

# Research on P2P Network Lending Pricing Based on Real Option

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**Abstract:** *P2P network borrowing is a kind of new financial service model which is based on the Internet. Its business model provides new financing channels for individual's small and micro enterprises and etc. On the basis of the existed research, this paper discusses the options of P2P platform lending behavior and set a price of P2P network lending platform based on real option theory. The real option is regarded as a more scientific and effective pricing idea.*

**Keywords:** Real option, P2P network lending, Option pricing

## 1. Introduction

With the progress of science and technology, the popularity of Internet technology, as well as the rapid development of quantitative digital data, Internet finance came into being. In 2005, the British ZOPA company founded, the main operation of P2P (Peer-to-Peer) network lending, marking a new beginning of Internet finance. At present, the British normal operation of the P2P platform has more than 40, including some cross-border P2P platform. June 2007, first P2P network loan platform "film credit" was established in Shanghai, China. P2P platform has undergone a trough period in China. In 2010, with the development of Internet technology, the number of P2P platforms has been expanding and the volume of transactions in the whole industry has increased geometrically. As of December 2016, the cumulative number of platforms reached 5877.

On December 10, 2013, at the meeting of the Central Economic Work Conference, General Secretary Xi Jinping first put forward the "new normal". And in February, Premier Li Keqiang put forward in the government work report: "Public entrepreneurship and innovation". In the new stage of economic development, P2P platform as a bilateral market platform, P2P platform can meet the needs of both sides of the loan. The P2P platform is profitable in both transactions, and the research on pricing of platform can provide a reference more clearly for both parties. However, the method of DCF is not accurate. The analysis method of DCF is used to forecast the future cash flow. The DCF analysis method requires an accurate prediction of the amount of future cash flows. And the DCF analysis method needs to decide whether to invest at the beginning. It has some flaws and is not suitable for modern scientific investment decisions.

Real Option is a broad financial derivative, which refers to those with financial options, but can't be marketed. Real Option are widely used by the firm to make investment decisions. Compared with the traditional investment

decision analysis method, the theoretical thinking of real option is not limited to the forecast of project cash flow, but a comprehensive analysis of the various uncertainties affecting the project. Contact investment project decision-making and financial markets, it will be find that the higher uncertainty of investment projects, the higher value. In 1997, Stewart Myers first discovered this theory and applied it in physical investment decisions.

In summary, this paper will discuss the options of P2P platform lending behavior and set a price of P2P network lending platform based on real option theory. The real option is applied to P2P network lending as a more scientific and effective pricing method. To establish a set of pricing that conforms to the characteristics of P2P network lending, in order to provide a reference for both borrowing needs.

## 2. Literature Review

On the study of real options, foreign scholars walk in the forefront. In 1973, Black and Scholes published a paper entitled "Option Pricing and Corporate Debt" in the American Journal of Political Economy [1]. It proposed a continuous option pricing theory to solve the problem of financial option pricing. Which has laid the status of B-S option pricing model and has milestone significance in the history of option pricing. In 1976, Cox and Ross wrote a paper ---"other option pricing laws"[2], it put forward a vision: a financial option to trade can get a "replica" in practice. He puts forward the binomial pricing model of the stock option under the discrete time condition. The model is called the binary tree pricing model. It creates the conditions for judging the value of a real option by directly applying the pricing method of financial options. In 1977, the Myers study found that DCF method is flawed in the evaluation of future strategic investment. This method will reduce the accuracy of the results. So Myers put forward the idea of real options: the value of the investment project not only comes from the direct cash flow from a single investment project, but also from the

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growth opportunities. And he suggest that the use of real options is more effective [3]. In conclusion, the pricing model of financial options is divided into two categories, namely, B-S option pricing model based on continuous time and binary tree pricing model based on discrete time. Real option application research is based on these two pricing models.

With the application and development of real option theory, more and more scholars have applied it to R & D investment research. In 1991, Morris, Teisberg and Kolbe argued that when selecting R & D projects, the greater risk projects should be selected with the same expected benefits and costs. In 1994, Newton and Pearson divided the R & D program into development phase and business investment phase. The business investment phase was viewed as a European call option and the development investment was seen as the cost of acquiring the option. Business investment costs and investment terms are known constants, the cost of commercial investment is equivalent to the option price in the European call option, the value of commercial investment is equivalent to the value of basic assets, so that to calculate and understand Option value of R & D projects.

