Equity Allocation in Equity-based Crowdfunding of Startups Based on Lobbying and Reputation Considerations

Jie Xiong, Ying Du
School of Economics and Finance, Xi'an International Studies University, Xi'an, China

Abstract

Starting with the problem of information asymmetry in equity-based crowdfunding of startups, this paper analyzes the process of equity-based crowdfunding based on startups, considers the lobbying behavior of startups among lead investors and lead investors' reputation influence among the following investors, constructs the moral risk model for the participation of startups and lead investors and following investors in equity-based crowdfunding, and demonstrate the optimal equity allocation proportion of startups for their investors. The research shows that when the lobbying degree of the startups or the reputation of the lead investors increase, the minimum capacity standard to satisfy the increase of the optimal equity distribution ratio with the increase of the project income is lower.

Keywords: Equity-based crowdfunding, lobbying, reputation, startups, equity allocation

I. Introduction

In just a few years, crowdfunding has gradually expanded from creative industries and philanthropic projects to a broader business platform [1], Equity-based crowdfunding is a mode in which investors invest in entrepreneurial projects and obtain equity or an equity-like income distribution mechanism [2]. It skillfully combines venture financing with angel investment through the Internet, builds a new bridge for the demand side and the supply side of capital, and opens up a new way for enterprise financing. In a platform of equity-based crowdfunding, a startup uploads its business plan to the project library of the platform first. The investors on the platform are usually divided into experienced lead investors, such as institutional investors, and ordinary investors, namely following investors (individual investors). Individual investors are often in a weak position, while institutional investors have more investment experience. Therefore, individual investors can obtain reference opinions from institutional investors, thus reducing the information asymmetry of ordinary investors and improving the financing efficiency of the market [3-4]. The lead investors looks for a suitable project through the project library, and then have an interview with the entrepreneur. The start-up can make certain efforts to lobby the lead investors to make investment in their projects. At this time, the startup needs to set the proportion of equity allocation between the lead investor and the following investors. After determining the investment intention and investment proportion of the lead investor (generally 10%~80% of the financing amount), the lead investor will issue an investment proposal on the platform for the reference of the following investors, who then choose whether to co-invest or not. The reputation and influence of the lead investor will affect the decision of the following investors, and thus affect the success rate of financing, as shown in Figure 1.

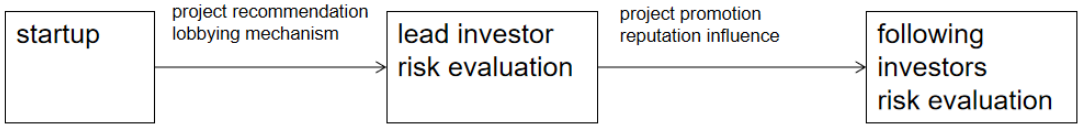

Figure 1 : The lobbying and reputation mechanism among the startup, the lead investor and the following investors

Equity-based crowdfunding is an innovation to solve the disadvantages of the financing mode in traditional capital market, such as financing conditions and long time, etc. Its goal is to be more open and equal, but it also causes new risks. Being open and equal means more investors with higher complexity. Since the startups lack capital and management experience, they need help from capital and investors in such aspects as financing and business management. Since neither party can observe the efforts of the other party, the problem of dual moral risk may exist.

So far, domestic studies on equity-based crowdfunding mainly focus on two aspects. First, the research on the risk prevention and control, platform construction and policy supervision of crowdfunding platforms. Through the identification and analysis of such risks as fraud and illegal financial activities that are prone to occur in crowd-funding financing, and drawing on the experience of foreign crowd-funding systems, these studies put forward corresponding suggestions on investor protection, fund-raisers and legal supervision of crowd-funding platforms (Mao Zhiqi et al., 2015; Zhang Bing et al., 2015; Zhao Yin, 2019; Yang Shuo, 2019) [5-8] Second, discussions on the factors influencing the financing success rate of equity-based crowdfunding projects. With the quality information disclosed by the crowdfunding platform "Renrentou" as a sample, Kong Zhaojun et al. (2019) studied the relationship between the quality information disclosed by financing parties and crowdfunding platforms and investors' willingness to participate [9]. Li Sen et al. (2018) constructed the index system for judging the success rate of equity-based crowdfunding projects, and tested the influence of capital injection, investment withdraw, financing guarantee terms of financing projects, operation scale of financing enterprises, and disclosed warrant data on equity-based crowdfunding [10]. Wei Jianguo et al. (2018) conducted an empirical analysis on the data of 128 successful financing projects on two platforms, Jingdong Dongjia and Zhongtou Bong, verifying the influence of such quality signals as project description, initial investment amount, whether there is a lead investor, number of followers and number of investors on the financing performance of these projects [11]. Fang Xing (2017) discussed the role of the lead investor in equity-based crowdfunding in China under the mode of "lead investor + following investors", pointing out that the higher the investment amount of the lead investor and the location of the lead investor and the sponsor in the same city will increase the financing ratio of the crowd-funding project, and the investment behavior of the lead investor can promote the success of equity-based crowd-funding project [12]. There are also abundant studies on the influencing factors of equity-based crowdfunding abroad. J Donovan et al. (2021) [13] pointed out that there is a positive correlation between financial reporting and financing. Nadia Oliva (2018) [14] analyzes crowdfunding from the perspectives of project threshold, project value, project influence, etc. D Zhang et al. (2018) draws on signal theory and the research findings of local bias in VC to examine how geographic distance (GD) and different signals affect equity crowdfunding platforms launching projects online [15]. Silvio Vismara (2016) investigate the signaling role played toward external investors by equity retention and social capital [16].

