

Applying Option Portfolio Strategy to Manage Crude Oil Trade Risk

-- Response to Rising Oil Price Under Russia-Ukraine Situation

Hongjing Ou^{1, a}

¹Guangdong University of Finance and Economics, Guangzhou, Guangdong, 510320, China

^aCorresponding Author's Email: ouhongjing2003@163.com

Abstract: Since February this year, the conflict between Russia, one of the important exporters of crude oil, and Ukraine has gradually intensified, causing the international market to worry about the supply of crude oil. Together with the speculation in the United States, international oil prices have been moving higher. We use an option portfolio strategy for hedging to offset the increased costs of crude oil purchaser firms with profits in the financial markets. We use a binomial tree option pricing model to calculate the crude oil option price and use it to derive its delta value. The option portfolio is constructed by selecting real and flat options based on the delta-neutral results. After comparing the results of the analysis, the call inverse ratio spread option is optimal and the bull call option is the next best. The protective strategy constructed using crude oil futures has good risk control but limited profitability. Finally, put forward suggestions for enterprises who uses derivatives for hedging.

Keywords: options portfolio, Russia-Ukraine conflict, Price of crude oil, Binomial tree option pricing model, Delta neutral.

1. Introduction

Crude oil is a very important strategic resource for every country. Crude oil is indispensable for the operation of national defense and military equipment, the fuel for residents' daily driving cars, and the development of petrochemical industry. Therefore, the fluctuation of oil price has a close impact on individuals, enterprises, industries, countries and the world. Oil prices are closely related to the state of the global macro economy. Some economists argue that high oil prices have a negative impact on global economic growth because higher oil prices directly raise the costs of buyers, leading to economic depression.

Option portfolio is a combination of options to form a new financial instrument by combining the time, quantity, price and method of issuance. In order to achieve the purpose of risk avoidance, value preservation and appreciation. Such as straddle options, band options and other typical option combinations. In the risk management of commodity trading, options have significant risk hedging benefits. Take the seller of oil, for example, if it is worried about a future decline in the price of oil, it can buy put options in advance. If the price does fall in the future, the profit from the options market is used to cover the loss from the spot sale. It is also possible to use oil directly as the underlying and when the market price falls below the strike price, the option is exercised to sell the oil at a higher price. Unlike individual options, an option portfolio can increase the ability to hedge risk because it contains multiple options.

Historically, there have been many cases of hedging commodities using derivatives such as futures. Both buyers and sellers can use derivatives to hedge market risk due to price fluctuations. Typical examples of hedging crude oil trade risk with option portfolio are China National Aviation Oil (Singapore) and China Eastern Airlines. Although hedging of these two companies ended in failure, they still have quite important reference significance, especially the

option portfolio specially created by Goldman Sachs. Therefore, this study will absorb the experience of these two cases and study how to correctly apply the option combination involved in the oil trade.

Recently, due to the conflict between Russia and Ukraine, international oil prices have experienced a sharp rise and fall. Therefore, option portfolio strategy can become one of the means to hedge the risk of oil trade [1].

2. Literature Review

On Delta neutrality, semi-nonparametric methods were used to find that implied skewness and excessive kurtosis were relevant sources of information about market expectations for hedging and risk management purposes[2]. For implied volatility of crude oil, the mean-reversion process based on stochastic convenience rate of return and stochastic volatility is more suitable for crude oil futures options in the selection of stochastic process to describe oil price changes[3]. Zhang analyzes the hedging of Cotton options in China by using option portfolios[4]. At present, there are few researches on crude oil option, which is another important option. This paper aims to provide reference for using crude oil option for hedging by combining Delta and option combination strategy.