In the 1990s, Chinese scholar began to introduce real options for extensive research. Related research objects include real estate investment, high-tech enterprise value evaluation, venture capital and option theory research, enterprise strategic decision-making and natural resource value evaluation. In 1998, Yang Feng applied to the option theory investment decisions by analyzing corporate debt. He believed that the investment was irreversible and could be delayed, so that could get future information to delay investment [4]. Shen Houcai used the theory of option pricing to compare R & D investment with financial option, and proposed R & D investment decisions based on option pricing [5]. In 2004, Xia Hui and Zeng Yong pointed out that the DCF analysis method is flawed, and it is considered that the real option theory is more applicable in the analysis of uncertain investment decision [6]. In 2007, Xu Shuang used real option pricing model to study the pricing of construction land in China [7]. She pointed out that land could be regarded as an American option with assets of land value, and the value of land was also divided into two parts .One part was the agricultural farming income and the other part was the value of the premium generated by land development.

In summary, domestic and foreign scholars have made great achievements in the study of real option theory and its application, among corporate strategy, venture capital investment, venture capital and R & D project investment. And these areas have much in common with the P2P network lending industry. But no scholars use real options to study P2P network lending industry. Therefore, this paper opens up a new research on P2P network borrowing industry based on real option theory.

### 3. The Option Characteristics Analysis of P2P Network Lending

#### 3.1 Definition of P2P network borrowing

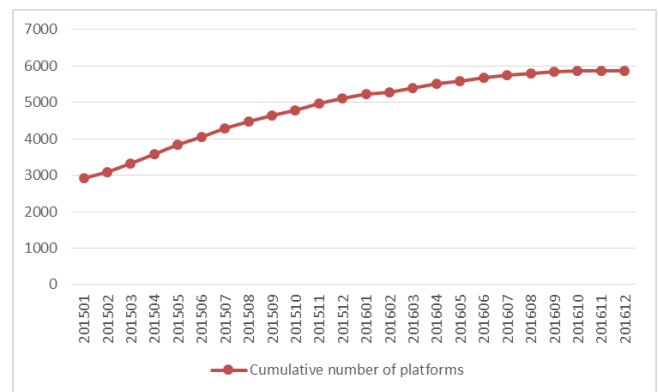
P2P network lending refers to both borrowing directly through the network to achieve lending, China is usually as "everyone loans". P2P network lending model mainly reflects capital flow and information acquisition between individuals. In the relationship between the debt and debt attributes to get rid of the traditional financial media. From this view, P2P network lending covers the "financial disintermediation" concept.

In this model, there is an intermediate financial services side --- P2P financial platform, that is, P2P network lending investment subject matter. The main function of the platform is to provide information for both parties of the loan, the value of the borrowing information and other services that can facilitate the transaction. The specific services include: the borrower's credit audit, the loan demand information announcement, the loan contract construction, the investment consultation, the overdue loan recovery and other related services.

P2P network lending was originally established to provide to provide small loans on Internet. On the one hand, it can provide financing channels for individuals and small businesses, on the other hand, it can provide a better investment channels for the low-income groups of small funds. These P2P network lending platforms are intended to fill the markets that are not covered by the banking system. This paper studies P2P network lending are such enterprises, because such enterprises accounted for the majority. And this type of the project has a lower threshold to enter and more investors, so it has a higher research value.

#### 3.2 P2P industry's current analysis

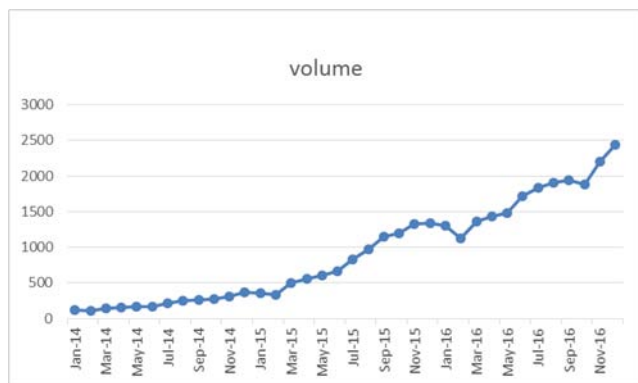
Since 2007, China's first P2P network lending platform established. After several years of development, it showed a geometric growth from the beginning of 2012. From the net loan home statistics, Chinese P2P network lending platform only 9 in 2007. It has 110 on-line operations by 2012. As of December 2016, it accumulated to reach 5877 domestic. The number of P2P network lending platforms as shown in Figure 3.1:



**Figure 3.1:** 2015-2016 P2P network lending platform total

Source: Net loan home

These platforms are mainly concentrated in Guangdong, Shanghai, Beijing, the rest of the company in Zhejiang, Jiangsu, Shandong and other regions accounted for a higher proportion. According to its distribution area, it is developed from economically developed areas to underdeveloped areas, from coastal areas to inland areas.



