Research on Hedging Strategies in Gold Futures Market

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Abstract. Since the ratio of gold to oil and gold to silver has an important impact on the financial market, its periodic changes will affect the trading of gold, so the trading mode and strategy of gold as futures must be analyzed and judged as an important conclusion, to use the correct strategy for trading. In order to obtain the most accurate way of gold trading, the knowledge of time series was used in statistics to analyze from the perspective of ratio historical data, to obtain the cyclical data of ratio, and finally summarize a set of strategies suitable for gold trading through the method of futures trading mode in finance. The findings showed that whether "Gold/Oil Ratio" or "Gold/Silver Ratio" both have a certain periodicity. There are no permanent boom and downturns in the futures market. When there is a market surge, the price will fall back to normal, and vice versa. Finally, this study provides an effective hedging strategy in gold futures market.

Keywords: Gold/Oil Ratio; Gold/Silver Ratio; arbitrage; futures; periodicity.

1. Introduction

Oil and gold, as two special commodities, play an important role in economic development. And in the international market, both oil and gold are quoted in US dollars [1]. As the value of the US dollar rises, commodities denominated in US dollars fall, and vice versa. Therefore, the relationship between gold and oil is very close. What's more, many industries are tied to oil, such as diesel, gasoline and natural gas as fuel sources, so a spike in oil prices could put a damper on economic growth to some extent.

Both gold and silver have historically been representatives of hard currency, and the gold-silver ratio has always been an important price reference in precious metals markets. For a long time, the monetary properties of gold have been stronger than those of silver, with outstanding characteristics of avoiding risks, resisting inflation and maintaining value [2]. However, the wide use of silver in precision instruments and high-end equipment makes silver have stronger industrial properties than gold.

Gold is not only a consumption commodity, but also an investment commodity. When the financial market suffers a certain crisis, the value of many assets falls sharply, but due to the role of gold in risk aversion, the price of gold shows a rising trend. In other words, when financial markets are volatile, investors often turn to gold because it may provide portfolio diversification and hedging benefits at this time [3].

Thus, Gold/Oil Ratio and Gold/Silver Ratio should be largely unaffected by the impact of consumption (gold and silver jewelry), and the changes in the ratio should correspond to the changes in financial market risks, which means that these two ratios can be used as key factors to measure the state of the economy.

For domestic research, some scholars studied the synergy between the US dollar and gold, while others focus on the arbitrage of domestic and foreign gold futures markets. Wei studied the co-movement of US dollar, oil futures and gold futures and concluded that the hedging effect of the combination of crude oil futures and gold futures on exchange rate risk is better than the traditional hedging strategy [4]. Zhu and Xu used the various hedging models to test the stationarity and cointegration relationship between the futures price and spot price data, finally found that the ECHM

and EC-GARCH models provide better hedging results than the OLS and B-VAR models [5]. Zhang and Xue put forward the US dollar index and international gold price cooperation set of interest strategy and give the international gold futures price risk-free arbitrage range [6]. For the domestic and foreign gold futures market, Chen selected AU 1806, AU 9999 and GC0Y then take the logarithm, the author studied the relationship between the three indices through empirical research and gave a paired trading model for arbitrage based on the cointegration relationship [7]. Fu focused on the feasibility of the cross-market arbitrage model of gold futures, and the common futures at domestic and international are mainly concentrated on precious metals and crude oil futures, so the cross-market arbitrage of various precious metals and crude oil futures can be made according to this model [8].

For foreign research, Adjani and Husodo investigated time-varying optimal hedge ratios for ASEAN-5 stock markets hedged with gold and bitcoin, providing a valuable starting point for studying dynamic hedging [9]. Xue et al. conducted investment research on bitcoin and gold as a group of hedging assets and explores the investment rules between Bitcoin and gold [10]. Guglielmo and Luis A. investigated whether gold and silver can be considered safe havens by examining their long-run linkages with 22 stock price indices [11]. David et al. pointed out that gold is not a hedge against inflation in the long run. In the short term, gold is only used as an inflation hedge in the UK, US and India. Moreover, there is no long-run equilibrium between gold prices and CPI in China, India and France [12].

To sum up, there are few studies on hedging in the gold futures market according to the Gold/Oil Ratio and Gold/Silver Ratio. Therefore, our research have important implications for investors, which lets investors understand the periodicity of Gold/Oil Ratio and Gold/Silver Ratio. And investors can control opportunities better, judge the investment of gold, silver and oil correctly, then use the best strategy for hedging arbitrage.