The above studies have conducted in-depth analysis on various factors influencing the success rate of crowdfunding projects, among which the positive influence of lead investors on the success rate of financing has been widely accepted. However, there is still a lack of studies on how fund-raisers, that is, financing enterprises can obtain effective value-added services of the lead investor through contract design after successful financing in the equity-based crowdfunding platform, that is, how to avoid the occurrence of moral hazard through equity allocation. Therefore, considering the lobbying behaviour of the startup towards the lead investor and the reputation influence of the lead investor on following investors, this paper aims to the optimal proportion of equity allocation between the lead investor and the following investors in successful funding in equity-based crowdfunding platforms, thus encouraging the lead investor and following investors to invest through a scientific arrangement and better facilitating the startup in financing and development.

II. Construction of the Moral Risk Model of Startups in Equity-Based Crowdfunding

2.1 Financing process of equity-based crowdfunding of startups

There are mainly two parties involved in equity-based crowdfunding, one being the startup as the financing party, and the other being investors, namely a large number of small and micro angel investors. Unlike venture investment, equity-based crowdfunding provides both the financing party and the investors with a platform of information service, so as to enable more startups to have effective contact in the absence of better and more transparent channels for investment, and lower the cost of communication and time, thus facilitating the startups to lobby the investors and increasing the success rate of the financing projects. Once the lead investor is determined, the large number of capital holders can decide whether to co-invest according to the reputation of the lead investor and the actual situation of the startup. Through online operation, shareholders of crowdfunding projects can check the development trends and capital flow of the projects at any time, and can also provide guidance, suggestions and resource support at any time, thus realizing the dynamic contacts between the entrepreneur, the startup projects and the investors. With these start-up services, entrepreneurs can also get more support and help. A special limited partnership will be established to hold the equity after the fundraising is completed. The income source of equity-based crowdfunding platforms is to charge a certain percentage of fees or equity from the financing parties.

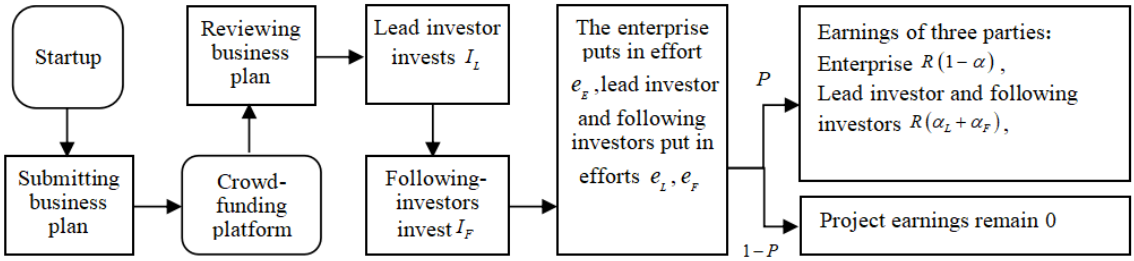

Figure 2: Process of equity-based crowdfunding of startups

The process of equity-based crowdfunding for startups is as shown in Figure 2, involving three behaviour subjects, respectively E, the startup, V_1, the lead investor and V_f, the following investors. A startup first submits its business plan to equity-based crowdfunding platforms. After receiving the plan, the platform will conduct a comprehensive assessment based on the quality of the entrepreneurial team, the type of the project and the potential for future profits. If the platform thinks the business plan is feasible, it will design and publish the financing plan, transforming the project from a common business plan into a project library connected with the capital market platform; after getting the attention of the lead investor through the project library, the startup can rely on the reputation and influence of the lead investor to attract more investment from following investors, thus obtaining the needed funds through the mode of "lead investor + following investors". If the enterprise succeeds in financing, it pays the crowdfunding platform a service charge equaling a proportion of β in the financed amount. After the funds are in place, the startup needs to make continuous efforts in research and development, production, sales and other aspects for the success of the enterprise. In the early startup stage, the products, technologies and management of the startup are not mature, and a lot of funds and resources are needed. Crowdfunding platforms provide startups with more investors and other resources (intellectual resources, customer resources, human resources, etc.) in addition to capital. The lead investor who chose to invest in the startup at the earliest time usually invests more capital, has a closer relationship with the enterprise, occupies a large share of equity, and will spend a lot of time and energy to provide value-added services for the startup; following investors pay less attention to the startup than the lead investor and make less effort, but they can also help the enterprise in publicity or promotion and produce a certain influence in the society.

2.2 Construction of the moral risk model of startups in equity-based crowdfunding

Based on the process of equity-based crowdfunding of startups, the moral risk model of startup, lead investor and following investors in equity-based crowdfunding is constructed and the following hypotheses are put forward.

Hypothesis 1: the startup needs capital *I* for project development or development of the enterprise, it will finance through the crowdfunding platform, and for simplicity of research, it's assumed that the financed capital will be appropriated with one payment. The lead investor invests I_L, and the following investors invest I_F, the equity transfer proportion of the startup is $\alpha = \alpha_L + \alpha_F$, where the lead investor and the following investors get α_L and α_F, respectively, the equity proportion obtained by the startup is $1-\alpha$, and the earnings after the success of the project is *R*, otherwise the earnings will be 0.

