

## Analysis on Risk Management Model of Second-Hand Car e-Commerce Platform Pricing-Based on the Revised Black-Scholes Pricing Model

Yuanyuan Chen<sup>1</sup>, Lei Ren<sup>1,\*</sup>, Jun Yang<sup>2</sup>

<sup>1</sup>Department of Management Engineering and Equipment Economics, Naval University of Engineering, Wuhan 430033, China

<sup>2</sup>Unit 91257 of the People's Liberation Army of China, China

E-mail:18438080@qq.com.

\*Corresponding Author

**Keywords:** Black-scholes pricing model, Used car e-commerce, Pricing method

**Abstract:** The risk pain point of the used car e-commerce platform is mainly due to the difficulty in pricing, which is also one of the core goals of risk management and control of the used car e-commerce platform. Based on the characteristics of second-hand car pricing on e-commerce platforms, this paper discusses and analyzes the reasons for choosing an option pricing model, and constructs a revised BS pricing model that is more suitable for second-hand car pricing on the Internet, so as to improve the Internet + second-hand car pricing method and provide reference for the prevention of Internet financial risks.

### 1. Introduction

In March 2018, Premier Li Keqiang of the State Council stated in the government report that the promotion of consumption upgrades, the development of new consumer formats and new models, and the abolition of the second-hand car restriction policy. In July 2018, the Ministry of Public Security promulgated the policy of digitizing second-hand transfer of used cars. This is not only conducive to improving the efficiency of the transfer of second-hand cars in different places, but also helps to increase the cross-regional circulation ratio of second-hand cars again. The promulgation of the new policy will enable the more digital second-hand car e-commerce platform to be empowered, and the platform's cross-regional transaction proportion and overall transaction efficiency will also be improved.

Table 1 Review of China's Consumption Changes

	1980-2000	2000-2010	2011-2017	2018s
Consumption stage	Food and clothing consumption	Personal consumption	Brand consumption	Quality consumption
Representative event	Color TV sets, refrigerators, Department stores meet consumer demand	Taobao appeared, Rapid rise	JD.com and Tmall rise rapidly	Xiaomi, Huawei And other brands rising rapidly
Representative format	Department store	Hypermarkets, Taobao, etc.	B2C e-commerce, shopping malls, etc.	Convenience stores, fresh supermarkets, boutique e-commerce, new retail formats, etc.
GDP per capita	Under \$800	\$ 800-\$ 3,000	\$ 5,000-\$ 8,000	Over \$8,000
GDP growth rate per capita	Around 9% on average	10%-13%	10%	6%-7%
Consumer psychology	Meet the needs of life, Price sensitive	Initial brand awareness based on price considerations	Focus on brand	Gradually return to rationality, Pursuit of personalization and quality
Advertising marketing method	Newspaper Advertising	TV advertisement	Internet marketing	The new media

Data source: Guotai Junan Securities Research

Table 2 New Round of Financing of Used Car e-Commerce Platforms (2018)

Company Name	Financing time	Latest financing situation	Financing line
Usin used car	June 2018	The IPO went public	\$225 million
Renren car	April 2018	New round	\$300 million
Che zhibao	June 2018	Round D	800 million RMB
Car Shooting Everyday	June 2018	Round D	\$100 million
Che Hao Duo Group	March 2018	Round C	\$818 million
Murray auto finance	April 2018	B+ round	239 million RMB

Data source: Guotai Junan Securities Research

Can be seen from Tables 1 and 2, from March 2016, the State Council issued “Several Opinions on Promoting the Convenient Transactions of Used Cars”, and in 2018, the Ministry of Commerce accelerated the revision of the “Measures for the Management of Used Car Circulation”. Policies are actively guiding the development of online and offline integration of used car trading companies, promoting the construction of used car information and credit systems, and standardizing the order of used car trading.

However, with the influx of capital, the “head effect” of second-hand car e-commerce platforms will be further strengthened, and the risks faced will be huge. Since the official appearance of the new State Council Financial Stability Development Committee (hereinafter referred to as the “Financial Committee”) in July 2018, in the two months, the Financial Committee has held several meetings to refine the focus of risk prevention in the financial field and specific areas. deploy. On September 7, 2018, the Finance Committee held its third meeting and proposed that “continue to effectively resolve various types of financial risks. We must prevent both stock risks and various” black swan “incidents, and maintain the stock market, bond market, and foreign exchange market. Steady and healthy development. “The risk pain point of the used car e-commerce platform is mainly due to the difficulty in pricing. This is caused by the complex factors affecting pricing.

