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JOURNAL OF BUSINESS MANAGEMENT AND ECONOMICS

Home page: http://innovativejournal.in/index.php/jbme

JBME ISSN: 2347-5471

Research on Participation Strategy of three Parties in Crowd Funding Market Based on Evolutionary Game

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DOI: https://doi.org/10.15520/jbme.v10i03.3422

Abstract: In recent years, China's Internet crowd-funding industry has been booming, The frequent occurrence of dereliction of responsibility and violation of regulations of Internet crowd-funding platforms and malicious investment by investors has brought investment and financing risks to investors and crowd-funding platforms and affected the development of the industry. In view of many problems in the crowd funding industry, this paper uses the analytical method of evolutionary game theory to construct a three-party game model of local government, crowd funding platform and sponsors, and analyzes the evolution process of the strategic choice of each stakeholder by replication dynamic equation analysis and numerical simulation. The results show that the initial strategy choice of each game subject affects the evolution speed of the system game. The social benefits under strict government supervision, the punishment of the platform irresponsible operation and the sponsors fraudulent financing, and the supervision of the platform to the sponsors are the key factors affecting the choice of three-party strategy in the game.

Key words: crowd funding platform; Tripartite evolutionary game; Local government supervision; The numerical simulation; Dynamic equation of replication.

INTRODUCTION

With the booming development of Internet finance, crowd-funding[1], as a new financing method, can effectively alleviate the financing difficulties of small and micro enterprises and individuals, activate the flow of capital inside and outside the community market, and have strong practical significance for promoting economic development and growth. As the number of Internet crowd funding platforms continues to increase and the scale of fundraising continues to expand, the accumulated problems are also becoming increasingly prominent. At the end of 2016, there were 608 crowd funding platforms in China. With the rapid development of the industry, a large number of problematic platforms have emerged. On the one hand, the raise industry development in our country at the primary stage, countries in this field of law and standardize policies is not enough mature, there is a greater risk of legal and regulatory risks, many irregular platform will take this opportunity to violate compasses operation, user information disclosure, and the originator of conspiring to raise project related information to all the fraud, diddle investment funds and other issues. Because, on the other hand, investors, the sponsors, the three of the raised platform there is information asymmetry, the project sponsor also exists certain risk[2], the originator after raising money, as a result of the project idea change, personal factors such as difficult to resist the temptation of money, to raise money for malicious misappropriation or misappropriate project funding, and thus lead to the raise project of bankruptcy, Investors and platforms will lose money; Or the project itself is not authentic, with the color of deception, the sponsors cheat the platform to release information by improper means, cheat the public funds and run away. Therefore, it is of great significance for the development of incentive crowd funding market to systematically study the operation mode of crowd funding platform, analyze the factors affecting its development and improve its operation mode. At present, there is a wide range of researches on crowd funding. Liu Mingxia and Huang Dan[3] took the incentive-based crowd funding initiators as the subjects of the investigation and explored the participation motivation of China's crowd funding initiators with the grounded theory method. The research found that emotional drive is the most influential entrepreneurial motivation. Wang Yan and Zhu Xiaodong[4] empirically analyzed the factors influencing the success of crowd funding websites in China by taking "Crowd funding website" as an example. The study showed that the only factors influencing the success of rewards crowd funding platforms in China were the number of comments, the number of supporters and the target amount. Meng

Defeng, Wei Dong et al.[5] analyzed the operation mechanism of JD crowd funding and showed that strengthening project review, professional construction of the platform and attaching importance to social networks are the basic norms of crowd funding platforms. Deng Biteng and Zhao Zheng[6] studied the operation mode of crowd funding platform and obtained the influencing factors of the operation of crowd funding platform. Based on the evolutionary game theory, Li Yongfei and Ma Guoshun[7] analyzed the strategy selection of crowd funding platforms and project sponsors, and proposed that the key to ensuring the sound development of crowd funding market is high-quality supervision of crowd funding platforms, better rights protection awareness of the following investors, and reasonable punishment for cheating. Liu Henan[8] made a detailed analysis of the necessity of legislative regulations and legislative ideas for serious disease crowd funding in view of many problems. The above research results have laid a rich theoretical foundation for the governance and development of the crowd funding industry, but generally speaking, there are still corresponding deficiencies. On the one hand, based on the research methods used, most of the existing researches adopt the classical game theory and seek game equilibrium under the condition of complete information based on the complete rationality of the players. However, due to the information asymmetry between the parties involved in crowd funding, they cannot be completely rational. , on the other hand, based on the content of the research, the existing research mainly general synthetically study the Internet mode, property, status quo of the raised platform problems and countermeasures and Suggestions, or only considers the local government and the raised platform, game between the originator and the raised platform, didn't consider the local government, the raised platform, the originator of game between the three parties. Therefore, by constructing a game model among "local government, crowd-funding platform and project sponsor", and by numerical simulation, this paper studies the influence of strategy selection and influencing factors of each subject on the operation of crowd-funding market with the participation of local government, hoping to provide reference for the healthy development of crowd-funding market.

MODEL BUILDING

2.1 Model assumptions and parameter description

Assumption 1 Local governments, crowd funding platforms and initiators are all groups of limited rationality, which constitute an evolutionary system. In other words, each player can choose the strategy to be adopted in the game process through continuous learning under the existing information to maximize the interests of the player.

Assumption 2 Local governments have two strategies of strict regulation and loose regulation, with probabilities x and $1-x$ and regulatory costs c_1 and c_2, respectively. If strict supervision is adopted, the cost of supervision will be higher, but social benefits will be gained, including the recognition and satisfaction of the sponsors for the fair and strict image of the local government. In addition, it is found that the crowd funding platform may also get certain economic benefits if it is not responsible for operation. If we adopt loose supervision, the supervision cost is relatively small, but we need to bear the risk cost caused by project violation.

