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Research on the Volatility Value of A-Share State-Owned Shipping Stocks

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Abstract

The A-share stock price of state-owned shipping enterprises is higher than the discount value constantly. It implies an American call option for a speculator, so the price contains the discount value and option value. In order to help the investors to find the real value and obtain higher returns under the high volatility caused by the fluctuations of the shipping cycle or the stock market valuation cycle, Least Square Monte Carlo Simulation (LSM) method is used to calculate the implied American call option with the date of COSCO shipping energy-transportation Co., Ltd. It is found that the discount value plus volatility value among 2016-2020 is approximate to the stock price. The option value increases with the extension of maturity and the rise of expected volatility. It explains the over value and high volatility of the A-share price of cyclical stocks and small-cap stocks with poor performance.

Keywords

A-Share Stock, State-Owned Shipping Enterprise, Volatility Value

1. Introduction

In traditional financial theory, volatility is often regarded as a risk, and the discount rate is used to influence pricing (Adrian & Rosenberg, 2008). However, it was found out that the portfolio consisting of low volatility stocks outperforms the portfolio consisting of high volatility stocks (Joshipura & Joshipura, 2019), which is similar to the share price of state-owned shipping stocks of A-shares which has been higher than the discount value for a long time, and the difference does not only come from the liquidity value (look back option) (Longstaff, 1995), but volatility value (Zhang & Wu, 2011). Market-based investors who buy low and sell high (heterogeneous investors) prefer risk, and regard state-owned

shipping stocks as a tool for cyclical fluctuations in the game and volatility as value (Zhang et al., 2018). Strong cyclical stocks attract different investors at different stages, leading to high volatility and strengthening volatility value (Hao et al., 2020). The liquidity value decreases with the delay of the investor's expected realization time, and eventually tends to zero (Zhang & Zhang, 2013). Therefore, the main value of state-owned shipping stocks is the discounted cash flow value and volatility value.

In the long-term holding process of state-owned shipping stocks, when the shipping cycle or the stock market valuation cycle fluctuates sharply, investors can sell them in a timely manner to obtain higher returns. When the shipping industry is at the bottom of the cycle and the state-owned shipping company faces the threat of bankruptcy, there is a high probability that state-owned capital will be injected, and the valuation is not less than 1 times PB, so the space and probability of value downward is limited. This feature is similar to a call option, that is, the volatility of state-owned shipping stocks with strong cycles is obviously valuable. However, foreign markets are dominated by private enterprises, and market-oriented bankruptcy reorganizations tend to greatly dilute the equity of shareholders, and the characteristics of options are not obvious, so there is little research on the value of volatility.

Volatility value can be regarded as option value. Since the stock has no expiration date and can be sold at any time, the option can be regarded as an American call option, and the exercise price is the initial price of the stock, and there is no expiration time constraint. The value of the option is mainly determined by the expected volatility, and is also affected by the volatility of volatility, the speed of mean recovery of volatility, and the correlation between volatility and price (Zhang & Wu, 2009). According to option pricing theory, the higher the volatility, the greater the value, the lower the dividend rate, the greater the volatility value (Zhang & Wu, 2012), the higher the correlation between the stock price and the volatility, the greater the volatility value. However, the existing research stays at the theoretical level and lacks empirical analysis. By regression analysis and numerical simulation, it is possible to capture the financial behaviors of an asset (Ek et al., 2021) and study the idiosyncratic volatility effect including stocks (Huang, 2021) and future prices (Zhu & He, 2021). In order to help the investors to find the real value regardless of the high volatility caused by the fluctuations of the shipping cycle or the stock market valuation cycle and for the A-share market, to attract more investors into state-owned shipping stocks, this study builds a model, taking COSCO Shipping Energy as an example to analyze the role of volatility value in stock pricing.

2. Models and Algorithm

2.1. Improving of the Monte Carlo Simulation

American options are usually solved by numerical analysis methods, including binary tree method, finite difference method and Monte Carlo simulation method (Caflisch & Chaudhary, 2004). Tari & Dahmani used to take Monte Carlo

simulation to reduce the sampling bias and eliminates the problem of descriptive sampling related to the sample size (Tari & Dahmani, 2006). For options that rely on the historical price of the underlying asset to be priced, Monte Carlo simulation is the most suitable (WU & Xuan, 2006). Among them, the least squares Monte Carlo simulation (LSM) has been verified quite robust to the choice of basic functions (Moreno & Navas, 2003) and become one of the standard methods for solving American options.