3. Method

3.1. Research Approach

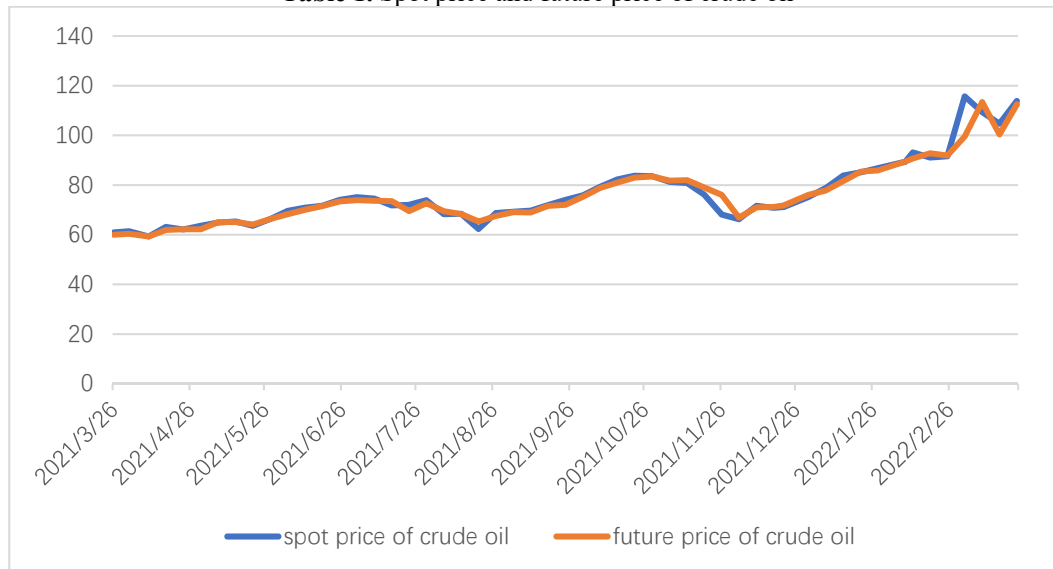
Analyze the hedging process using options from a short crude oil spot perspective, calculate the optimal ratio for hedging crude oil futures using the OLS model, and calculate the delta value using binomial tree simulations, obtain the hedging effect of using crude oil options using the hedging method of maintaining a delta-neutral strategy, and evaluate the delta-neutral strategy in conjunction with the hedging process and results. The hedging process and results are combined to evaluate the Delta-neutral strategy.

Then, try to match with futures and options with different strike prices to design a protective strategy, a bull call strategy and a reverse spread option strategy to further compare and analyse the effect of option hedging from three perspectives: occupation of funds, revenue and the maximum severity of ruin.

3.2. Calculating the Hedging Ratio

We choose a time horizon of one year to study crude oil spot prices and crude oil futures prices, i.e. from 26 March 2021 to 25 March 2022, and choose crude oil futures with contract SC2205.

Table 1. Spot price and future price of crude oil



With crude oil spot price as independent variable X and crude oil futures price as dependent variable Y, OLS

regression was performed in SPSS software. get.

Table 2. Results of OLS regression

model	R	R party	R squared after adjustment	Errors in standard estimates
1	977. ^a	954.	953.	2.64807

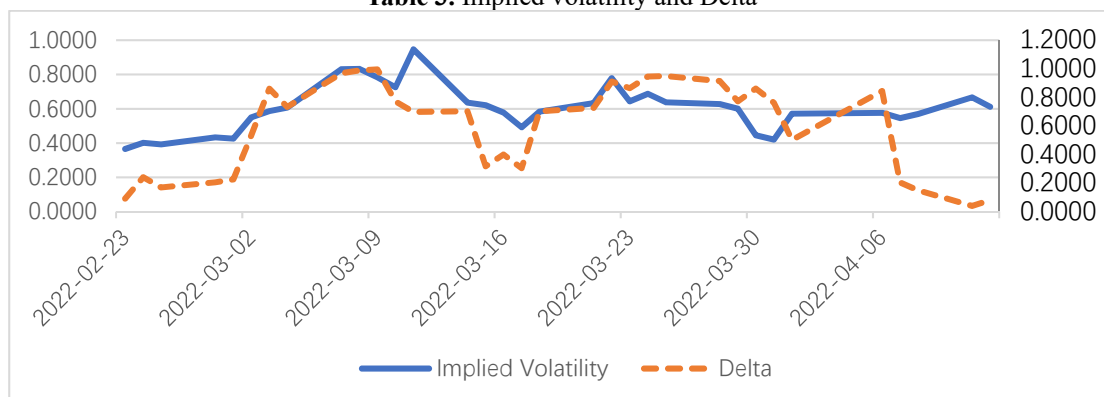
The correlation coefficient between them was 0.977, and the OLS model result was $y=0.917x+5.913$

Delta value of an equal-value option is 0.5; The Delta value of an out-of-the-money option is less than 0.5. Select a call option with contract SC2205C650, download its daily closing price from Shanghai Futures Exchange, and download its daily implied volatility data from choice financial terminal. Then calculate the theoretical price of the option using binary tree option pricing model. Calculate Delta values based on theoretical and actual closing prices.