Hypothesis 2: Due to the high risk of startups, it is assumed that the probability of success is $P(0 \le P \le 1)$ and the probability of failure is $1-P$. The probability of success is related to the ability and efforts of the startup, the lead investor and the following investors. Assume the success rate $P = \min(\theta_E e_E + \theta_L e_L + \theta_F e_F, 1)$, in which θ_E is the startup's capacity of project management, and θ_L and θ_F are the project operation capacity of the lead investor and the following investors, which can be used to indicate the contribution of each party's effort to the success of the project and all three parties are continuous variables in (0, 1). e_E, e_L and e_F are the effort of the three parties, and there will be cost arising from the effort of the three parties, $C(e_E) = \gamma_E e_E^2 / 2$, $C(e_L) = \gamma_L e_L^2 / 2$, $C(e_F) = \gamma_F e_F^2 / 2$, in which γ_E, γ_L and γ_F are the effort cost coefficient of the three parties. With the improvement of the effort level, the effort cost keeps rising, and the marginal cost of the effort increases. The success of the project is positively correlated with the effort level and ability of the startup and the investors. Generally speaking, the startup is the technical developer and creative proposers of the venture project, mainly responsible for project research and development and daily management. It has a very strong professional management ability for the venture project and plays the most important role in the success of the project; the lead investor has certain experience and professional investment knowledge, is responsible for the organization of funds and peripheral resources, and has a relatively high professional ability for the venture project it has invested in; following investors are not so strict with the industry of the invested project. Generally, they are only responsible for part of the investment, publicity and other work. They may be weak in the professional ability of the invested venture project, but the following investors can exert a certain social influence on the success of the project. θ, namely the capacity of the three parties in a specific project depends on the type and characteristics of the project.

Hypothesis 3: The startup can improve the lead investor's judgement of the success rate of the project through lobbying $\vartheta(0 \le \vartheta \le 1)$, after being lobbied, the success probability identified by the lead investor changes into $\overline{P} = \min(\theta_E e_E + \theta_L e_L + \theta_F e_F + i\vartheta, 1)$, $i \ge 0$ stands for the lobbying efficiency of the startup. If the lead investor decides to invest, it needs to influence the following investors' estimation of the success rate of the project through its reputation W, $W \ge 0$ is a constant indicating the reputation of the lead investor, $k \ge 0$ stands for the influence coefficient of the lead investor's reputation on the following investors, the higher the lead investor's reputation W, the greater its influence k on the following investors, and the higher the success probability perceived by the following investors. If the project fails, the lead investor will suffer a loss of reputation $(1-\overline{P})W$.

If the lead investor decides to invest, it will need to invest reputation *W* to influence the following investors' estimation of the success rate, $W \ge 0$ is a constant standing for the reputation of the lead investor, and $k \ge 0$ stands for the influence of the lead investor's reputation on the following investors, the higher *W* is, the

higher the success rate of the project in the following investors' eyes. If the project fails, the lead investor will need to a cost of reputation loss, that is, $(1-\overline{P})W$.

Hypothesis 4: After a successful financing, the enterprise need to pay the crowdfunding platform a proportion of β of the financing amount as the service charge and charge for capital custody. Since crowdfunding platforms have relatively strict standards for lead investors, they have a certain capacity of risk bearing, and they have a close relationship with the startup. Therefore, in case a project fails, the platform will return this income to the lead investor as a compensation, so as to encourage the lead investor to conduct monitoring of the startup together with the platform, and lower the probability of moral risk behaviour of the enterprise.

The total output of a successful project should be greater than the total investment (including the cost of effort, which is denoted as $e=\gamma_E e_E^2/2+\gamma_L e_L^2/2+\gamma_F e_F^2/2$), therefore:

$$\left(1-\alpha_L-\alpha_F\right)PR+\alpha_L\overline{P}R+\alpha_F\left(P+kW\right)R+\left(1-P-kW\right)\beta I-\left(1+\beta\right)\left(I_L+I_F\right)-(1-\overline{P})W-e>0 \tag{1}$$

When the lobbying of the startup and the reputation influence of the lead investor are considered, if the startup succeeds in financing in the equity-based crowdfunding platform, the utility function of the enterprise is:

$$U_E=\left(1-\alpha_L-\alpha_F\right)PR-C\left(e_E\right)-\beta I \tag{2}$$

The utility function of the lead investor is:

$$U_L=\alpha_L\overline{P}R-(1-\overline{P})W-C\left(e_L\right)-I_L \tag{3}$$

And the utility function of the following investors is:

$$U_F=\alpha_F\left(P+kW\right)R+\left(1-P-kW\right)\beta I-C\left(e_F\right)-I_F \tag{4}$$