The key to solving American options is to find the best exercise time and exercise income. Whether to exercise the right in each period depends on the current exercise income and the expected return of continuing holding, and the latter depends on the future exercise decision. The basic principle of LSM: Based on simulated discrete price panel data, use LS to calculate the expected return of the current period of continuing to hold the option (a function of the price of the underlying asset in the current period), compare the return of exercise and continued holding, and decide whether to exercise. This method solves the difficult problem that the current exercise decision depends on the decision of the next period and has been used successfully in the Brazilian financial stocks market (Nascimento et al., 2021), which took historical statistics.

2.2. The Application of the LSM

Assuming that the price of the underlying asset obeys the geometric Brownian motion, randomly sample the price sequence S of the underlying asset

$$\mathrm{d}S/S = \alpha \mathrm{d}t + \sigma \mathrm{d}z$$

where $\mathrm{d}S/S$ represents the instantaneous rate of return of the underlying asset, α represents the average rate of return of the underlying asset, and σ represents the volatility of the underlying asset, z is Wiener process, $\mathrm{d}z = \varepsilon \cdot \sqrt{\mathrm{d}t}$, ε obeys the standard normal distribution.

According to Ito's lemma, $\mathrm{d}\ln S = \left(\alpha - \frac{\sigma^2}{2}\right)\mathrm{d}t + \sigma \mathrm{d}z$, discretize the above formula, divide $[0,T]$ into N subintervals, the length of each subinterval is $\Delta t = T/N$. $\ln S_i - \ln S_{i-1} = \left(\alpha - \frac{\sigma^2}{2}\right)\Delta t + \sigma\sqrt{\Delta t}\cdot\varepsilon_i$, and $i \in \{0,1,2,\cdots,N\}$, $S_i = \exp\left(\ln S_0 + i\cdot\left(\alpha - \frac{\sigma^2}{2}\right)\Delta t + \sigma\sqrt{\Delta t}\cdot\varepsilon_i\right)$. Then, the sample path of the underlying asset can be obtained, and M paths can be simulated $h_j(S_0, S_1, S_2, \cdots, S_T)$, $j \in \{1,2,\cdots,M\}$, in any time i, Intrinsic value of call options $V_i^j = \max\{S_i^j - X, 0\}$, S_j^i is the price of the underlying asset on the path j at time i, X is the strike price.

Whether exercise option on time i, depending on the value of the exercised option and the value of the continued holding, which is

$F_i^j = \max\left(V_i^j\left(S_i^j\right), E^Q\left[\mathrm{e}^{-r\Delta t}\cdot F_{i+1}^j\left(S_{i+1}^j \mid S_i^j\right)\right]\right)$

And among them, $E^Q\left[\mathrm{e}^{-r\Delta t}\cdot F_{i+1}^j\left(S_{i+1}^j \mid S_i^j\right)\right]$ is the expected return of con-

tinuing to hold the option. It depends on the future exercise decision and is difficult to solve directly. LSM uses the Lagrange function of the current asset price to fit the expected return of holding options,

$E^{Q}\left[\mathrm{e}^{-r\Delta t}\cdot F_{i+1}^{j}\left(S_{i+1}^{j}\mid S_{i}^{j}\right)\right]=a_{1}+a_{2}S_{i}^{j}+a_{3}\left(S_{i}^{j}\right)^{2}$.

Regression is performed on the asset price panel data S_i at time i and the discounted income of the next period, calculate the fitting parameters of each period, and then use S_i to calculate the expected return of continuing to hold the option. At this time, the exercise decision is to compare the exercise income $S_i - X$ with the expected return of continuing to hold $a_{1i}+a_{2i}S_i+a_{3i}\left(S_i\right)^2$, there is an optimal exercise time for each simulation path $t^{*}\in\{0,1,2,\cdots,N\}$, when the exercise value is $\max\left(S_{t^*}-X,0\right)$. Discount and average the simulated exercise value of each item to get the value of the option

$$E\left[F\left(S_0,S_1,S_2,\cdots,S_T\right)\right]=\frac{\sum_{j=1}^{M}\mathrm{e}^{-rt_j^*}F_{t_j^*}}{M}$$

3. Empirical Analysis

For the dry bulk and tanker transportation industries that are close to perfect competition, based on the no-arbitrage rule of ship buying and chartering, ship prices are equal to the discounted value of future operating income, and the discounted value of state-owned shipping stocks can be replaced by replacement value. Volatility value is the value of American call options, which depends on expected volatility, initial price, exercise price, holding time, risk-free interest rate, etc.