**Figure 3.2:** 2014 - 2016 P2P network lending platform Volume

Unit: billion  
 Source: Net loan home

As shown in Figure 3.2, according to net loan home statistics, December 2016 turnover of 244.426 billion yuan, increased by 20 times than January 2014. It can be seen that China's P2P industry is developing rapidly, thanks to Chinese consumer credit, as well as personal investment and financial management. Individual operating loans and small micro-enterprise loan financing is a very large market, but because of the lack of good security and mortgage, it is difficult to gain loan from banks and other financial institutions. On the other hand, with the increase in the middle class and the affluent in our society, the demand for financial management has gradually expanded, but the investment channels of ordinary people in our country are very limited. P2P network lending platform just to meet these two aspects of the market demand, so Chinese P2P network lending platform has a larger space.

### 3.3 Options for P2P network lending

Option is a kind of future option, real and financial options have three typical characteristics: future uncertainty, management flexibility and irreversibility. That is, investors are unable to make reliable judgments of the investment environment, as long as the option value is not optimal, investors have the right but not the obligation to exercise options, while investors also need to pay for this right. P2P network lending also exists in these characteristics.

## 4. P2P network lending uncertainty

P2P network lending has developed in China for ten years. It can be said as a new industry, the government and the masses' attitude is not yet clear, so it has a lot of risk. According to the characteristics of P2P network lending, we can divide the risk into technical risk, policy risk, large

financial risk and social risk. So P2P network borrowing has greater uncertainty.

### 1. P2P network lending management flexibility

In the course of the project, "management flexibility" is equivalent to the investors have the financial market options contracts. When the market conditions are favorable to investors, investors have the right to implement these investment strategies; when the market conditions in the negative for investors, investors have no obligation to choose to implement these investment strategies.

### 2. P2P network loan irreversibility

In the early stage of P2P network lending investment projects, the costs of development and construction are "sunk costs". These costs are irreversible. In this case, investors usually take the "wait-and-see" approach, waiting for more information to reduce the project's uncertainty.

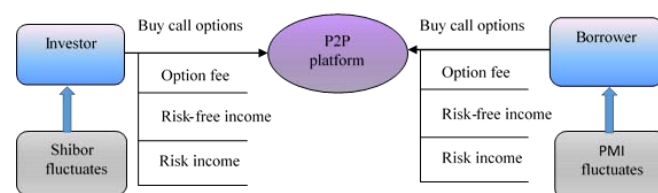
### 3. P2P network loan model construction - based on real options

In this paper, we use the option pricing method of continuous time and the B-S option pricing model to divide the P2P network loan process into two stages: the first stage is the process of investors to purchase an investment from P2P network loan platform. Through the macroeconomic fluctuations, copy a European call option. The expected rate of P2P platform is equivalent to the expected future price of the underlying item, the market interest rate is equivalent to the cost of the assets. The second stage is the process of borrower to purchase an investment from the P2P network. Through the PMI fluctuations, copy a European call option. The expected rate of P2P platform is equivalent of the expected future price of the underlying assets. The loan base rate is equivalent to the opportunity cost of the asset.

#### 1. Model assumptions

1. P2P platform is a legitimate business;
2. Investors in the P2P platform investment, P2P platform is a legitimate lend to the borrower;
3. P2P platform for the project are strictly audited and from the industry, are productive investment, not consumer credit;
4. The project is real, not investment in the stock market.

Based on the above assumptions, the P2P loan model can be shown in Figure 4.1:



**Figure 4.1:** P2P network loan model

Source: Author preparation

To sum up, investors buy call options from the P2P platform and borrower buy the call options from the P2P platform are all European call options. Therefore, the B-S option pricing model is:

$$C = S(t)N(d_1) - Ke^{-r_f(T-t)}N(d_2)$$

$N(\square)$  is the cumulative normal distribution function,

$$d_1 = \frac{\ln(s(t) / K) + (r_f + \sigma^2 / 2)(T - t)}{\sigma\sqrt{T - t}}$$

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

Where C is the option fee, S (t) is the market price at time t, K is the strike price of the option, rf is the risk-free rate of return, T is the expiration time of the option, t for time,  $N(\square)$  is the cumulative distribution function.