In order to achieve a win-win situation, a startup will arrange contracts in the process of equity-based crowdfunding, and when transferring equity to leading venture investment institutions and following investment institutions, the expected earnings need to be greater than the reservation utility, and satisfy the incentive constraint and participation constraint of each party, so as to maximize the joint earnings, and the principal-agent model participated by three parties is constructed as:

$$\max_{\alpha_L,\alpha_F} U_E=\left(1-\alpha_L-\alpha_F\right)PR-C\left(e_E\right)-\beta I \tag{5}$$

$$\text{s. t. } U_L=\alpha_L\overline{P}R-(1-\overline{P})W-C\left(e_L\right)-I_L\geq\underline{U_L} \tag{6}$$

$$U_F=\alpha_F\left(P+kW\right)R+\left(1-P-kW\right)\beta I-C\left(e_F\right)-I_F\geq\underline{U_F} \tag{7}$$

$$\max U_E=\left(1-\alpha_L-\alpha_F\right)PR-C\left(e_E\right)-\beta I \tag{8}$$

$$\max U_L=\alpha_L\overline{P}R-(1-\overline{P})W-C\left(e_L\right)-I_L \tag{9}$$

$$\max U_F=\alpha_F\left(P+kW\right)R+\left(1-P-kW\right)\beta I-C\left(e_F\right)-I_F \tag{10}$$

Theorem 1: In equity-based crowdfunding of the startup, the optimal equity allocation proportions among the startup, the lead investor and the following investors are respectively $1-\alpha_L^*-\alpha_F^*$, α_L^* and α_F^*.

Demonstration: According to the first order condition, derivatives of the incentive compatible formulas of the three participants in the model are taken, therefore:

$$e_E^* = \left(1-\alpha_L-\alpha_F\right)R\theta_E/\gamma_E \tag{11}$$

$$e_L^* = \left(\alpha_L R+W\right)\theta_L/\gamma_L \tag{12}$$

$$e_F^* = \left(\alpha_F R-\beta I\right)\theta_F/\gamma_F \tag{13}$$

According to the optimality conditions of Kuhn-Tucker, when formulas (6) and (7) are tight, the objective function takes the maximum value. By substituting participation constraint and e_E^*、e_L^*、e_F^* into formula (5), the Lagrangian function is constructed as:

$$\max\left(1-\alpha_L-\alpha_F\right)PR+\alpha_L\bar{P}R+\alpha_F\left(P+kW\right)R+\left(1-P-kW\right)\beta I-(1-\bar{P})W-e-\left(1+\beta\right)I-K-\underline{U_L}-\underline{U_F} \tag{14}$$

In formula (14), first-order derivative of α_L is:

$$\frac{\theta_E^2}{\gamma_E}R\left(\beta I-W\right)+\frac{\theta_L^2}{\gamma_L}R\left(R-\beta I\right)+i\vartheta R-\frac{\theta_E^2}{\gamma_E}R^2\alpha_F{}^* = \left(\frac{\theta_L^2}{\gamma_L}R^2+\frac{\theta_E^2}{\gamma_E}R^2\right)\alpha_L$$

$$\alpha_L^* = \frac{\frac{\theta_E^2}{\gamma_E}\left(\beta I-W\right)R+\frac{\theta_L^2}{\gamma_L}\left(R-\beta I\right)R+i\vartheta R-\frac{\theta_E^2}{\gamma_E}R^2\alpha_F{}^*}{\left(\frac{\theta_E^2}{\gamma_E}+\frac{\theta_L^2}{\gamma_L}\right)R^2} \tag{15}$$

And the derivative of α_F in formula (14) is:

$$\frac{\theta_E^2}{\gamma_E}R\left(\beta I-W\right)+\frac{\theta_F^2}{\gamma_F}\left(R^2+RW\right)+kWR-\frac{\theta_E^2}{\gamma_E}R^2\alpha_L{}^* = \left(\frac{\theta_F^2}{\gamma_F}R^2+\frac{\theta_E^2}{\gamma_E}R^2\right)\alpha_F$$

$$\alpha_F^* = \frac{\frac{\theta_E^2}{\gamma_E}R\left(\beta I-W\right)+\frac{\theta_F^2}{\gamma_F}\left(R^2+RW\right)+kWR-\frac{\theta_E^2}{\gamma_E}R^2\alpha_L{}^*}{\left(\frac{\theta_E^2}{\gamma_E}+\frac{\theta_F^2}{\gamma_F}\right)R^2} \tag{16}$$

Further simply it and:

$$\alpha_L^* = \frac{\left(1-\beta I/R\right)\left(\gamma_E\theta_L^2\theta_F^2+\gamma_F\theta_L^2\theta_E^2-\gamma_L\theta_E^2\theta_F^2\right)-\left(2\gamma_L\theta_F^2+\gamma_L\gamma_F k\right)\theta_E^2W/R+\left(\gamma_L\gamma_F\theta_E^2+\gamma_E\gamma_L\theta_F^2\right)i\vartheta/R}{\gamma_E\theta_L^2\theta_F^2+\gamma_F\theta_L^2\theta_E^2+\gamma_L\theta_E^2\theta_F^2} \tag{17}$$

Similarly:

$$\alpha_F^* = \frac{2\gamma_F\theta_E^2\theta_L^2\beta I/R+\left(\gamma_L\theta_E^2\theta_F^2+\gamma_E\theta_L^2\theta_F^2-\gamma_F\theta_L^2\theta_E^2\right)\left(1+W/R\right)+\left(\gamma_F\gamma_L\theta_E^2+\gamma_E\gamma_F\theta_L^2\right)kW/R-\gamma_F\gamma_L\theta_E^2i\vartheta/R}{\gamma_E\theta_L^2\theta_F^2+\gamma_F\theta_L^2\theta_E^2+\gamma_L\theta_E^2\theta_F^2} \tag{18}$$

