

Research on Characteristic Town's Crowd-Funding Pricing Based on Real Option

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Abstract: *The characteristic town's crowd-funding is a new type of financial service based on the Internet, which provides new financing channels for the construction of characteristic towns. Based on the existing relevant research, real option theory and B-S pricing model, this paper discusses the option features of crowd-funding model in characteristic town, and establishes the real option pricing model. The real option can be regarded as a more scientific and effective pricing method.*

Keywords: Real option, characteristic town, crowd-funding

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1. Introduction

After the reform and opening up, China began to accelerate the construction of urbanization, but the level of industrialization has always been higher than the level of urbanization. Characteristic towns as the place carriers of urbanization of rural surplus labor force, play an important role in the urbanization process in China. Characteristic towns is not a town in the administrative sense, but a collection of items which has the special industry-oriented, tourism and living features. Characteristic town reflects that the market in the allocation of resources plays a decisive role and gives better play to the role of government. And characteristic town is also an important carrier connecting effective supply with demand in supply side structural reform. The development of characteristic town has high investment and long period, so the mortgage of the project is difficult. Now the government supports characteristic town using PPP financing, fund management, crowd-funding, trust planning, policy Bank loans and other financing for development.

In May 2016, the national development and Reform Commission in the new urbanization standing at a new starting point to a new breakthrough in reference, during the State of "Thirteen-Five" encourages regions to develop characteristic towns, arrange the full deployment construction of the characteristic towns, and strengthen the characteristic town of the infrastructure funding. Characteristic town can use crowd-funding for financing, the subject-matter of characteristic town can be shares, products or services, such as the 3rd tour in the characteristic towns. As a connection bridge between project promoters and potential investors, crowd-funding platform creates a two-sided market, both introducing the financing channels of social funds for characteristic town, and providing investment channels for consumers. Therefore, the study of characteristic town crowd-funding pattern of pricing can provide suggestions for investment decisions and propose improvement measures for the construction of characteristic town, so it is of great significance.

Discounted cash flow method is the traditional method of

investment decision, which applies to lower cash flow uncertainty, cannot be suspended or revoked in the middle of the investment projects. But due to the lack of flexibility in investment decision, it is not reasonable for proceeds with a high degree of uncertainty of dynamic risk investment project evaluation. Real options are generalized financial derivatives, which are consistent with the characteristics of financial options, but not trade investment opportunities in the financial markets. It is widely used in actual investment decisions in the corporate world. Compared with the traditional method of investment decision analysis, real option theory is not confined to project cash-flow projections, but based on the no-arbitrage theory to analyze the uncertain factors affecting the project. It reflects that the uncertainty of the investment project is higher, the investment value is higher.

In summary, this article will study option characteristic and pricing method about the characteristic town's crowd-funding pattern, based on the real options theory. We regard real options as more scientific and effective pricing idea, and apply it to the mode of financing, establish a set of Black-Scholes pricing model of characteristic town's crowd-funding, to be referred by both borrowing and lending sides in the field.

2. Literature Review

In 1977, the Myers study found that DCF method is flawed in the evaluation of future strategic investment, the defect of the methods in some way will reduce the accuracy of the results, so presented real options: the value of the investment project is not only from the direct cash flows of a single investment project, also from the opportunity to grow, and to make recommendations, using the real options method to evaluate such investment projects will be more effective. Financial options pricing models can be divided into two categories, which are based on continuous-time of B-S option pricing model and based on discrete-time of the binomial tree pricing model, application of real option is evolved from this two pricing models.

In the 20 century 90 years, China began to introduce the real option method to invest estate, evaluate the value of high-tech

enterprise, decide strategic and so on. Havi and Zeng Yong (2004) noted that DCF analysis was flawed, that under uncertainty analysis of real option theory in investment decision is more applicable. Shuang Xu (2007) used real option pricing model to solve the land pricing problem in the real estate market. Zhao Wen Jun (2007) amended the Geske complex real options pricing model, and analyzed the characteristics of high-tech companies, on the view point of the investors, to high-tech companies as containing complex real options of venture capital projects to value.

Theory at present to all the crowd-funding study focuses on two aspects, one is the research on the scientific connotation of crowd-funding, clearing the differences between crowd-funding with traditional modes of financing. The other is the study on the inner mechanism of crowd-funding, the motivation of crowd-funding participants and the key effect factors of the performance of crowd-funding. There is less research on the pricing of crowd-funding. Meng Dao (2014) from the financial flow, information flow and reward perspective to build a business model which regarding a crowd-funding platform as the core, connecting investors and project sponsors (financing enterprises or individuals). As a bridge to connect entrepreneurs and potential investors, crowd-funding platform creates a two-sided market (Lin Huang, Zhou qinye, 2014). Theory of the two-sided market comes from network economics and the theory of product pricing, its primary problem is pricing, which is currently one of the most urgent problems in crowd-funding.

In summary, domestic and foreign scholars on the real options theory and its application research have had a lot of success, which in the company's strategy, venture capital and R&D project investment research method has gradually matured. These investment properties and content has a lot of similarities with the study of this paper. But for the crowd-funding industry is in its early stages, as well as the financing model of characteristic town, no relevant scholar study on the application of real options theory to analyze the pricing.