2. Data Analysis

Because outdated data can't help us effectively in hedging and trading today, so we choose the Gold/Silver Ratio and Gold/Oil Ratio historical monthly data in recent 20 years (2000 to 2022). The data was extracted from a website called macrotrends (https://www.macrotrends.net/). At the same time, due to the cyclical analysis, our initial method of analysis is to draw a line chart of the relative ratio over time, in monthly terms. By observing the trend of the line chart to initially judge its cycle, so as to compare with the cyclical data obtained by the later statistical method and give a more reasonable trading strategy.

Firstly, we analyze the line chart of the Gold/Silver Ratio (Fig. 1). The line chart showed that from 2000 to 2003, the ratio showed an upward trend. However, the trend declined from 2003 to 2007. And in the subsequent ratio trend, it is roughly satisfied a situation that the ratio has increased for 3 years and decreased for 4 years. Therefore, after analyzing the information in the figure, we can preliminarily conclude that the cyclical trend of the Gold/Silver Ratio is about 7 years.

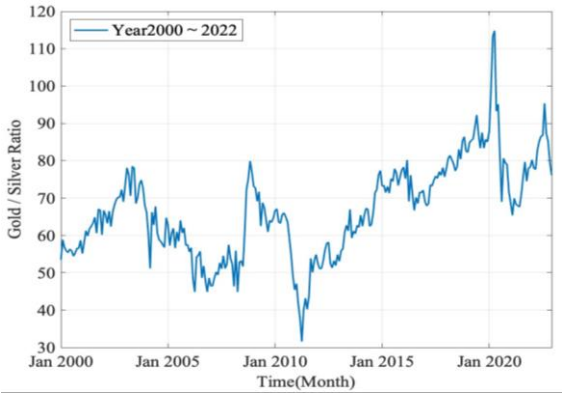

Fig. 1 Gold/Silver Ratio monthly indices from Jan. 2000 to Dec. 2022

Secondly, we perform a cyclical analysis of the line chart of the Gold/Oil ratio (Fig. 2). From the line chart, it can be seen that the period from 2000 to 2002 showed an upward trend, while the period from 2002 to 2006 showed a downward trend. Excluding the interference of the external epidemic on the oil price in some periods of 2020 and 2021, the periodicity of the whole line chart also roughly meets the process of rising for 2 years and declining for 4 years. According to the results we read from the figure, the cyclical trend of the Gold/Oil Ratio is about 6 years.

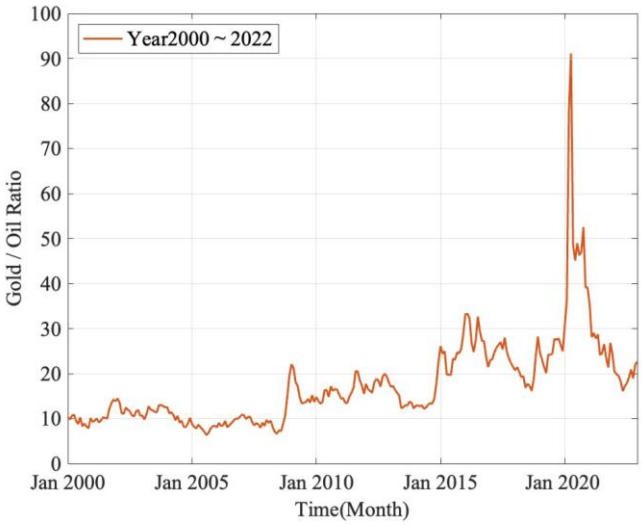

Fig. 2 Gold/Oil Ratio monthly indices from Jan. 2000 to Dec. 2022

The above content is our preliminary analysis of the graph, which is not the most accurate data support. Therefore, based on the statistical correlation method, we take the two groups of data as time series for analysis and judgment. For the judgment of the period, we use the spectrum analysis into the time series, and we choose to use the spectrum analysis in SPSS software.

Take the analysis data as the dependent variable, and the time as the independent variable to operate, then the periodogram corresponding to the two sets of ratio data with respect to time is obtained. In the image presented by the analysis results, the abscissa corresponding to the peak of the broken line is its corresponding period (Fig. 3 and Fig. 4).