ISSN: 0010-8189

Thus it can be known that

$$\alpha_E^* = 1-\alpha_L^*-\alpha_F^* = \frac{(1-\beta I/R)\left(\gamma_F\theta_L^2\theta_E^2+\gamma_L\theta_E^2\theta_F^2-\gamma_E\theta_L^2\theta_F^2\right)-\gamma_E\gamma_L\theta_F^2 i\vartheta/R}{\gamma_E\theta_L^2\theta_F^2+\gamma_F\theta_L^2\theta_E^2+\gamma_L\theta_E^2\theta_F^2} \\ \frac{-\left(3\gamma_L\theta_E^2\theta_F^2+\gamma_E\theta_L^2\theta_F^2-\gamma_F\theta_L^2\theta_E^2+2\gamma_F\gamma_L\theta_E^2 k+\gamma_E\gamma_F\theta_L^2 k\right)W/R}{\gamma_E\theta_L^2\theta_F^2+\gamma_F\theta_L^2\theta_E^2+\gamma_L\theta_E^2\theta_F^2} \quad (19)$$

Demonstrated.

Thus it can be seen that from the perspective of the startup, not only is the optimal proportions of equity allocation for the lead investor and the following investors related to the relative strength and effort of the three parties, as well as the cost of the startup, the cost of the project and the final earnings, it's also subject to the lobbying effect of the startup towards the lead investor and the lead investor's influence on the following investors.

III. Numerical Analysis of the Model

According to the optimal equity allocation proportion of the startup, this paper conducts further analysis on such aspects as the capacity of the startup, the lobbying of the startup towards the lead investor and the reputation influence of the lead investor on the following investors, and the following conclusion is obtained through numerical simulation.

Assume that a startup carry out equity-based crowdfunding for project development, if the needed capital $I=60$, and if the earnings in case of successful project $R=100$ and the earnings in case of a failed project is 0, after the successful financing, the enterprise needs to pay the platform a service charge in a proportion of $\beta=0.025$, and the project investment capacity of the startup, the lead investor and the following investors are $\theta_E=0.8$, $\theta_L=0.6$ and $\theta_F=0.4$, respectively, and the effort cost coefficients of the three parties are $\gamma_E=20$, $\gamma_L=30$ and $\gamma_F=10$.

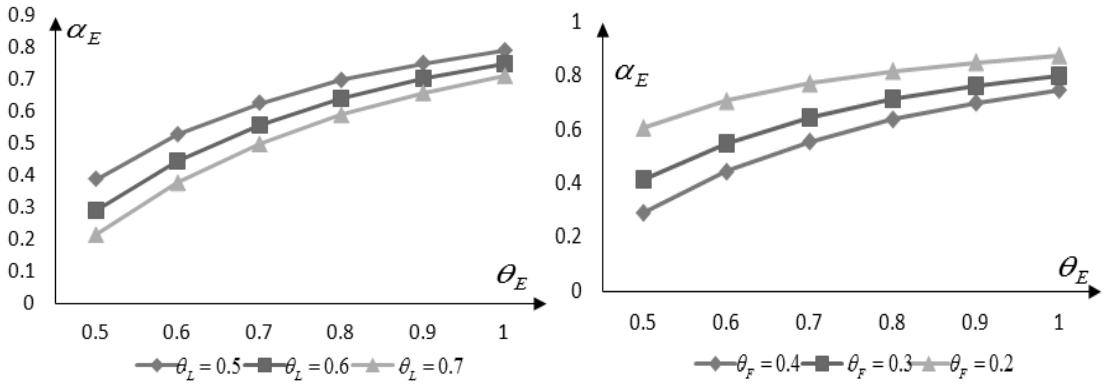

Figure 3(a) α_E when θ_E changes *Figure 3(b) α_E when θ_E changes*

Through analysis of theorem 1, when the lead investor's capacity θ_L is 0.5, 0.6 and 0.7 respectively, the influence of the increase of the startup's capacity θ_E on the optimal equity allocation of the startup is as shown in Figure 3(a), when the following investors' capacity θ_F is 0.4, 0.3, 0.2, respectively, the influence of the increase of the startup's capacity on the optimal equity allocation of the startup is as shown in Figure 3(b). The stronger the

startup's capacity in such aspects as investment and operation, the higher the proportion it shares in equity allocation; the stronger the capacity of the lead investor or the following investors, the higher proportion of equity the enterprise needs to transfer. Thus it can be known that compared to financing through venture capital institutions, when a startup finance through equity-based crowdfunding, since the number of investors is large and the investors are with varying qualities, and since their comprehensive capacity is relatively lower than that of venture capital institutions, the proportion of equity that an enterprise must transfer in order to obtain the same amount of capital, which is conducive to lowering the financial cost of the enterprise.

Proposition 1: when the capacity and effort effect of the startup, the lead investor and the following investors satisfy $\gamma_E / \theta_E^2 > \gamma_F / \theta_F^2 + \gamma_L / \theta_L^2$, the optimal equity allocation proportion increases with the increase of β, the proportion of charges it needs to pay; when the capacity and effort effect of the three parties satisfy $\gamma_E / \theta_E^2 < \gamma_F / \theta_F^2 + \gamma_L / \theta_L^2$, the optimal equity allocation proportion decreases with the increase of the charges it needs to pay.

