Design of Incentive Mechanism for Venture Enterprises Based on the Perspective of Simulation

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ABSTRACT: To motivate the long-term sustained efforts of venture entrepreneurs is of vital importance for the sustainable and steady development of enterprise. By introducing observable variables towards short-term and long-term sustained efforts, a two stage principal-agent model is established, and the validity of the model is verified by the computer simulation technology.

KEYWORDS: Venture Investment; Short-Term Efforts; Long-Term Sustained Efforts; Stock Ownership Incentive; Principal-Agent.

1 INTRODUCTION

Venture investment is an investment activity to offer equity capital to newly established enterprises or small and medium-sized enterprises with certain development potentials. Known as the “engine of economic growth”, venture investment plays a significant role in modern economic development. Venture capitalists and venture entrepreneurs, also the foundation of the value creation and growth, are two important resources of venture enterprise. Venture capitalists possess venture capitals and seek for considerable profits through these capitals, while venture entrepreneurs try to implement programs they hold by making use of the capitals venture capitalists raised. Due to the goal incompatibility and information asymmetry of venture capitalists and entrepreneurs in their utility maximization pursuing process, moral hazard behaviors between the two sides are inevitable. The principal-agent relationship between them frequently becomes the research question of interest for a number of scholars. The researches in this field are mainly about how to design feasible incentive mechanisms to reduce moral hazards. To take examples, scholars like Zhuan Ruiyao et al. [1] integrated the dual principal-agent relationship in venture investment from the perspective of venture capitalists, and designed incentive mechanism to ensure utility maximization of venture capitalists. Sahlman [2] believes that the unanimity of both sides’ expected utility can only be achieved through the motivation and constrains venture capitalists, after getting the information they observed, put on venture entrepreneurs. As to the impact of venture entrepreneurs’ effort level towards the enterprise value, some scholars also carried out their researches. For example, scholars as Jin Yong-hong et al. [3] argued that the fame-affected periodic effort level of venture entrepreneurs is much higher than that of those without being affected; the longer the time of being affected, the stronger the incentive functions of fame towards venture entrepreneurs. Scholars like Dang Xing-hua et al. [4] pointed out that under the condition of a same effort level between venture capitalists and entrepreneurs, the respective stock equity proportion between the two sides’ changes to the variation on the importance degree of their efforts accordingly. Zheng Jun-jun et al. [5] and Li Yun-fei et al. [6] explored the optimum stock equity incentive model based on other observable variables. Chen Feng-wen et al. [7] analyzed the optimum equity structure of venture enterprises based on complementary effect. Scholars as Wu Meng et al. [8] classified entrepreneurs’ efforts into two categories: short-term efforts and sustained efforts, and analyzed the incentive function of cost reimbursement upon sustained efforts by
combining theoretical model analysis and numerical simulation.

To summarize, this paper will divide venture entrepreneurs’ efforts into short-term effort and long-term sustained effort, based on which, two main incentive indexes of short-term effort and long-term sustained efforts are introduced. Moreover, to reduce the future uncertainties appearing in the post effort stage, corresponding observable variables (or supervisory signals) are also introduced to reduce uncertainties of each effort stage, or, in other words, to make these uncertainties observable and controllable within a certain range, and upon which two stage equity incentive models (rather than cash incentive measures) are established. The following contents of the paper are: the second part puts forward the basic assumption and introduces the model constructing process; the third part gives us the conclusion and simulation of the model; the fourth part summarizes the text.

2 MODEL CONSTRUCTION

2.1 Basic assumption of the model

To provide convenience for research, following assumptions are made:

(1) The effort level of venture capitalists can be classified into short-term effort level $e_1$ and long-term sustained effort level $e_2$. Short-term effort level $e_1$ mainly influences the profit of the current period, while long-term sustained effort level $e_2$ of the next period. What’s more, a short-term effort has certain complementary function towards long-term performance $e_{12}$, and conversely, long-term sustained effort also complement short-term performance to some extent $e_{21}$.

(2) As long-term sustained effort level $e_2$ has hysteretic nature, multi-period decisions should be taken into consideration. It also possesses common quality, thus the consideration of the first and second period decisions.

(3) The category of venture capitalists (the immediate gains emphasized impulsive type and the long-term interest emphasized moderate type) determines the main effort category of venture entrepreneurs, which may both be short-term or long-term sustained effort. Moreover, venture capitalists are neutral, while venture entrepreneurs are risk-avoided.