## 2. Construction of Black-Scholes Revised Pricing Model

### 2.1 Standard Black-Scholes Pricing Model

In 1973, Fischer Black and Myron Scholes derived a b-s pricing model to calculate the value of call options for non-dividend paying stocks based on some assumptions and on the principle of no arbitrage.

Before proposing the formula of b-s option pricing model, the following assumptions are established:

- 1) A1: Frictionless market. This means: there are no transaction costs or tax costs, securities transactions are carried out continuously, and all shares of all securities are infinitely divisible;
- 2) A2: During the option period, the stock does not pay dividends;
- 3) A3: There is no risk-free arbitrage opportunity, and the short-term risk-free interest rate  $r$  is constant and is the same for all terms;
- 4) A4: Investors' attitude towards risk is neutral;
- 5) A5: The stock price follows the Wiener process.

According to the theoretical basis of the Wiener process, combined with the above assumptions, the following well-known standard B-S pricing model formula can be obtained by using the corresponding mathematical derivation method:

$$C = SN(d_1) - Xe^{-r(T-t)}N(d_2)$$

Among them:

$$d_1 = \frac{\ln(S/X) + (r + \sigma^2/2)(T - t)}{\sigma\sqrt{T - t}}$$

$$d_2 = d_1 - \sigma\sqrt{T - t}$$

The meaning of each parameter in the formula is shown in Table 3:

Table 3 Meaning of Parameters in the Standard B-s Pricing Model

Variable	Meaning	Variable	Meaning
C	Call option price	r	risk-free rate (year)
S	The current price of the underlying asset	$\sigma$	Standard deviation of the underlying asset
X	Fixed strike price of option	T - t	Option time to expiration
$N(d_1)$	Cumulative probability of standard normal distribution	$N(d_2)$	Probability of option being executed under risk neutral conditions

Thus it can be seen that the factors influencing the option price are S, X, r, T - t,  $\sigma$ , which can be expressed as  $C = f(S, X, r, T - t, \sigma)$ .

### 2.2 The Revised Black-Scholes Pricing Model

First, variable analysis. The B-S option pricing model is applicable to the pricing of physical assets in addition to financial assets such as stocks and bonds. After the previous explanation, we can use the B-S pricing model to conduct pricing research on used cars on the e-commerce platform. Of course, due to the special nature of e-commerce platform used car pricing, some of these parameters need to be revised. The meaning of the parameters of the used car on the e-commerce platform is shown in Table 4:

Table 4 Meaning of Parameters of Used Cars on e-Commerce Platform

Option	variable	E-commerce platform used car
The option value	C	The option value of second-hand cars on e-commerce platforms
The current price of the underlying asset	S	The sum of the present value of all future cash flows of used cars on the e-commerce platform
Executive price	X	Initial input cost of used car on e-commerce platform
Time to maturity date	T-t	Economic validity period of used cars on e-commerce platforms
Fixed risk-free interest rate	r	Risk-free interest rate
The volatility of stock prices	$\sigma$	Volatility of used cars on e-commerce platforms in the future

The specific analysis of each parameter is as follows:

1) S: represents the sum of the present value of all the benefits that a used car can bring within the validity period. The determination of this parameter requires prediction based on historical operating conditions and changes in the future operating environment. Discount the discount rate to get the present value at the time of second-hand car investment;

2) X: It means the initial investment cost of used cars. The value of this parameter is the cost of buying used cars;

3) T-t: It means the economic validity period of the used car, that is, the number of years in which the used car can bring benefits. This validity period may not be equal to the effective period of the law. It mainly depends on the advanced technology of the used car and the length of the income period;

4) R: It means the risk-free interest rate. Generally, the maturity rate of the government bonds with the same maturity is used as the risk-free interest rate. Among them, because the vehicle has a mandatory retirement period, the period is based on the remaining useful life between the vehicle's useful life and the mandatory retirement period Prevail.

5) It indicates the volatility of the used car's future income. The volatility of the used car price with the same or similar price can be used to approximate the standard deviation of the used car price

Second, the parameter modification of B-S option pricing model. The standard B-S option pricing model is derived under idealized assumptions. However, for used cars on e-commerce platforms, because of their own particularities, the actual situation and the assumptions of the model are different, so it is necessary to combine the characteristics of pricing of used cars on the e-commerce platform and the environment in which the models are used. The parameters in the system are appropriately modified and introduced, and the parameters are redefined and the corresponding important parameter determination methods are selected.