Fig. 3 and Fig. 4 respectively show the images obtained after spectrum analysis of two groups of ratio data. From both graphs, we can see that the point marked in red is the peak of the whole periodogram. From the perspective of spectrum analysis, the value of the abscissa corresponding to the point is its period. After observation and analysis, we can conclude from the cycle chart that the Gold/Silver Ratio has a cycle of 90 months or 7.5 years, and the Gold/Oil Ratio has a cycle of about 84 months or 7 years.

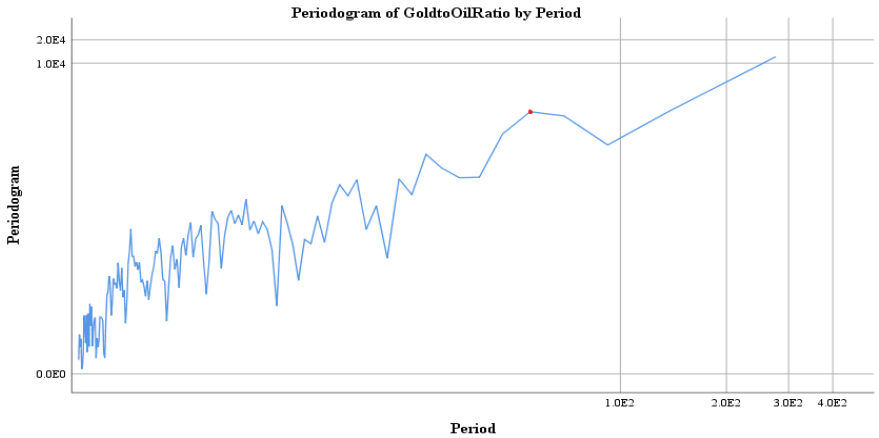

Fig. 3 Periodic plot of spectrum analysis results for Gold/Silver Ratio

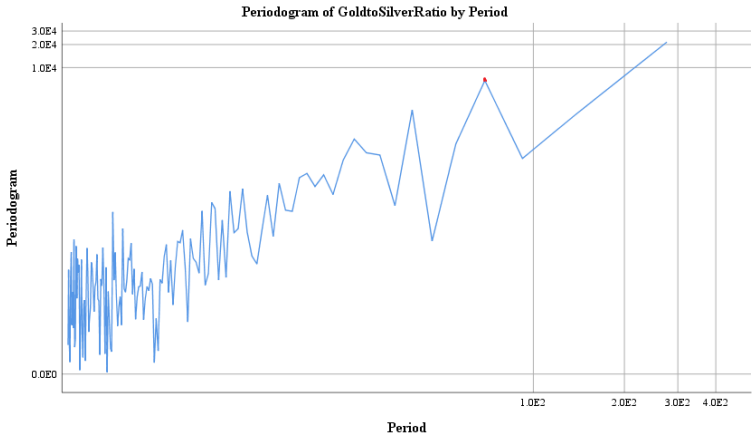

Fig. 4 Periodic plot of spectrum analysis results for Gold/Oil Ratio

The results show that after each period, the ratio will change in the original way, so changing the data of the ratio will affect the various situations of trading. At the same time, the hedging strategy of using gold as futures will also change due to the cyclical change of the ratio. Therefore, we should study the strategy by obtaining the ratio period and give a set of trading methods that work best.

From the results of spectrum analysis, the periodic results obtained through the line chart are consistent with the data results of time series analysis. It shows that the results of the period obtained by us are appropriate and accurate.

3. Discussion

The following part used EViews11.0 to describe the statistical characteristics of the data. In addition to the monthly gold/silver ratios and gold/oil ratios analyzed above, there are three separate variables were added. The newly added variables are the daily closing price data of COMEX Gold, COMEX Silver and WTI Oil futures. All data with a time span of nearly 20 years (From December 30, 2012 to December 30, 2022). The basic characteristics of the variables can be clearly seen from Table 1. The data in Table 1 can serve as an important reference for the following strategy formulation.

From the Table 1, we can clearly see the mean and median of the ratio and price, from which we can judge the normal level of the ratio and futures price. By studying the price and the ratio together, we can more clearly see whether the futures are overvalued or undervalued at this moment.