(4) During the process where expected greatest short-term and long-term sustained efforts of venture enterprises are paid, corresponding uncertainties $e_1$, $e_2$ that impact the performance appear. Each of them is independent from each other.

2.2 Incentive model with observation index

Based on the assumptions above, at the initial stage, according to prior information, an incentive contract is firstly established by venture capitalists, which specifies the fixed income of the venture enterprises $\alpha$ and the proportion of variable profit $\beta$, which also represents the incentive degree towards venture entrepreneurs. Just as what Holmstrom B and Milgrom P has pointed out, compositions of linear incentive contract $(\alpha, \beta_1, \beta_2)$ are as follows:

$$s(\alpha, \beta_1, \beta_2) = \alpha + \beta_1 \pi_1 + \beta_2 \pi_2$$  \hspace{1cm} (1)

Once the contract is agreed by both parties, the risk project will be implemented. Because of the information asymmetry between venture entrepreneur and venture capitalist, once the risk project appears bad situation, the venture capitalists will by no means get to know the reason for the unhealthy conditions of the venture projects. It may because the venture entrepreneurs did not work hard enough, or it may because of the exogenous uncertain factors. Although it’s not possible for the venture capitalists to get to know the effort degree of the venture entrepreneurs directly, nor to supervise the whole project, they, however, can perceive other information related to the exogenous random variables $e_1$, $e_2$, such as the short-term and long-term yield of other enterprises or the corresponding industry average value.

Therefore, next we will take into account of the venture investment incentive contract when introducing other observable variables:

$$s(\alpha, \beta_1, \beta_2, Y_1, Y_2) = \alpha + \beta_1 (\pi_1 + Y_1 y_1) + \beta_2 (\pi_2 + Y_2 y_2)$$  \hspace{1cm} (2)

According to the formula, the observable variables can be divided into two types, that is, the short-term one $y_1$ and the long-term one $y_2$, and there is no relationship between the two observable variables and $y_i$ obey normal distribution, that is,

$$y_i \sim N \left(0, \sigma^2_i \right).$$

The $y_i$ is only related to the exogenous random variable $e_i$. In this model, the definition of the short-term indicator $y_1$ is that: $y_1$ is the industrial short-term rate of return, related to the exogenous random variable $e_2$, where it assumes that it’s the rate of return in the first phase of the industry, and $y_2$ is also similar to the definition of $y_1$, to avoid repetition, it’s not described in this paper.

$Y_i$ reflects the weight of the observable variable $y_i$ in the contract to the payment of the venture entrepreneurs. Generally, the two sides of the
impulse type of investment pay more attention to the evaluation of the short-term indicator $y_1$, while the two sides of the moderate type attaching more attention to the evaluation of the long-term indicator $y_2$. Therefore, the two different types of investment parties have different requirements for the weight of the indicators. The impulsive venture entrepreneurs would prefer short-term indicator $y_1$ and the weight $Y_1$, expecting a bigger value of $Y_1$, and the moderate venture entrepreneurs would focus on the long-term indicator $y_2$ and the weight $Y_2$, expecting a bigger value of $Y_2$. If $Y_1 = 0$, then there is no relationship between the income of the venture entrepreneurs and the value of $y_i$.

Based on the above model, the venture capitalists would choose $\alpha, \beta_1, \beta_2, Y_1, Y_2$ to get the solution of the flowing optimization problems:

(Denoted as Model I)

$$\max_{(\alpha,\beta_1,\beta_2,\gamma_1,\gamma_2)} \sum_{i=1}^{2} (1-\beta_i)(A_i e_i) - \alpha \quad i = 1, 2$$

(3)

$$st.(IR): \alpha + \sum_{i=1}^{2} \beta_i (A_i e_i) - \frac{u_i}{2} e_i^2$$

$$- \frac{\rho}{2} \sum_{i=1}^{2} \beta_i^2 \left[\gamma_i^2 + Y_i^2 \gamma_i^2 + 2Y_i \text{cov}(\epsilon_i, y_i)\right]$$

$$\geq \omega$$

(4)

$$IC : e_1, e_2 \in \arg \max \left\{ \alpha + \sum_{i=1}^{2} \beta_i (A_i e_i) - \frac{u_i}{2} e_i^2 \right\}$$

$$- \frac{\rho}{2} \sum_{i=1}^{2} \beta_i^2 \left[\gamma_i^2 + Y_i^2 \gamma_i^2 + 2Y_i \text{cov}(\epsilon_i, y_i)\right]\}$$

(5)

Among which, $A_i$ satisfies the equation $A_1 e_1 = a_1 e_1 + a_{12} e_{12}$; and $A_2$ satisfies the equation $A_2 e_2 = a_2 e_2 + a_{12} e_{12}$.