1) Correction of discount rate

Risk-free interest rate refers to the rate of return that investors can get by investing funds in investment projects without any risk. The standard B-S option pricing model is mainly for short-term

financial bond valuation. In the short-term, if uncertain factors such as inflation are not considered, the parameter  $r$  in the model can use a risk-free interest rate. But for used cars on e-commerce platforms, the benefit period is generally longer than financial bonds, which is determined by the characteristics of real options on fixed assets. However, within the economically useful life of the e-commerce platform, its pricing will not only be affected by relevant national policies, but also by the level of social and economic development at that time. Therefore, it is necessary to consider the uncertainty of the market, that is, the risk premium. Therefore, the discount rate needs to be determined in a dynamic manner by adding market risk and enterprise risk on the basis of risk-free interest rates. Use the capital asset pricing model to determine the discount rate  $k$ :

$$k = r + \beta \times \text{MRP} + r_f$$

In the formula:

$r$ : the selection of the risk-free interest rate value: the maturity yield of the national debt corresponding to the remaining life of the vehicle shall prevail;

$\beta$ : Equity system risk coefficient;

MRP: market risk premium;

$r_f$ : Pending risk adjustment factor.

### 2) Determination of future volatility of used cars on e-commerce platforms

Volatility is used to measure the uncertainty of the benefits provided by used cars. For second-hand cars on e-commerce platforms, the relevant data of the same or similar projects in the industry are generally used to approximate the future volatility of its value, the formula is as follows:

$$\gamma = \sqrt{\frac{\sum(u_i - \bar{u})^2}{n - 1}}$$

Among them:

$$u_i = \ln\left(\frac{S_i}{S_{i-1}}\right)$$

In the formula:

$\gamma$ : Corrected volatility;

$S_i$ : The stock price of the same or similar listed company at time  $S_i$ ;

$\bar{u}$ : Average of  $u_i$ .

### 3) Introduce the expected return rate of used cars on the e-commerce platform

The standard B-S pricing model is based on risk-neutral pricing assumptions. On the e-commerce platform, the value of used cars is determined to some extent by the buyer's expected return on the used car. At this time, the expected return rate of the used car on the used car needs to be introduced to the BS pricing model. The necessary correction, this rate of return will directly affect the pricing of used cars to some extent. It needs to be emphasized that the expected return rate of used cars on the e-commerce platform is not only considering the economic factor, but also comprehensive factors such as politics, technology, and after-sales. This article uses a comprehensive evaluation method to determine the expected return rate of used cars on the e-commerce platform. The process is as follows:

Based on the factors that affect the pricing of second-hand cars on the e-commerce platform, experts use the form of scoring as a process of simulating bilateral hypothetical negotiations (see the attached expert scoring table), and adjust the coefficients derived from the corresponding standard treatment. The average expected return rate of used cars on the commercial platform is adjusted to obtain an effective expected return rate. It should be emphasized here that the determination of the average expected return rate of used cars on the e-commerce platform needs to be calculated through actual research and a large amount of historical data. In the process of determining the expected return rate  $ex$  of the used car pricing of the e-commerce platform, methods such as analytic hierarchy process and comparative analogy are also used.

4) Modified B-S option pricing model By modifying the parameters in the standard B-S option pricing model, this article draws a B-S option pricing model that is more in line with the e-commerce platform used car pricing:

$$C = Se^{(ex-r)(T-t)}N(d_1) - Xe^{-r(T-t)}N(d_2)$$

Among them:

$$d_1 = \frac{\ln(S/X) + (r + \gamma^2/2)(T - t)}{\gamma\sqrt{T - t}}$$

$$d_2 = d_1 - \gamma\sqrt{T - t}$$

### 3. Prospects and Countermeasures

Based on the analysis of the particularity of second-hand car transactions on the e-commerce platform and the characteristics of real options, this article builds a modified BS model based on the classic BS model, with a view to future used car transactions on the e-commerce platform Standardization of prices provides ideas.

Due to space limitations, this article does not conduct an empirical test on the modified Black-Scholes pricing model. Therefore, the impact of the revised parameters on online second-hand car e-commerce platform pricing is an issue that will continue to be studied in the future.

### References

- [1] Ye Qing et al. Research on risk identification of P2P online lending platform [J]. Accounting Research. 2016.6.
- [2] Zhang Qiwen and others. Modification of Stock Option Pricing Model and Empirical Test [J]. Finance and Accounting Monthly, 2016.
- [3] Zhou Xiaohua et al. Exploration of Deposit Insurance Pricing Based on Modified Black-Scholes Option Pricing Model [J]. Finance and Accounting Monthly, 2017.
- [4] Fu Weizhong. A Probe into the Operating Risks of Internet Financial Enterprises [J]. Finance and Accounting Monthly, 2017.