**2. Scalar description**

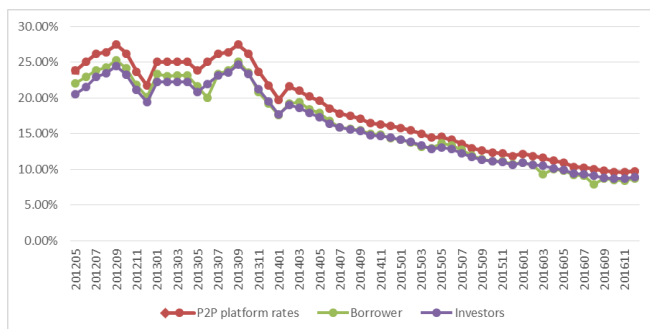
**Table 4.1:** Variable definitions and variable descriptions

Variable name	Variable definitions	Data Sources
$r_f$	Risk-free rate of return, with the balance of the annualized rate of return	Alipay
S	The market price of the underlying assets, that is, the monthly average of the one-year lending rate in the Shanghai interbank market	Shanghai interbank market
K	Option contract execution price, with P2P network loan platform average monthly average annual interest rate	Net loan home
$\sigma_1$	Monthly volatility of PMI	In the macro database
$\sigma_2$	The one - year base rate volatility of the Shanghai interbank market	Shanghai interbank market

Source: Author preparation

**3. Empirical Analysis**

Results Descriptive analysis is shown in Figure 4.2:



**Figure 4.2:** Real Option Pricing Description Statistics

As shown in Figure 4.2, the comprehensive interest rate of the P2P platform is higher than 15% before May 2012 to December 2014, and fluctuates greatly, due to the

geometric growth of the domestic P2P network lending industry during this period. The national law is basically blank, the industry is uncertain, that is, the greater the risk. After 2015, with the continuous improvement of the market, the state introduced the relevant policies to regulate the development of the industry tends to be stable.

It can also be seen from the figure that the results obtained from the B-S option pricing model are consistent with the rates of the P2P platform. Which is equivalent to the criteria for the industry interest rate for investors and industrialists respectively. For the investor side, it can be concluded that the investor may abandon the project when the expected yield of the investment project deviates from the B-S option pricing model, since the risk and the income do not match. For the entrepreneurial side, if the interest rate of the borrowing contract is much higher or lower than the B-S option pricing model, the result may be considered to be abandoned because the project's funding sources are at greater risk.

**5. Conclusion and Suggestion**

P2P network borrowing has strong uncertainty, this uncertainty not only comes from outside, but also comes from the inside, which led to the investment of such projects have greater risks, investment investors also have strong management flexibility. These characteristics lead to the use of traditional net present value and internal income compensation law cannot be reasonable to evaluate such projects. Therefore, the introduction of real option theory on the P2P network lending industry research is very necessary.

**5.1 Conclusion**

In this paper, the real option theory is used to analyze the real option characteristics of the P2P network borrowing industry, and the pricing model is studied according to the B-S option pricing model, and the decision-making principle of the investors in the decision-making process is obtained. The main conclusions are as follows:

1. The uncertainty and management flexibility of the P2P network loan project make the project have real option, that is, increase the value of the project investment, so the value of the real option must be taken into account in the investment analysis.
2. The option value obtained by the real option pricing method can be used as the standard of investment in the industry. If the expected rate of return of an investment project deviates from the standard value, the investor must be careful, because the risk and income of the project do not match.
3. The result of the real option pricing model is consistent with the change of the comprehensive interest rate of the industry, which proves that the real option is applicable in the P2P industry research.

## 5.2 Suggestion

1. The P2P industry should be regulated from the legal aspects by the state. The state should determine the legitimacy of P2P legally, standardize the nature of their business, and eliminate the possibility of illegal fund-raising.
2. P2P industry needs to improve self-discipline. P2P industry should form the industry self-discipline organization, the association should monitor the P2P platform business compliance, be warning the platform risk, reduce the risk of running.
3. Risk and income are matched. The market should be aware of the risks and benefits of rational, high-yield with high risk, for the high income of the P2P platform should be a reasonable understanding of its risk, cannot pursue high-yield blindly.

## Author Profile



**Peng Bo Yang** works as an associate professor in school of Economics and Management, XIDIAN University. His specialization lies in consumer finance and behavioral finance.



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