Demonstration: in formula (19), by taking the derivative of β:

$$\frac{\alpha_E^*}{\partial\beta} = \frac{\left(\gamma_E\theta_L^2\theta_F^2 - \gamma_F\theta_L^2\theta_E^2 - \gamma_L\theta_E^2\theta_F^2\right) I / R}{\gamma_E\theta_L^2\theta_F^2 + \gamma_F\theta_L^2\theta_E^2 + \gamma_L\theta_E^2\theta_F^2}$$

When $\gamma_E\theta_L^2\theta_F^2 - \gamma_F\theta_L^2\theta_E^2 - \gamma_L\theta_E^2\theta_F^2 > 0$, that is, $\theta_L^2 > \frac{\gamma_L\theta_E^2\theta_F^2}{\gamma_E\theta_F^2 - \gamma_F\theta_E^2}$, $\alpha_E^{*\prime} > 0$, demonstrated.

At this time, the higher the proportion of charges the enterprise needs to pay, the higher the optimal equity allocation proportion. On the contrary, when $\theta_L^2 < \frac{\gamma_L\theta_E^2\theta_F^2}{\gamma_E\theta_F^2 - \gamma_F\theta_E^2}$, that is, $\alpha_E^{*\prime} < 0$, the higher the charges that the enterprise needs to pay, the lower the optimal equity allocation proportion the enterprise can get. Thus it can be seen that when the crowdfunding platform charges transaction charges, as the work efficiency and capacity of the enterprise improve, the enterprise should choose lead investors and following investors with higher capacity and higher work effectiveness, so as to guarantee the increase of equity allocation that the enterprise gets, which, to some extent, helps avoid damages to the interests of the startup, and drives the lead investor and the following investors to put in more effective effort, thus realizing maximization of joint interests of all parties.

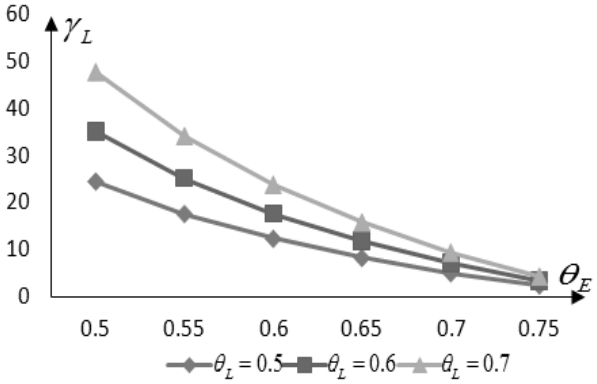

Figure 4: γ_L as θ_E changes

It should be ensured that the equity allocation proportion a startup gets increases as β, the management charge, increases, that is, when $\gamma_L < \left(\frac{\gamma_E}{\theta_E^2} - \frac{\gamma_F}{\theta_F^2}\right)\theta_L^2$ is satisfied, the maximum value of the effort cost coefficient of the lead

investor should decrease as the investment capacity of the startup increases, that is, the stronger the investment capacity of the startup, the higher its requirement for the minimum work efficiency of the lead investor, thus realizing the increase of the equity allocation proportion it gets as the management charge increases, as shown in Figure 4. At the same time, when θ_L, the capacity of the lead investor, is 0.5, 0.6 and 0.7, which increases gradually, the maximum effort cost coefficient required by the startup decreases, that is, when faced with lead investor with higher capacity, the enterprise can lower its requirement for the work efficiency of the investor.

Proposition 2: When the capacity and effort effect of the startup, the lead investor and the following investors satisfy $\theta_E^2 > \frac{\gamma_E\theta_L^2\theta_F^2\beta I - \gamma_E\gamma_L\theta_F^2 i\vartheta - \left(\gamma_E\theta_L^2\theta_F^2 + \gamma_E\gamma_F\theta_L^2 k\right)W}{\left(\gamma_F\theta_L^2 + \gamma_L\theta_F^2\right)\beta I + \left(3\gamma_L\theta_F^2 - \gamma_F\theta_L^2 + 2\gamma_F\gamma_L k\right)W}$, the optimal equity allocation proportion of the enterprise increases as the project earnings increase; otherwise, the optimal equity allocation proportion the enterprise gets decreases as the project earnings increase.

Demonstration: in formula (19), by taking the derivative of *R*:

$$\frac{\partial\alpha_E^*}{\partial R} = \frac{\left(\gamma_F\theta_L^2\theta_E^2 + \gamma_L\theta_E^2\theta_F^2 - \gamma_E\theta_L^2\theta_F^2\right)\beta I + \gamma_E\gamma_L\theta_F^2 i\vartheta + \left(3\gamma_L\theta_E^2\theta_F^2 + \gamma_E\theta_L^2\theta_F^2 - \gamma_F\theta_L^2\theta_E^2 + 2\gamma_F\gamma_L\theta_E^2 k + \gamma_E\gamma_F\theta_L^2 k\right)W}{\left(\gamma_E\theta_L^2\theta_F^2 + \gamma_F\theta_L^2\theta_E^2 + \gamma_L\theta_E^2\theta_F^2\right)R^2}$$

When $\alpha_E^{*\prime} > 0$, that is, $\left[(W-\beta I)\gamma_L\theta_F^2 - (2\beta I + W)\gamma_F\theta_L^2 - 2i\vartheta\gamma_F\gamma_L\right]\theta_E^2 > kW\gamma_E\gamma_F\theta_L^2 + i\vartheta\gamma_E\gamma_L\theta_F^2 - (2\beta I + W)\gamma_E\theta_L^2\theta_F^2$, the optimal equity allocation proportion of the startup only increases when the earnings of the enterprise increases, demonstrated.