3. The Option Features of Characteristic Town's Crowd-Funding Analysis

3.1 Feasibility analysis of characteristic town's crowd-funding

Crowd-funding refers to a placement model which the project sponsors through the crowd-funding platform release their creativity to investors, in kind, services or equity as a return. This model breaks the traditional mode of financing, and every ordinary people can obtain funds by this pattern. It allows the sources of financing come from the public. Crowd-funding mainly consist three parties: project sponsors, investors and the crowd-funding platform:

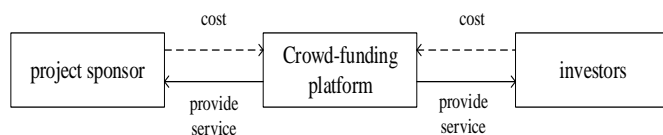


Figure1: logic diagram of crowdfunding participants

Characteristic town's crowd-funding construction should regard projects as the subject, be supported by urban investment and tourism investment, take future earnings and assets for investment income. On this basis, it can form a three-tier structure of crowd-funding: investment property crowd-funding; the crowd-funding to introduce business operators as the subjects; consumers crowd-funding, leading in the consumer into the equity investment side.

To follow the crowd-funding approach, using PPP's model, its funding pressures and operating structures will be different from the traditional one. This competitive advantage is that during the crowd-funding the characteristic towns will absorb a number of comments coming from people to participate in the crowd-funding of shops, operators and consumers, to adjust the design features of characteristic towns, making characteristic towns from the beginning orient consumers, early in the market docking. And generalize characteristic towns through promotion of crowd-funding platforms during the project's construction period, in access to social capital to participate in at the same time, for the town's tourist, commercial and business foundation in the future.

Meanwhile, national policy encourages innovation of investment and financing in the characteristic town construction, supports the use of crowd-funding to introduce social capital. Therefore, the crowd-funding mode of characteristic town has raised policy and commercial viability.

3.2 The option features of characteristic town's crowd-funding

The real option pricing method is based on non-arbitrage theory. It constructs a portfolio of underlying assets, and quotes the risk neutral probability. Finally we can obtain the corresponding option value. Option is a kind of future option. Real options, like financial options, have three typical characteristics: future uncertainty, management flexibility and irreversibility. That means 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 (opportunity cost + time cost).

The investment of characteristic town's crowd-funding mode can be divided into two stages. Investors put some funds in the first investment stage, which is the construction and early operation stage of characteristic town. The funds are regarded as sank cost and irreversible, equivalent to the option fee. In the second investment stage, which is the operation and development stage of characteristic town, investors can decide whether continue to additional investment or not according to the operation situation. If it operates well, investors can select to continue investing, or else abandon the investment. This process is equivalent to buying a call option. The uncertainties of characteristic town's crowd-funding are as follows:

(1) The successes or failures of crowd-funding projects are uncertain

For investors, both equity crowd-funding and commodity crowd-funding, are to predict estimate of the characteristic town, and then invest, so the risk needs to be considered. The

existence of crowd-funding failures is one of the most striking differences comparing with traditional bilateral market. Investors invest the characteristic town projects at present. And if the project is successful, investors will get the pre-commitment return from the sponsors; if the project failed, investors will get the return of investment funds from sponsors. The successes or failures of crowd-funding projects depends on many factors, so it is uncertain.

(2) The investment return of crowd-funding projects is uncertain

If the project's financing is successful, the investment return in the future is also uncertain. Due to the investment is staged, with the preparatory process, investors can decide whether further participation and additional investment or not. After the success of characteristic town construction, its tourism income, land premium income, property sales income are affected by many factors. Characteristic town doesn't produce excessive profits, sharing interests as well as taking the necessary risk of the project, the investment return of investors is uncertain.

Therefore, the characteristic town's crowd-funding is a general feature of option, and the investment process of can be considered as an option. Using real option pricing method has some legitimacy.

4. Model Construction – Based on Real Option

In this paper, using the option pricing method of continuous time and the B-S option pricing model, we can copy the staged investment to characteristic town's crowd-funding platform as a European call option.

4.1 Establishment of real option model

Model assumptions are as follows:

- 1) The characteristic town's crowd-funding is legitimate business;
- 2) Investors will invest in the crowd-funding platform, and the platform is legally lend to characteristic towns;
- 3) The characteristic town projects are strictly audited, which belongs to the productive investment;
- 4) Characteristic town project is real, and not investing in the stock market.

Based on the above assumptions, the B-S option pricing model of characteristic town's crowd-funding is:

$$C = S(t)N(d_1) - Ke^{-r_f(T-t)}N(d_2) \quad (1)$$

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

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

$$d_2 = d_1 - \sigma\sqrt{T - t} \quad (3)$$

Where C is the option fee, S (t) is the market price at time t, K is the strike price of the option, r_f 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.