The exercise price of a volatility option is the price at which the investor buys the stock, while it is equal to the current stock price when the investor has not yet bought it. For perpetual stocks, the option has no expiration time limitation so investors wouldn't exercise the option for a long time. However, considering the convenience of institutional investors' funding period and option value calculation, the option value is calculated separately in 1 to 10 years.

The expected stock price volatility σ_s depends on the stock market valuation volatility σ_m and the industry cycle volatility σ_{tce}. The former is replaced by historical volatility, and the latter is related to factors such as capacity utilization and oil prices.

Then a typical stock is required to finish the simulation (Otaify, 2020), take COSCO Ocean Energy's A shares as an example, calculate the rate of return and its volatility based on historical stock price data, r = 5%, $S_0 = 6.7$, the expiry time is 1 - 10 years, and the volatility is the historical average volatility and expected volatility. Rate. It turns out that when taking the average volatility in 2011-2020 into calculation, the value of the 3-year option is 1.94 yuan, and the value of the option increases with time. By the time of June 30, 2020, the replacement value of COSCO SHIPPING Energy per share is 4.94 yuan, and the sum of discount value and volatility value is 6.88 yuan, which is close to the stock price of 6.43 (**Figure 1**).

Expected volatility is a key factor in determining the value of an option. The

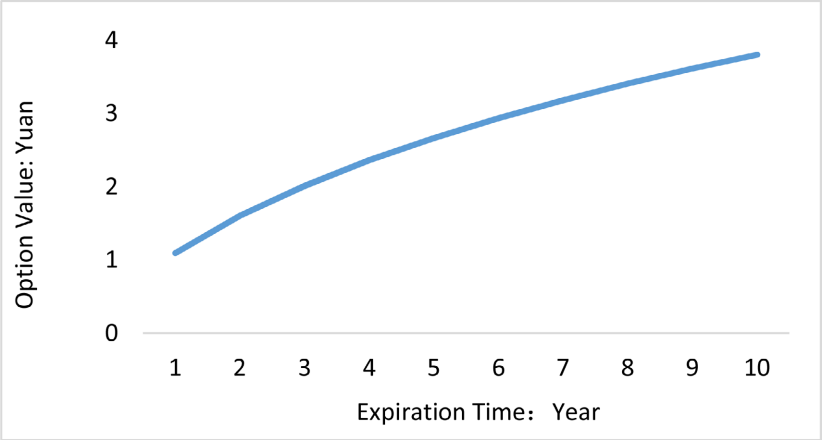

Figure 1. Option value increases with expiration time.

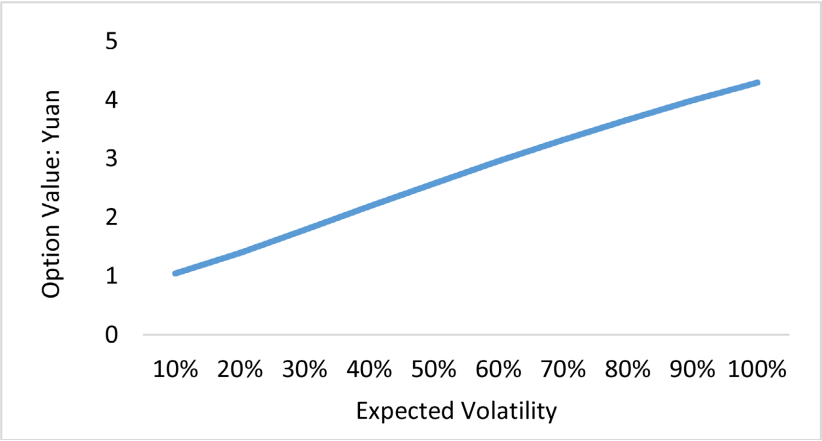

Figure 2. The value of an option increases as the expected volatility rises.

value of volatility options increases as expected volatility rises. If events that drive up volatility are expected to occur in the future, such as loose market liquidity, large fluctuations in demand, and port congestion, the value of options will rise (**Figure 2**).