Therefore, for a startup with relatively low capacity, as project earnings increase, it needs to transfer a greater equity allocation proportion to the lead investor and the following investors, and the goal of increasing its own equity proportion as the earnings increase can only be realized when the startup satisfies a certain level of capacity. 2015 Report on the Development of Equity-based Crowdfunding Industry in China, which was jointly published by Internet Financing Research Institute of Shanghai Jiaotong University and Jingbei Think Tank, pointed out that in the process of investigation, most investors expressed that the capacity and quality of the founding members are one of the important criteria in project evaluation. Even though a project may be with defects in the startup stage, investors may still consider investing in it as long as the founding team has a strong learning capacity and are with a strategic vision.

Let $\theta_E^2 > \frac{\gamma_E\theta_L^2\theta_F^2\beta I - \gamma_E\gamma_L\theta_F^2 i\vartheta - \left(\gamma_E\theta_L^2\theta_F^2 + \gamma_E\gamma_F\theta_L^2 k\right)W}{\left(\gamma_F\theta_L^2 + \gamma_L\theta_F^2\right)\beta I + \left(3\gamma_L\theta_F^2 - \gamma_F\theta_L^2 + 2\gamma_F\gamma_L k\right)W} = f(\vartheta, W)$, by taking the derivatives of the lobbing degree of the startup to the lead investor and the reputation effect of the lead investor on the following investors, ϑ, W, it can be got that $\frac{\partial f(\vartheta,W)}{\partial\vartheta} < 0$, $\frac{\partial f(\vartheta,W)}{\partial W} < 0$, when ϑ, the lobbying degree of the startup to the lead investor or when W, the reputation of the lead investor, increases, the lower the standard for θ_E, that is, the minimum capacity criterion for the goal of increasing the equity allocation proportion of the enterprise as *R*, the project earnings, increases, that is, startups can get greater project earnings by lobbying the lead investor or choosing a lead investor with higher a reputation.

Proposition 3: The optimal equity allocation proportion decreases as the lobbying degree increases; and the optimal equity allocation proportion of the enterprise increases as the lobbying decreases.

Demonstration: in formula (19), by taking the derivative of ϑ:

$$\frac{\partial \alpha_E^*}{\partial \vartheta} = -\frac{i\gamma_E\gamma_L\theta_F^2 / R}{\gamma_E\theta_L^2\theta_F^2 + \gamma_F\theta_L^2\theta_E^2 + \gamma_L\theta_E^2\theta_F^2} < 0$$

Demonstrated.

The lobbying conducted by the startup can increase the lead investor's expectation for utility, thus increasing the optimal equity allocation proportion required by the lead investor, which increases the financing cost of the enterprise. However, it can be seen from conclusion 4-2 that by lobbying, the startup can lower the investors' requirement for its capacity, thus realizing the goal of getting greater optimal equity allocation proportion as the project earnings increase. Therefore, to a startup, appropriate lobbying can help improve the success rate of financing, thus ensuring that the enterprise gets the value from the increase of earnings yet excessive lobbying can lower the equity proportion the enterprise gets, thus leading to higher financing cost.

Proposition 4: when the capacities of the startup, the lead investor and the following investors satisfy $\theta_E^2 > \frac{\gamma_E\theta_L^2\theta_F^2 + \gamma_E\gamma_F\theta_L^2 k}{\gamma_F\theta_L^2 - 3\gamma_L\theta_F^2 - 2\gamma_F\gamma_L k}$, the optimal equity allocation proportion of the startup increases as the reputation of the lead investor increases; otherwise the optimal equity allocation proportion of the enterprise decreases as the lead investor's reputation increases.

Demonstration: in formula (19), by taking the derivative of *W*:

$$\frac{\partial \alpha_E^*}{\partial W} = \frac{\left(\gamma_F\theta_L^2\theta_E^2 - 3\gamma_L\theta_E^2\theta_F^2 - \gamma_E\theta_L^2\theta_F^2 - 2\gamma_F\gamma_L\theta_E^2 k - \gamma_E\gamma_F\theta_L^2 k\right) / R}{\gamma_E\theta_L^2\theta_F^2 + \gamma_F\theta_L^2\theta_E^2 + \gamma_L\theta_E^2\theta_F^2}$$

From $\gamma_F\theta_L^2\theta_E^2 - 3\gamma_L\theta_E^2\theta_F^2 - \gamma_E\theta_L^2\theta_F^2 - 2\gamma_F\gamma_L\theta_E^2 k - \gamma_E\gamma_F\theta_L^2 k > 0$, it can be deduced that:

$$\theta_E^2 > \frac{\gamma_E\theta_L^2\theta_F^2 + \gamma_E\gamma_F\theta_L^2 k}{\gamma_F\theta_L^2 - 3\gamma_L\theta_F^2 - 2\gamma_F\gamma_L k} = f(k)$$

When a startup chooses a lead investor with a high reputation, it will increase the following investors' expectation for future utility, thus increasing the success rate of financing. When the capacity of the startup is relatively low, a high reputation of the lead investor can help attract more following investors for the enterprise, and at the same time, it also means a higher reputation cost paid for the failure of the enterprise, leading to a higher requirement of the lead investor for its equity allocation proportion. In $f(k)$, by taking the derivative of k, it can be obtained that $f(k)' > 0$, indicating that the higher the influence of the lead investor on the following investors, the higher requirement of capacity the startup needs to meet.

