Study on value assessment of listed companies based on the improved real options model

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Abstract. Real option value should be taken into account in the comprehensive evaluation value of listed companies because listed companies are faced with the high degree of uncertainty in decision-making. This paper uses the BP neural network to improve the B-S model and on this basis, real option value evaluation model is established. We do empirical research on new energy industry listed companies and by analyzing the result, the accuracy of the improved model was verified.

Introduction

Followed securities market development, it is more and more important to assess the value of listed companies reasonably. The conventional Discounted Cash Flow doesn't take into account the high growth and profitability of the project in the future. Under the uncertainty environment, the enterprise has a flexible management value, namely, real option value [1]. This paper uses the BP（Back Propagation）neural network method to improve the classic real option method B-S model, and then with the new energy industry as an example for empirical study, using the improved real option model, we assess the value of the selected target companies. Evaluation results show that the improved real options method can more accurately assess the value of listed companies which can help investors to make the right investment decisions.

The introduction of relevant theories

1.1 The B-S model

The B-S model is a stock pricing model without paying dividend established by Black and Scholes in 1973, on the basis of continuous time hypothesis. [2] When using the model, the following assumptions should be satisfied:

The model includes three formulas:

$$C_0 = S_0\left[N\left(d_1\right)\right] - Xe^{-r_c t}\left[N\left(d_2\right)\right] \tag{1}$$

$$d_1 = \frac{\ln\left(S_0 \div X\right) + \left[r_c + \left(\delta^2 \div 2\right)\right]t}{\delta\sqrt{t}} \tag{2}$$

$$d_2 = d_1 - \delta\sqrt{t} \tag{3}$$

In the formulas, C_0 represents the current value of the call; S_0 indicates the current price of the underlying option; X means the strike price of options; r_c represents the annual riskless rate of continuous compounding; t indicates the time left to expiration of the option; δ represents the price's volatility.

In B-S model, some of the variables are highly subjective which may cause inaccurate results. The assumption of B-S model is quite harsh which are not agreeing with practice situation, so its application is limited to a great extent.

1.2 The BP neural network

The BP neural network is a multilayer feed forward neural network based on back propagation algorithm. The network is composed of input layer, hidden layer and output layer. When a group of

learning samples is input to the network, each neuron gets the response and connection weights are generated. In the direction of decreasing the error between target and actual output, correct each connection weights step by step from the output layer through the hidden layer, then come back to the input layer. By repeating this process, the network's response to the input signal is increasingly accurate so that the global error tends to the given minimum [3].

In order to improve the learning efficiency of neural network and processing speed, we adopt the data processing method. Formula is as follows [4]:

$$x_i^{'} = \frac{x_i - \min(x)}{\max(x) - \min(x)} \qquad i = 1, 2, 3\cdots \qquad (4)$$

In the formula, x represents each column; x_i indicates the value of line i in each column. After the above formula, All the data are classified into the interval [0, 1].

Improved real option model

We choose the five factors of the B-S model as input variables of the BP neural network and establish improved real option model to evaluate the value of listed companies.

1)"S", the present value of the underlying assets: For listed companies, the value of total assets on the balance sheet can be seen as their transaction price which has very good representative for the enterprise value.

2)"X", exercise price: Because shareholders have flexibility in using their equity, it can be seen that stock equity has the nature of option. For call options, the option value is equal to the market price minus the executive price($C=S-X$). Equity of the enterprise is C in this article, and the total assets is S, then you can get the real option exercise price X for the value of company's debt.

3)"δ", enterprise value volatility: Analysis of listed company trading day closing price data over time, and calculate the standard deviation of daily proceeds rates in order to calculate daily fluctuation rate, then multiply the square root of the number of trading days, which is the historical volatility of a listed company [5].

4)"t", execution time: To estimate the life of a corporate, many factors should be taken into account such as macro-economic, natural environment and so on .

5)"r_c", riskless rate: Riskless rate should be estimated by the gains fixed riskless securities.

Normalizing these five factors with the formula (4) as variables input to neural networks. This article sets the target value for the actual option value C, and uses the net pricing method to determine the equity value. The formula is as follows:

Equity value =Stock price × outstanding shares number of shares + Net assets per share ×Number of non-circulating stock unit (5)

Empirical analysis

Fengfan Stock Limited Company is the leader in the field of new energy battery. The stock code is 600482. This paper puts Fengfan as the research object, and analyzes the data of the listed companies by real option model to evaluate the enterprise value at the end of the third quarter of 2012.

