespread application in industrial construction profoundly impact the global economy. To some extent, these fluctuations also affect gold prices, creating a complex interplay between the two commodities.

The price of gold is influenced by multiple factors, including the US dollar exchange rate, stock market performance, inflation rates, interest rates, and oil prices [1]. This research highlights the interconnection between crude oil and gold resource prices, suggesting more precise relationship exists between them. Specifically, this study provides valuable insights into market trends and operating mechanisms, offering policymakers and investors a clearer understanding of making informed decisions to reduce investment risks.

Previous studies have explored the relationships between the US dollar and various factors such as exchange rates, stock market performance, inflation rates, interest rates, and oil prices. Building on this foundation, the current study delves deeper into the comovement of gold and crude oil prices. This research considers crude oil prices as the independent variable and Gold prices that serve as the dependent variable, utilising Ordinary Least Squares (OLS) regression to measure the strength and nature of their relationship.

2 Literature Review

There may be a certain relationship between gold and oil. After the collapse of the Bretton Woods system in the 1970s, the price of gold and crude oil experienced significant increases. In the 21st century, with the continuous and steady growth of the economy, both gold and the crude oil have risen synchronously. This research reveals a statistically meaningful linkage between gold and crude oil markets, as evidenced by the two key indicators.

Firstly, there is a certain correlation between crude oil and the global economic level. The financial market can predict the price of crude oil. The price of crude oil is measured in US dollars, and the US dollar index can reflect the fluctuations of US dollar price in the international forex arena. Since the price of crude oil is measured in US dollars, the trend of US dollar fluctuations also affects the price of crude oil [2]. Therefore, the financial market can affect the price of crude oil to a certain extent. Specifically, there is an inverse relationship between the US dollar index and the price of crude oil [3]. When the price of the US dollar rises, the price of crude oil falls; when the price of the US dollar falls, the price of crude oil rises [2]. Therefore, rather than two unrelated individuals, a certain correlation exists between the financial market and crude oil prices. When the US dollar appreciates, crude oil becomes more expensive, decreasing market demand for oil and its price. Conversely, when the US dollar devalues, the demand for oil increases, leading to an increase in its price. The depreciation of the US

dollar also means that investors tend to shift their assets to anti-inflation assets such as gold and commodities, which indicates inflation.

Secondly, there is also a certain relationship between inflation and gold. There is a positive correlation between the supply of US dollars and the price of gold in the long run. The supply of US dollars affects the price of gold mainly through inflation and exchange rates [4]. When inflation occurs, the demand for gold increases as a good hedging asset and value-preserving product to mitigate the inflation crisis [4]. Therefore, when investors expect inflation to occur, they buy gold and other hedging products. When the US dollar devalues, when the exchange rate decreases, gold becomes more popular with investors, increasing demand for gold and thus raising its price. Empirical analysis shows that the long-term weakness of the US dollar is related to the simultaneous appreciation of these two commodities as investors adopt a dual hedging strategy: buying gold to preserve value.

In summary, there may be a certain correlation between oil and gold. From previous research, it can be seen that the US dollar price may be influenced by a series of related factors such as oil, inflation, the US federal funds rate, and the exchange rate (US dollar index). In this study, the price dynamics between crude oil and gold commodities was mainly analysed and studied to determine whether the two commodities exhibit cointegrated price behavior during different periods. Relevant conclusions were drawn by analysing the relationship between the two using models and software. So, we can speculate on the relevant conclusion that there is a positive correlation between oil and gold.

3 Methodology

3.1 Data

Data were collected and analysed from 2015 to 2025; for these 10 years, all data were analysed more refined using SPSS. Similarly, previous studies noted that the gold data were analysed and collected every quarter for 16 years from January 2, 2014, to December 31, 2020 [5]; here, this research analyses annual data; many factors affect gold, crude oil prices, inflation, US federal funds rate, exchange rates, and (US dollar index) and a series of macroeconomic influences. The research gold data will use New York gold for research and projections, and all data will be from Sina Futures.