The historical volatility of shipping stocks provides a reference for the expected volatility center, but the future volatility depends on the valuation volatility of A-shares and the volatility of shipping freight rates (Tang & Qu, 2015). The volatility of market valuation is related to liquidity and risk appetite. The stock market's sharp rise and fall in 2007 to 2010 and 2015 to 2016 have led to a sharp increase in market valuation volatility. The volatility in early 2021 was at a historically low level and is expected to increase in the future. Mean reversion. Freight rate volatility is related to factors such as shipping demand, ship breaking and building, emergencies, etc. (Tang & Qu, 2015), which stays historical high level and is expected to fall near the center at the beginning of 2021. Based on the average value of σ_m and σ_{tce} over the past ten years, the expected volatility is calculated to be 0.34.

$$\sigma_s = -0.1604 + 1.5638\sigma_m + 0.1137\sigma_{tce}$$

From 2016 to 2020, the stock price of COSCO Shipping Energy fluctuated up and down in discount value + volatility value. In 2016 to 2020, the replacement value of COSCO SHIPPING Energy is 4 - 5 yuan, and the value of 3-year volatility options is 1 - 4 yuan, so the reasonable stock price is 5 - 9 yuan, which is more consistent with the actual stock price fluctuation range. Volatility options better explain that the stock price of COSCO Ocean Energy A shares is higher than the replacement value and the fluctuation range of the past five years (Figure 3).

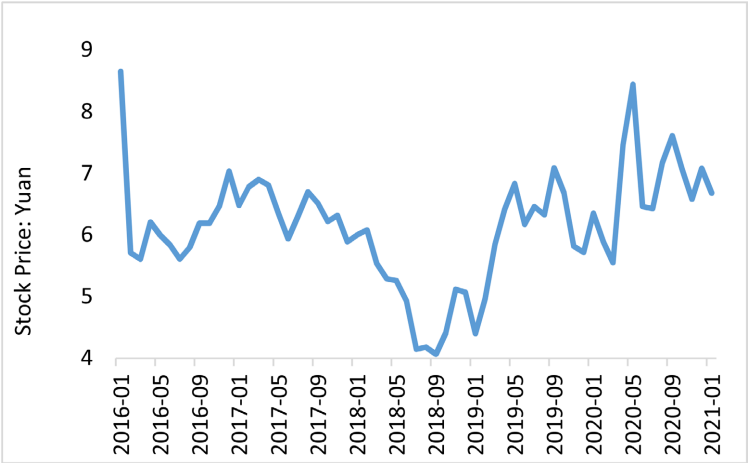

Figure 3. COSCO SHIPPING Energy's stock price fluctuates between 4 - 9 yuan between 2016-2020.

4. Results and Findings

From the above empirical analysis, it can be found that the lower the discount value of the stock, the higher the volatility value. If the listed company has a meager profit for a long time, then the discount value is low. However, the volatility value is mainly determined by the stock price volatility and has nothing to do with the discount value, so the stock value depends on the volatility value. Fluctuations in stock prices lead to changes in the value of volatility, which in turn leads to fluctuations in stock prices, that is, historical volatility affects expected volatility. The greater the historical volatility of the industry and the smaller the free float market value of stocks, the higher the possibility of substantial fluctuations in stock prices in the future. This explains the high valuation and high volatility of A-share cyclical stocks and small-cap stocks with poor performance.

5. Conclusion

The potential support behind state-owned enterprises has caused the market value of A-share state-owned cyclical stocks to be higher than the discount value for a long time. Market investors continue to hold when the stock price is lower than the discount value and sell when it is higher than the discount value, which is equivalent to the implied American call option of the stock. So stock value is

the sum of discount value and volatility value. Using the LSM method to solve American options, an empirical analysis of the data of COSCO Ocean Energy found that the discounted value per share plus the volatility value is closer to the actual stock price; as the investment period increases and the expected volatility increases, the option value increases. The idea of volatility options also explains the high valuation and high volatility of A-share cyclical stocks and small-cap underperformance stocks.

Fund Project

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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