It means to deduce the increase or decrease of the marginal contribution ratio on the short-term (long-term) effort itself from the increase or decrease of the long-term (short-term) over short-term (long-term) performance. If increase, the striving directions are the same, then $A_1 > a_1$; if decrease, the striving directions are no the same, then $A_1 < a_1$.

3 NUMERICAL SIMULATION

In order to be simplified and intuitive, the following contents are simulated respectively on the basis of the above model I in this section:

(1) Under the condition of information asymmetry, the changing rule of the relevant indicators along with the increase in risk aversion degree after introducing the observable variables;

(2) Under the condition of information asymmetry, the variation rule of the relevant indicators along with the increase in risk aversion degree after introducing the observable variables;

The parameters in the model are set as follows: $a = b = 1, u = 0.8, v = 1.5, \omega = 3, \sigma_1^2 = 4, \sigma_2^2 = 0.25$. The initial value of $\rho$ is set to be 0 and increased to 1 by step of 0.1, which does not affect the correctness of the conclusion.

In order to see the relationship between these indexes more directly, the intuitionistic figures are drawn as follows according to Model I, see Figure 1. and Figure 2.

According to Figure 1, numerical result 1 can be obtained.

Numerical result 1: Under the condition of asymmetric information of numerical result 1, after the introduction of observable variables, the venture enterprisers that accept the new contracts show a similar law to that before the introduction of such variables based on the different degree of the risk aversion, that is, the effort level is lower than that under the condition of asymmetric information with ethics risks. The same, as the risk aversion degree increases, the selected effort level is lower and the corresponding equity share proportion is also lower, but the fixed income is required to be higher. But with respect to the conditions of no observable variables, interesting changes have taken place in quantity as shown in Figure 2.
Figure 2. Simulation results of comparison under the condition of information asymmetry.

According to Figure 2, numerical result 2 can be obtained.

Numerical result 2: Under the condition of asymmetric information of numerical result 2, after the introduction of observable variables, for the venture enterprisers that accept the new contracts, no matter how the degree of the risk aversion (except risk-neutral valuation) changes, in comparison with the stage before the introduction of observable variables, the variation in both short-term and long-term effort levels and the variation in the equity share ratio and the fixed income are strictly positive, indicating that: the introduction of observed variables really encourages the venture enterprisers to work with more efforts, reducing ethics risks.

The simulation results above give a further verification on the conclusion, and the more important is that the results show that introducing the observable variables really encourages the venture enterprisers to work with more efforts, reducing ethics risks.

The simulation results above give a further verification on the conclusion, and the more important is that the results show that introducing the observable variables into the two different efforts plays a role in inspiring the entrepreneurship, and the incentive weight setting must be worked out by the venture capitalists with a lot of historical data and traits of the enterprisers both inside and outside the industry through consultation with the venture enterprisers, in order to create favorable conditions for ultimately achieving a win-win situation.

4 SUMMARY

On the basis of existing research, this paper constructed a venture investment incentive model from the perspective of venture capitalists. Different from the traditional incentive model, the contract model in this paper has taken into account the fact that the venture entrepreneurs will hold shares in proportion according to their effort types, and introduced observable variables for venture capitalists. Studies show that the venture capitalists would prefer to signing conformable contracts with relative large incentive intensity, so as to pass on its own message, by which the venture capitalist can also identify the competent venture entrepreneurs who are willing to make extra effort after the signing, thus improving the expected income of the venture capitalists. Further, during the development of the venture business, this paper has analyzed the functions of observable indicators under different situations of the interaction effect between the venture entrepreneurs’ short-term efforts and the long-term sustained efforts behaviors. In conclusion, this incentive mechanism can help address the adverse selection and moral hazard problems brought by the serious information asymmetry between the venture capitalists and the venture entrepreneurs, and provide a reference for the venture capitalists to design a suitable incentive contract with the venture entrepreneurs.

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