IV. Conclusions

Based on analysis of the characteristics and process of equity-based crowdfunding of startups, this paper constructs the principal-agent model of startup, lead investor and following investors, so as to examine the optimal equity allocation proportions of the startup for the lead investor and the following investors under the influence of lobbying conducted by the startup and the reputation of the lead investor, and the following.

The optimal equity allocation proportion of a startup in equity-based crowdfunding is related to the working capacity and effort effect of the lead investor, the following investors, and the startup itself, a startup can only ensure that the optimal equity allocation proportion increases as the transaction charge increases by choosing investors with greater capacity and efficiency, and the startup itself must satisfy a certain requirement for capacity so that it can realize the goal of higher equity allocation proportion of the enterprise as the earnings of the enterprise or the reputation of the lead investor are higher.

When the startup has a relatively low capacity, a higher reputation of the lead investor can help the enterprise attract more following investors but it also means a higher reputation cost paid for the failure of the enterprise, thus leading to a higher requirement for the equity allocation proportion. Only when the capacity of the startup itself is high enough can it get greater equity allocation proportion by choosing a lead investor with a high reputation.

Lobbying the lead investor can lower the optimal equity allocation proportion of the startup, but lobbying can increase the investors' expectation for future utility, thus attracting investors to invest and stimulate them to put in effort. The higher the lobbying degree of the startup to the lead investor or the higher the lead investor's reputation, the lower the minimum capacity standard for the goal of increasing the optimal equity allocation proportion of the enterprise as the project earnings increase, that is, by lobbying the lead investor or choosing a lead investor with a high reputation, a startup with a low capacity can get greater project earnings.

References

[1] J.Q. Huang, Q.L. Xin, "Crowdfunding-- Concept, Characteristics and Enlightenment of New Network Financing Model," International Finance, vol. 9, pp. 64-69, 2013.
[2] "BRADFORD C S. Crowdfunding and the federal securities laws," Columbia Business Law Review, vol. 21, no. 6, pp. 1081-1154, 2012.
[3] R. LENZ, "Take care of the crowd! - legal protection of retail investors in crowdfunding is long overdue," Business Horizons, vol. 3, pp. 31-33, 2015.
[4] D.C. BROWN, S.W. DAVIES, "Equity crowdfunding: harnessing the wisdom of the crowd," Journal of Business Venturing, vol. 4, pp.72-74, 2015.
[5] Z.Q. Mao, D. Yang, "New Trends and Reference of Japanese Crowdfunding Legislation," Securities Market Review, vol. 04, pp. 4-12+69, 2015.
[6] B. Zhang, W.J. Sun, "National Social Science Fund of Internet Finance Major Project Research Group. The development, risk and regulation of Internet finance: A review of the Internet finance development forum," Economic Research Journal, vol. 50, no. 11, pp. 183-186, 2015.
[7] Y. Zhao, "Construction of Regulatory Legal System of Internet Equity Crowdfunding from the Perspective of Financial Security," Jiangxi Social Sciences, vol. 39, no. 03, pp.177-186, 2019.
[8] S. Yang, "An international comparative study on the investment agreements of public offering crowd-funding," Journal of Nanjing University (Philosophy, Humanities and Social Sciences), vol. 56, no. 06, pp.62-69, 2019.
[9] Z.J. Kong, S.Y. Xia, Z.H. Fu, "Influence of quality signal on investor participation in equity-based crowdfunding," Journal of Beijing Institute of Technology (Social Science Edition), vol. 21, no. 04, pp.95-103, 2019.
[10] S. Li, X.W. Zhao, E.J. Xia, "The success rate of equity-based crowdfunding project financing: A comparative analysis of Logistic regression and neural network model," Technology Economics, vol. 37, no. 09, pp. 80-91, 2018.
[11] J.G. Wei, Z.H. Zhang, "An empirical study on the impact of information disclosure on financing performance of equity-based crowdfunding projects," Journal of Wuhan University of Technology (Social Science Edition), vol. 31, no. 03, pp.74-80, 2018.
[12] F Xing, "Can lead investors contribute to the success of equity-based crowdfunding projects?" Economic Issues in China, no. 06, pp. 122-133, 2017.

[13] J. Donovan, “Financial Reporting and Entrepreneurial Finance: Evidence from Equity Crowdfunding,” Management Science, 2021.
[14] N. Oliva, Crowdfunding and Civic Crowdfunding: Theoretical Features and Future Prospect, 2018.
[15] D. Zhang, Y. Li, J. Wu, et al., “Online or Not? What Factors Affect Equity Crowdfunding Platforms to Launch Projects Online in the Pre-Investment Stage?” Entrepreneurship Research Journal, 2018.
[16] Vismara, Silvio, “Equity retention and social network theory in equity crowdfunding,” Small Business Economics, vol. 46, no. 4, pp.579-590, 2016.