Crude oil futures are based on the US oil price and serve as a reference point for global oil pricing. Crude oil prices are generally affected by a series of factors: the supply side of the part of the world's crude oil reserves, production and storage and extraction ratio of factors, while the demand side of the part of the global economic cycle and the changes affected to some extent [6]. Crude oil is also affected by the trend and price of the dollar, which is an important factor affecting the price of crude oil. In this study, the crude oil data will be calculated and analysed using WTI crude oil, which was chosen for the projection because it does not contain other metals or energy sources. All of the original data is from Trading Economics and Sina Futures, and the crude oil data will be intercepted in the same way as the gold data, using quarterly data. The data will be extracted in the same format as the gold data, using quarterly data.

Since crude oil is the independent variable in this study, gold is the dependent variable, and several other factors may affect crude oil and gold, these data and factors are examined and calculated as control quantities. The data for the control variables include inflation, exchange rate (i.e., the United States dollar index), and the United States federal funds rate.

The inflation rate data for this study comes from Trading Economics, which has inflation data from all over the world. The inflation rate of the United States will be chosen as the data for this study because both crude oil and gold use data in United States dollars, so the inflation rate of the United States will be chosen to standardise the unit of data.

The exchange rate (i.e., the dollar index) is also an important indicator that affects gold and crude oil. From previous studies, it can be found that in the study of gold, the dollar is often used together with the study of the price of gold and the US dollar index by taking the natural logarithm of each and then analysing it [7]. Similarly, previous studies found that the price of crude oil in Japan is affected by the exchange rate and changes [8]. Therefore, this study chooses the exchange rate as the US dollar exchange rate (i.e., the US dollar index) to analyse gold and crude oil. The data for this study was obtained from trading economics.

The exchange rate is also an important indicator affecting gold and crude oil prices. Previous experiments found that the interest rate affects the price of gold to a certain extent [9] and crude pricing. The interest rate in this study will be selected from the US federal funds rate and data from Trading economics.

This study will use the OLS regression model to analyse the data, which SPSS will analyse. Conclusions will be drawn relative to the correlation between gold and crude oil. In this study, the independent variable is the price of crude oil, the dependent variable is the price of gold, and the control variables are the US inflation rate, the US federal funds rate, and the exchange rate (i.e., the US dollar index).

3.2 Method

This study utilised SPSS to analyse the data's normality. The data, such as the median, mean, and standard deviation, were analysed descriptively.

The correlation coefficient measures the effect of the independent variable, crude oil, on the dependent variable, gold. If the correlation coefficient dares to be 1, then it is a completely positive correlation, -1 is a completely negative correlation, and 0 is no relationship. In previous studies, researchers have also used correlation to analyse the relationship between the dollar and gold, the dollar and crude oil, and the dollar, oil-gold pair and better use of data to reflect the results. So, this study will also use the correlation coefficient.

3.3 Variables

The regression coefficients of the OLS regression model visualise the effect of the independent variables on the dependent variables, which can reflect the relationship between the variables more accurately and quickly. This study uses the OLS regression

model to determine the correlation between the independent variable (crude oil) and the dependent variable (gold) by utilising the data on gold and crude oil in the past 10 years.

4 Findings

4.1 Descriptive Statistic

This study uses the OLS regression model to analyse and calculate the following economic model according to the object to be analysed. (Equation (1))

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \quad (1)$$

Where Y is the price of the dependent variable gold, X_1 is the price of the independent variable crude oil, X_2 is the inflation rate, X_3 is the US Federal Funds Rate, and X_4 is the exchange rate (the US dollar index).

4.2 Regression Result and Discussion

Based on the above variables, and to ensure the accuracy of the data, the data in this article are from Trading Economics and Sina Finance, and the following table is based on the data collected from these two websites. (Table 1)

Table 1. Descriptive statistics

Index	Crude oil (WIT)	Rate of inflation (US)	US federal interest rate	Exchange rate (US)	Gold (COMEX)
Mean	62.14	2.74	2.47	97.77	1647.36
Maximum	105.99	9.1	2.93	112.22	2904.2
Minimum	20.1	-0.1	1.83	89.12	1060.5

Table 1 shows the mean, maximum and minimum values of the relevant variables in this study.