According to the statistics from great wisdom software, in the third quarter of 2012, Fengfan has total assets of 3.3374801 billion yuan; Debt of 2.0815845 billion yuan. The number of the first three quarters of 2012 trading days is 180. With each trading day's closing price, the calculation of the stock price volatility is 37.78%. This paper argues that Fengfan has been on the market for a long time and has the very good development prospects, so estimates that the option execution time for 10 years. In addition, We take the Treasury's 10-year coupon rate 3.39%, issued in 2012,as the riskless rate. Using the formula (5) to determine the value of C, and in order to make the result more accurate, the stock price in the formula is the average closing price in the third quarter of 2012. Concrete samples are shown in table 1:

Table 1 Sample values

Stock code	Factors					
	S[million yuan]	*X*[million yuan]	*t*(year)	δ	r_c	*C*[million yuan]
002011	9479.6958	6125.4238	10	27.53%	3.39%	8056.1891
300068	3689.7306	858.0677	10	33.52%	3.39%	3258.6896
601311	4211.8461	1181.7325	10	38.25%	3.39%	4423.3196
002580	1337.2153	554.2268	10	36.56%	3.39%	992.3340
300207	1719.9490	517.8087	10	44.53%	3.39%	1776.9112
000862	5062.4006	4516.1091	10	32.07%	3.39%	1885.2329
000012	14789.4595	7410.4114	12	34.25%	3.39%	16102.3365
002218	2184.5684	749.2843	10	36.86%	3.39%	3524.7371
600482	3337.4801	2081.5845	10	37.78%	3.39%	3613.3890

Using the formula (4), the above data are normalized which is shown in table 2:

Table 2 The training sample

Stock code	Factors					
	S	*X*	*t*	δ	r_c	*C*
002011	0.6053	0.8136	0	0.2753	0.0339	0.4675
300068	0.1749	0.0494	0	0.3352	0.0339	0.1500
601311	0.2137	0.0963	0	0.3825	0.0339	0.2271
002580	0	0.0053	0	0.3656	0.0339	0
300207	0.0285	0	0	0.4453	0.0339	0.0519
000862	0.2770	0.5801	0	0.3207	0.0339	0.0591
000012	1	1	1	0.3425	0.0339	1
002218	0.0630	0.0336	0	0.3686	0.0339	0.1676
600482	0.1487	0.2269	0	0.3778	0.0339	0.1735

With the first eight companies as training samples and the ninth "Fengfan" as testing samples, use "train" functions to train the network. After training, use the "sim" function to do network simulation. The calculation is implemented by MATLAB7.0 programming.

Table 3 Error between network training results and the actual value

Stock code	Actual value	Training results	Error
002011	0.4675	0.4584	-1.95%
300068	0.1500	0.1460	-2.67%
601311	0.2271	0.2234	-1.63%
002580	0	0.0224	——
300207	0.0519	0.0497	-4.24%
000862	0.0591	0.0599	1.35%
000012	1	0.9997	-0.03%
002218	0.1676	0.1621	-3.28%

As shown in table 3, the error between the training result and the actual value has been controlled within 5%. Input the ninth sample, ”Fengfan”, to the network simulation and get the test value of 0.1701.According to formula (4), performing normalization to 0.1701,getting the target value of 3562.5454.

By the formula (1) (2) (3), equity value of Fengfan is calculated to be 2210.9078 million yuan while the actual equity value is 3613.3890 million yuan. It is observed that the option value calculated by B-S model differs a lot from the actual value. However, the calculation of the option value is 3562.5454 million yuan by improved real option model, with the error of -1.41%.

Conclusion

In real options evaluation model based on BP neural network, the influence factors of each sample have same standard, which greatly reduces the subjectivity of results. Run the calculation program multiple times to determine the optimal weight and threshold value so that optimal results are obtained. The empirical analysis shows that compared to B-S model, the accuracy is greatly

increased when using the improved real option model to evaluate the enterprise value. Moreover, comparing equity value obtained by BP neural network simulation to the actual stock average closing price, we can basically determine the stock market price is consistent with enterprise real value or not. It contributes to judge the Changing trends of stock price in the future and help investors to make correct investment decisions.

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