3.3. The Delta Neutral

The Delta value is used to describe the impact of the underlying price change on the value of the financial derivative, and it ranges from -1 to 1. In general, the Delta value of a real option is greater than 0.5 and less than 1. The

Table 3. Implied volatility and Delta



As can be seen from the figure, the Delta value calculated based on the binary tree model fluctuates greatly and is higher than the risk-neutral value of 0.5 most of the time, indicating that the strike price of the option SC2205C650 has a high

probability of being lower than the underlying price. It is a real option and can sensitively rise with the underlying price.

3.4. Protective Policies

The protective strategy is to use futures to hedge, in order to avoid large losses, purchase options for protection.

According to the linear regression, the hedging ratio is 0.977, and the spot and futures can be hedged 1:1. As long oil futures, we choose to buy 1000 barrels of SC2205 oil futures for 546,900 yuan on Feb 10, 2022 followed by a put option on SC2205P540 for 36,650 yuan. In this way, we can gain from the rising price of crude oil in futures. At the same time, if there is sudden bad news and crude oil prices fall sharply, we can still offset some of the risk through put options to protect returns. According to the exchange's data, the settlement price on the expiry date of SC2205 was 709 yuan. Therefore, we waived the exercise and gained 125,450 yuan.

3.5. Bull Market Call Strategy

Bullish strategy is that the futures price will rise sharply in the future, and build bullish spread option portfolio. In order to take advantage of options to profit from rising crude oil futures prices, we choose to buy 33 call options of SC2205C550 at 32,000 yuan each and sell 33 call options of SC2205C600 at 14,150 yuan each. Then the debit difference is 589,050 yuan, that is, cost = maximum loss = 589,050 yuan. When the option contract expires, as the futures price is higher than the strike price, the time value of the two option contracts disappears, and the profit is equal to the difference between the strike price, i.e., the profit is 1,650,000 yuan and the yield is 280%.

3.6. Reverse Spread Strategy

The bullish inverse ratio spread strategy is the transformation of the bearish call option, which consists of a call option with unlimited return and a bearish call option with limited return. Combination 1: Buy 56 call options on SC2205C600 at 52,400 yuan each and sell 28 call options on SC2205C550 at 84,250 yuan each. The debit difference is 575,400 yuan, that is, the cost is 575,400 yuan, and the maximum loss is the sum of the difference between the cost and the exercise, that is, 576,800 yuan. Combination 2: Buy 388 April call options with a 650 yuan strike price at 27,700 yuan each and sell 194 April call options with a 600 yuan strike price at 52,400 yuan each. The cost is 582,000 yuan and the maximum loss is 591,700 yuan. Compare the two portfolios: portfolio 1 has a smaller maximum loss with similar input costs. Meanwhile, according to the previous calculation of Delta value, the option with the strike price of 650 yuan is close to risk-neutral, while the option with the strike price of 600 yuan is closer to 1 and more profitable. Therefore, we choose portfolio 1 to execute the reverse spread strategy and set a stop price of 700 yuan, that is, when the crude oil futures price rises to near 700 yuan to settle. The portfolio earned 3,943,800 yuan.