Table 2. The results of the linear regression analysis are tabulated

Linear regression results n=41									
	Decomposition coefficient		Transformation coefficient	t	P	VIF	R2	R2	F
	B	Mistake	Beta						
Constant	-1800.061	767.391	--	-2.346	0.025**				
Crude oil (WIT)	7.548	3.796	0.299	1.988	0.054*	3.166			
Rate of inflation (US)	-58.428	29.419	-0.299	-1.986	0.055*	3.176	0.744	0.715	F=26.114;
US federal interest rate	1165.101	150.726	0.833	7.73	0.000**	1.633			P=0.000*;
Exchange rate (US)	3.428	9.058	0.039	0.378	0.707	1.497			

From table 1, we know that when inflation peaked at 9.1%, the interest rate also neared its highest level (2.93%), reflecting the Fed's logic of 'raising rates to combat inflation' when the USD exchange rate peaked at 112.22, gold prices did not decline significantly (specific timing requires verification), likely because safe-haven demand offset the dollar's strength, and last the simultaneous peaks in crude oil prices (105.99) and inflation (9.1%) likely reflect the role of energy prices in driving inflation.

Table 2 shows the results of the linear regression analysis using the data collected. It contains the magnitude of the relationship between the independent variable and the dependent variable and the control variable.

4.3 Analysis

From the above table, it can be concluded in Equation (2).

$$Y = -1800.61 + 7.548X_1 - 58.428X_2 + 1165.101X_3 + 3.428X_4 \quad (2)$$

X_1 is the price of crude oil, X_2 is the inflation rate, X_3 is the US Federal Funds rate, and X_4 is the exchange rate (US dollar index)

From the above table, it can be seen that the value of P is less than 0.05, which indicates that the level presents significance and rejects the original hypothesis that the regression coefficient is 0. Therefore, the model meets the requirements, indicating that the data are feasible. The overall fit of the model shows that R 2 is 0.744, R 2 refers to the degree of fit of the curve, R 2 is 0.744 shows that the model explains 74.4% of the variance of the dependent variable (gold), which indicates that the model has a strong explanatory power. The adjustment of R 2 is 0.715, which is still as high as 71.5%, indicating that the fit is better. At the same time, good can be seen F is 26,114; the F test is significant, indicating that the model is statistically significant and that the crude oil significantly affects the gold order between the lattice.

From the formula, this research shows that B is -1800.061, P is 0.025, and the intercept is significantly non-zero. This indicates that the price of gold is significantly negative when all independent variables are zero. It also shows that no other factors in this model negatively impact the price of gold.

The crude oil data are B is 7.548, and P is 0,054. The crude oil price positively influences the gold price, which is Beta is 0.299. The standardised coefficient shows that the crude oil price has a medium influence on the gold price; VIF is 3. The 166 data is slightly higher than 3. There may be a slight problem of multicollinearity, but it is acceptable.

The US Federal Funds Rate data is B is 1165.101, P is 0.000 * At a 1% significance level, the US Federal Funds Rate has a significant positive impact on the price of gold. Beta is 0.833. From the data, it can be seen that its interest rate level has the greatest degree of influence on the price of gold. VIF is 1.633; this data is low, which indicates that the problem of multicollinearity is not serious

The exchange rate data are B, which is 3.428, P, and 0.707, which shows that the exchange rate is insignificant on gold, and Beta, which is 0.039. From the standardised coefficients, it can be seen that the exchange rate has less influence on gold. At the

same time, VIF is 1.497, which is lower, indicating that the covariance problem is not serious.

In conclusion, there is a positive relationship between crude oil and gold, and an increase in the price of crude oil will also lead to an increase in the price of gold simultaneously, thus proving the hypothesis mentioned earlier in this study. The previous research also found that gold and crude oil have the same fluctuation trend, which also verified the authenticity of the research conclusion [10].