4.2 Variable description

The B-S real options model of characteristic town are defined and described as follows:

Table 1: Variable definitions of model

Variable name	Real options	Variable definitions
T	the expiration time of option	the duration of project investment
K	the future cost of acquiring the asset	one-year lending rate in the Shanghai interbank market
S	the expected future price of the asset	the present value of annualized return on characteristic town's crowd-funding investment
r_f	risk-free interest rate	the annualized rate of return of Yuebao
σ	the volatility of the asset value	the average volatility of stock markets in characteristic town

Source: Author preparation

- 1) T: defined as the duration of the project investment, namely the time interval from next stage of investment or decision-making of characteristic town's crowd-funding project.
- 2) K: defined as the one-year lending rate in the Shanghai interbank market (Shibor), which means that the opportunity costs of giving up other forms of investment and choosing the characteristic town's crowd-funding investment.
- 3) S: defined as the present value of annualized return on characteristic town's crowd-funding investment. Currently the main method is DCF.
- 4) r_f : defined as the annualized rate of return of Yuebao, because it has the advantages of high security, net worth and mobility.
- 5) σ : defined as the average volatility of stock markets in characteristic town. As financial markets pricing is relatively objective, we can choose the similar assets' stock to calculate the historical volatility.

4.3 Empirical Analysis

Assuming that 2014 is the first year to construct the characteristic town, investors decide to invest its crowd-funding project. If the characteristic town develops well when the construction period (the first investment stage) is over, investors will choose to invest more in 2017 (the second investment stage). If not, they will give up additional investment. This process is equivalent to buying a European call option. The parameters in the B-S option model are as follows:

- 1) T: The construction period of characteristic towns is usually 3~5 years, and the payback period is 8~10 years. Therefore, we assume that the first investment stage is 3 years, the second investment stage is 8 years.
- 2) K: Inquiring the official website of Shibor, we learned that the one-year Shibor interest rate in first investment stage in 2014 is 4.9564%, and the second investment stage in 2017 is 4.0866%.

Table 2: K value

Time	The first investment stage (2014~2016)	The second investment stage (2017~2024)
	2014	2017
K	4.9564%	4.0866%

Source: The official website of Shibor

3) S: Considering the current market operation situation and investment return of characteristic towns, have characteristic small town, we can estimate the expected value and the present value, whose discount rate is the risk-free rate.

Table 3: S value

Time	2017	2018	2019	2020
investment return (ROI)	0.41%	0.73%	1.04%	1.75%
discount rate (r)	3.1%	3.1%	3.1%	3.1%
present value of ROI	0.40%	0.69%	0.95%	1.55%
Time	2021	2022	2023	2024
investment return (ROI)	2.05%	2.58%	2.93%	3.12%
discount rate (r)	3.1%	3.1%	3.1%	3.1%
present value of ROI	1.76%	2.15%	2.37%	2.44%

Source: Author preparation from physical truth

Consequently,

$$S = \frac{ROI_1}{(1+r)} + \frac{ROI_2}{(1+r)^2} + \dots + \frac{ROI_8}{(1+r)^8} = 12.3\% \quad (4)$$

(4) r_f : Through inquiring data we learned that the annualized rate of return of Yuebao is 3.1%.

(5) σ : Selecting 23 relevant stocks' price data in the conceptual section of the characteristic town, we can calculate the monthly volatility and then calculate the annual volatility is about 55.82%.

The above selected parameter values are brought into the B-S option pricing model, and the results are as follows:

Table 4: B-S results table

T	3	d1	1.7193
K	4.0866%	d2	0.7525
S	12.3%	N(d1)	0.9572
r_f	3.1%	N(d2)	0.7741
σ	55.82%	C	8.89%

Source: Author preparation

The calculation shows that, using the B-S option pricing model of characteristics town's crowd-funding project gets the value is 8.89%, more than the sunk cost 4.9564%. So the project value is positive, and investors can choose to invest.

5. Conclusion and Recommendations

Characteristic town crowd-funding project is with strong uncertainty, and investors have strong management flexibility. These features lead that the use of NPV could not be reasonable for this type of project evaluation. Therefore, it is necessary to apply the real option theory to price the characteristic town's crowd-funding.

5.1 Conclusion

In this paper, the real option theory is used to analyze the real option features of characteristic town's crowd-funding. And the pricing is studied according to the B-S option pricing model, through which the decision basis of the investors in the decision-making process is obtained. The main conclusions are as follows:

- 1) The uncertainty and management flexibility of characteristic town's crowd-funding make it possess the real option features. It increases the investment value of the project, so the investment analysis must take the real option value into account.
- 2) Through the real option pricing method, the option value can reflect the flexible decision-making of the project better. Investors can set B-S pricing model parameters according to their own and market conditions, and acquire reference for the decision-making of investment.

5.2 Suggestion

Firstly, the use of Internet can achieve breakthroughs in investment and financing of characteristic towns, promote the use of crowd-funding of characteristic towns, and increase the possibility of characteristic towns' profit.

Secondly, investors should pay attention to match the returns and risk of investment, combining with their own investment preferences and market fluctuations to make investment decisions. And they should have a rational understanding of risks, not blindly pursue high returns.

Finally, we should strengthen the management of the investment and financing mode of characteristic towns, and standardize the business nature of characteristic town's crowd-funding, so as to promote its steady development.

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