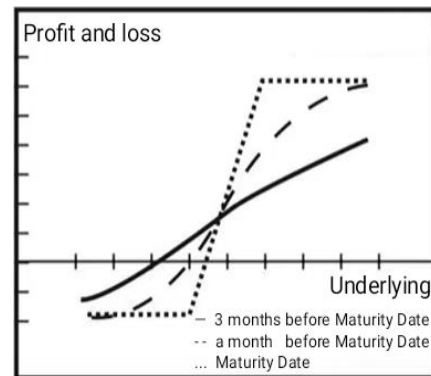


Figure 1. Bullish call option yield trend

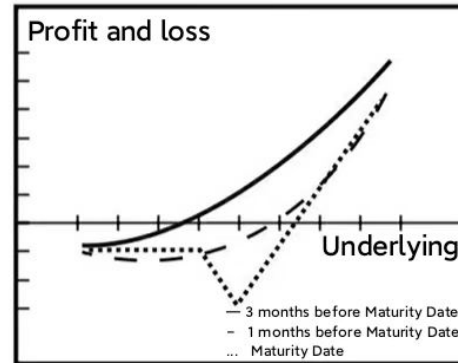


Figure 2. Bullish inverse ratio spread option yield trend

4. Conclusion

There is less research related to the official listing of Chinese crude oil options contracts for trading on 21 June 2021. And the recent Russia-Ukraine situation has had a major impact on crude oil prices. For companies on the buy side of crude oil, hedging is necessary. This paper therefore hopes to fill the research gap in this area by creating a suitable portfolio for crude oil options based on the current situation.

In this paper, the simulation of airlines short crude oil in the case of rising crude oil spot price, which method to choose to hedge, so as to avoid the decrease of operating income caused by cost increase.

First, we calculate the hedging ratio of crude oil spot and futures, and the result is 0.977. Therefore, it is feasible to use futures and options for hedging. And since the result is close to 1, we can buy spot and futures in a 1:1 ratio.

Then we use the binary tree option pricing model to calculate the option Delta value of crude oil, and conclude that the option Delta value of 650 yuan strike price is near neutral, which is suitable for hedging. Options with strike prices below 650 yuan have deltas close to 1 and are suitable for profit.

Then we created a protective strategy, a bullish strategy, a contrarian spread strategy. The maximum loss, income and capital occupation of the three combinations are as follows:

Table 4. Result of the strategy

Strategy	The maximum severity of ruin	Revenue	occupation of funds
Protective strategies	43,550	125,450	583,550
Bull market call strategy	589,050	1,650,000	589,050
Call inverse ratio spread strategy	576,800	3,943,800	575,400

We have kept the amount of money invested in these three strategies to a uniform level of around 580,000 yuan to

facilitate comparison of returns and losses. As can be seen from the table, with the same amount of money invested, the call inverse ratio spread strategy has the highest revenue, with a return of 685%, but the highest maximum loss value; the bull market call strategy has a slightly smaller maximum loss value than the call inverse ratio spread strategy, but the return is lower; the protective strategy has the smallest maximum loss value, but the return is much lower than the other two strategies. On balance, the choice of protective strategy is robust. However, as we forecast a big rise in the spot price of crude oil in the coming period. Therefore, taking into account the current international situation and market sentiment, we should choose the call inverse ratio spread strategy.

The takeaway we can draw from our results is that we can choose to build a bullish portfolio of options when there is an expectation of a large future increase in the price of the underlying. Typical examples are bullish call options and bullish inverse ratio spread options. Bullish call options are suitable for smaller rallies as they have limited returns. The bullish inverse ratio spread option, on the other hand, is suitable for larger rallies because of its unlimited returns.

Based on the above conclusions, the following suggestions are put forward for enterprises to use crude oil options for hedging:

1. Pay close attention to the macro market environment, capturing the strong impact of inventory levels, weather,

short-term supply and demand imbalances, and political issues. When the oil price is about to face large fluctuations, you can choose the option portfolio strategy for hedging.

2. Be careful in the selection of options, and choose options with a long distance from the expiration date, so as to ensure the benefits of options. But don't mistake hedging for speculative profit. A stop-profit price should be set for options with unlimited earnings. Offset losses can be achieved to end the execution of the plan to prevent the expansion of risk exposure.

References

- [1] Olmstead, E. (2013) *Options For The Beginner And Beyond*. Machinery Industry Press, Beijing.
- [2] Cortés, L., Mora-Valencia, A., Perote, J. (2020). Retrieving the implicit risk neutral density of WTI options with a semi-nonparametric approach. *The North American Journal of Economics and Finance*, 54: 100862-100924.
- [3] Xu wc, Li jh. (2021). Analysis of Crude Oil Options Contract Trading Strategy Based on Stochastic Convenience Yields and Stochastic Volatility. *Finance.*, 11: 287-296.
- [4] Zhang Qijun China.(2021) Cotton option hedging strategy analysis and optimization. <http://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202102&filename=1021577746.cn>.