Fig. 1. Plot of the fitting effect

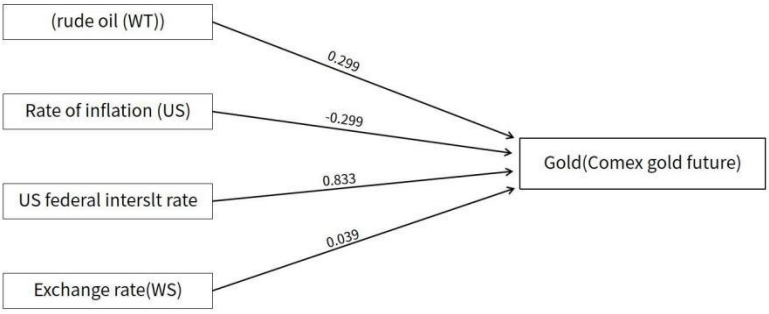

Fig. 2. Map of modelled right-of-way

Fig 1 shows the original data graph, model fitting value and model prediction value of this model are shown, blue line means the true value and the green line means the

predicted value. Fig 2 shows the results of this model in the form of a path graph, including the coefficient of the model, which is used to analyze the influence of X on Y.

5 Discussion

The data studied in this research, such as inflation, the United States federal funds rate and exchange rate (dollar index), are important indicators of the macro-financial markets; changes in inflation in the market for economic changes in an indicator that the economy is in a growth stage, will lead to price increases to affect the price of gold, changes in interest rates and market economic changes related to interest rates will lead to financial markets, fluctuations, so will affect the price of gold to a certain extent, and finally the exchange rate (dollar index), exchange rate changes will affect financial markets, and therefore lead to changes in the price of gold. Fluctuations will affect the price of gold to a certain extent. Finally, the exchange rate (dollar index) and exchange rate changes will affect the financial market to a certain extent, thus leading to changes in the price of gold.

6 Conclusion

The following points are concluded based on the research on the relationship between crude oil and gold.

According to regression model analysis, CL/GC have a positive correlation, with crude oil prices influencing gold prices. Oil inflation can indicate gold inflation. Previous studies have also shown a tendency for both to fluctuate in unison. This passage verifies the authenticity of the results.

Secondly, regression analysis reveals that the inflation rate, exchange rate (US dollar index), and the U.S. federal funds rate all have certain effects on gold. Inflation hurts gold, indicating that gold prices may fall when the market's inflation rate rises, serving as a tool for hedging.

Thirdly, the U.S. federal funds rate positively affects gold, reflecting complex macroeconomic environments, including high inflation expectations and increased demand for hedging. This phenomenon suggests that multiple factors influence gold prices and cannot be predicted solely based on one variable. A comprehensive analysis with more data is necessary.

Lastly, there is a positive correlation between the exchange rate and gold prices. An increase in the exchange rate is accompanied by an increase in gold prices, possibly indicating that increased hedging demand leads to higher gold prices.

References

1. Han, X., & Niu, D. Analysis of influencing factors of gold price. *Wealth Life* (02), 109 (2019).

2. Liu, C.Y. Study on the forecasting effect of financial market on international crude oil price. *New West* (02), 58–59, 50 (2018).
3. Wu, C. Analysis on the influencing factors of international crude oil price based on the VAR model. In: *Proceedings of the 2nd International Conference on Schooling Advances, Microeconomics and Management Science (SAMMS 2021)*. Wuhan Zhicheng Times Cultural Development Co., Ltd., pp. 160–169 (2021).
4. Gao, L. Analysis on the influence of Dollar money supply on gold price. Master's thesis, Zhejiang University (2013).
5. Yan, T. Factors affecting the empirical analysis and recommendations. Master's thesis, Shanghai University of Finance and Economics (2022).
6. Liu, X. Gold and crude oil prices: Correlation analysis. *Circulation of the National Economy* (12), 112–114 (2019).
7. Jia, Y., Dong, Z., & An, H. Study of the modal evolution of the causal relationship between crude oil, gold, and dollar price series. International Journal of Energy Research 2023(1), 7947434 (2023).
8. Fan, Y.Z. Crude oil price, exchange rate and Japanese economy. *Northern Economy and Trade* (04), 101–104 (2022).
9. Wu, L. Real interest rates affect the gold price research. Master's thesis, Shanghai University of Finance and Economics (2023).
10. Kang, Y. Analysis of historical fluctuation trajectory of gold price and its influencing factors. *Modern Enterprise* (09), 94–96 (2022).

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.