Table 1. Descriptive statistical characteristics of the data

	Gold/Silver Ratio	Gold/Oil Ratio	COMEX Gold	COMEX Silver	WTI Oil
Mean	73.8559	23.9646	1459.5318	20.3280	68.5510
Median	74.5817	22.2719	1334.9000	18.4600	63.0200
Maximum	124.1820	133.3488	2075.2000	36.8500	124.7700
Minimum	47.3611	11.7910	1051.9000	11.9800	12.9300
Std. Dev.	11.7122	10.8562	255.0182	5.2055	23.0382
Skewness	0.3043	3.3456	0.4464	0.9808	0.2417
Kurtosis	3.8759	23.1719	1.7552	3.0633	1.8957
Observations	2801	2800	2831	2825	2817

It can be found from Fig. 1 that the Gold/Silver Ratio has been fluctuating around 80 in the past decade, with the maximum fluctuation around 2.45 standard deviations. Let P be the ratio price, M be the mean, the minimum value is slightly less than M–2.45σ=45.88, and the maximum value is slightly more than M+2.45σ=103.28. Thus, the price is between 45<P<104. That is to say, when the ratio price reaches 2.45σ of the mean, then from the perspective of statistical arbitrage. When the ratio

is above 103.28, sell gold futures and buy silver futures. When the ratio is below 45.88, sell silver futures and buy gold futures until the ratio reverts to around the mean. See Table 2 for specific strategies.

Table 2. The strategy set according to the Gold/Silver Ratio

Gold/Silver Ratio	Strategies
slightly more than M+2.45σ	short gold futures and long silver futures
slightly less than M–2.45σ	long gold futures and short silver futures

The Federal Reserve adopted the policy of dollar depreciation to stimulate economic growth and slashed interest rates from 2000 to 2004, resulting in a large number of asset bubbles in the US capital market. As more speculative funds were invested in the crude oil market, the rise in crude oil prices was much higher than the rise in gold, resulting in the Gold/Oil Ratio significantly lower than the historical average. Until July 2008, when crude oil hit a record high, the Gold/Oil Ratio reached a record low.

In 2009, the Gold/Oil Ratio wavelike rose after hitting the historical low. In 2020, during the COVID-19 period, the oil price was negative in a period. The Gold/Oil Ratio data was extremely abnormal at this time, and then began to fall sharply and return to the normal value. In conclusion, when the ratio is much lower than the historical average, the oil price can be considered seriously overvalued, at this time, the crude oil futures can be shorted and long the gold futures, and vice versa. See Table 3 for specific strategies.

Table 3. The strategy set according to the Gold/Oil Ratio

Gold/Silver Ratio	Strategies
around 10	long gold futures and short oil futures
Extreme Case (negative oil prices)	short gold futures and long oil futures

Table 4 below shows the returns that would have been obtained if the position had been long gold futures and short silver futures for a period of seven years (2012 to 2019). Futures trading is usually leveraged trading, paying 5%-20% of the value of the contract can complete several or even dozens of times the contract trading. If you add 15 times leverage to the final yield, then the yield will reach 522.45%.

Table 4. Long gold futures and short silver futures

	Gold Futures Price	Silver Futures Price
2012	1663.9000	31.6675
2019	1412.4000	15.8500
Rate of Return	-15.12%	49.95%
Total	34.83%	

4. Conclusion

Since the Gold/Silver Ratio and the Gold/Oil Ratio play an important role in financial markets, their study can have a good impact on financial markets. Cyclical changes in ratios affect trading with gold as futures. Therefore, gold's trading patterns and strategies must be explored as an important research direction to obtain the right and suitable trading strategy. In order to provide a good strategy by studying new changes in the ratio cycle, we need to use the knowledge of time series statistics to analyze it from the perspective of ratio historical data.

When the Gold/Silver Ratio is high, it means that silver is undervalued relative to gold, and vice versa. According to the historical data of the Gold/Silver Ratio back test, arbitrage opportunities begin

to appear when the ratio above 80, and when extreme conditions occur in the market, the ratio will reach above 100. After entering this region, it is an excellent opportunity to sell gold futures and buy silver futures. When the Gold/Silver Ratio is slightly more than M+2.45σ, it is an opportunity to go short gold futures and long silver futures, and when the ratio is below M–2.45σ, it is an opportunity to go long gold futures and short silver futures.

For the Gold/Oil Ratio, it remained around 10 from 2000 to 2008, it means that the value of oil was significantly overvalued and investors could short oil futures and long gold futures. However, for the extreme Gold/Oil Ratio in 2020, there is clearly a problem of negative oil prices, which is a good time to buy oil futures at bargain prices. In this case, the strategy becomes short gold futures and long oil futures.

In view of this paper, there are still some shortcomings, this paper uses statistical methods to analyze the simple ratio to judge the trading strategy. Future research can add more macro environmental factors, so as to more accurately judge the reasons for the changes of each node, and then judge the choice of strategy.

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