Assumption 3 The crowd funding platform can choose from two strategies, namely responsible operation and not responsible operation. The probability of choosing the two strategies is y and $1-y$ respectively, and the operating cost is R_1 and R_2 respectively. If the platform is responsible for operation and complies with laws and regulations to ensure the compliance and legality of crowdfunding projects, it will cost a lot of time, energy and capital, but will gain social benefits, including the positive evaluation of the platform by the public and the absorption of more customer resources. If irresponsible operation is adopted, the operation cost is relatively small, but negative social benefits will be obtained, including negative evaluation of the public and loss of customer resources. At the same time, it should bear the risk cost of violating the regulations of crowd-funding projects and the possible penalty loss caused by the local government finding out its irresponsible behavior.

Assumption 4 The project sponsor has two strategies to choose, namely, honest financing and fraudulent financing, and the probability of choosing the two strategies is z and $1-z$ respectively. In the case of honest financing, in addition to the corresponding financing benefits after successful project financing, the sponsors will also gain additional social benefits from "wisdom of the masses"[9] if they enter the platform of "strict supervision and responsible operation". If you choose fraudulent financing, you will get a huge amount of financing funds. However, if you are detected by the platform, you will be punished for cheating.

Assumption 5 After the occurrence of project violations, a series of derivative events will be brought to the society, which will damage the income of investors and sponsors and destroy the stability of the crowd funding market. Therefore, both the local government and the crowd funding platform need to bear the risk cost, and the payment cost of both parties is linearly correlated.

Assumption 6 Local governments and crowd funding platforms influence each other in the supervision of crowd funding projects, and both have synergistic and complementary effects. That is, the probability of project violations will change with the selection strategies of local governments and platforms.

Assumption 7 If the platform finds out the cheating behavior of the project sponsor, the financing will be terminated, and the local government, local government and crowd funding platform shall bear the risk cost of project violation.

Based on the above assumptions, the parameter setting and the three-way game benefit matrix are shown in Table 1 and Table 2 respectively.

Table 1 Parameter Settings

symbol	Instructions	symbol	Instructions
c_1	The cost of strict regulation by local governments	s_1	Social benefits gained when local governments were strictly regulated
c_2	The cost of lax regulation by local governments	P_1	Crowdfunding platform is responsible for the social benefits gained during operation
R_1	The platform is responsible for the sum of operating costs and monitoring costs	P_2	Crowdfunding platforms are not responsible for the social benefits lost during operation
R_2	The platform is not responsible for the sum of operating costs and monitoring costs	F	Crowdfunding platforms are not responsible for the social benefits lost during operation
B_{z1}	The benefits of the promoter's credit financing	D	The punishment imposed by the platform when the promoter is found to have cheated in financing
B_{z2}	The benefits of the promoter's cheat financing	C	The full risk cost of crowdfunding violations
B_{w1}	Service fee paid by the promoter to the platform	m	When the local government is strictly supervised and the platform is not responsible for operation, the discount coefficient of the risk cost that both sides of the game need to bear after the project violates the rules,$0 < m < 1$
Q	The extra social benefits that promoters get from "wisdom of the crowd"	n	When the local government is lax in supervision and the platform is in charge of operation, the discount coefficient of the risk cost that both sides of the game need to bear after the project violates the rules,$0 < n < 1$
α	The violation rate of projects under the strict supervision of local governments and when the platform is not responsible for operation,$0 < \alpha < 1$	δ	Risk cost transfer coefficient,$0 < \delta < 1$
β	The violation rate of the project when the promoter is in good faith financing, the local government is lax in supervision and the platform is in charge of operation,$0 < \beta < 1$	μ	When the local government is lax in supervision and the platform is not responsible for operation, the probability of the sponsors being detected by the platform when they cheat in financing (supervision success rate),$0 < \mu < 1$
γ	The violation rate of the project when the promoter is in good faith financing, the local government is lax in supervision and the platform is not responsible for operation,$0 < \gamma < 1$	ν	When the local government is lax in supervision and the platform is in charge of operation, the probability of being detected by the platform when the promoter cheats on financing (supervision success rate),$0 < \nu < 1$
K	The loss of the the promoter's utility after the violation of the crowdfunding project financing in good faith financing		

Table 2 Profit matrix of subject of tripartite game

Game player strategy		**Strict government supervision**		**lax government supervision**	
		The platform is responsible for operations	The platform is not responsible for operations	The platform is responsible for operations	The platform is not responsible for operations
promoter	Gredit financing	（a_1,a_2,a_3）	（b_1,b_2,b_3）	（c_1,c_2,c_3）	（d_1,d_2,d_3）
	Cheat financing	（e_1,e_2,e_3）	（f_1,f_2,f_3）	（g_1,g_2,g_3）	（h_1,h_2,h_3）

among，

$$a_1 = -c_1 + s_1 \qquad b_1 = -c_1 + s_1 + F - \alpha\delta mC$$
$$a_2 = -R_1 + P_1 + B_{w1} \qquad b_2 = -R_2 - P_2 + B_{w1} - F - \alpha mC$$
$$a_3 = B_{z1} - B_{w1} + Q \qquad b_3 = B_{z1} - B_{w1} - \alpha K$$

$$c_1 = -c_2 - \beta\delta nC \qquad d_1 = -c_2 - \gamma\delta C$$
$$c_2 = -R_1 + P_1 + B_{w1} - \beta nC \qquad d_2 = -R_2 - P_2 + B_{w1} - \gamma C$$
$$c_3 = B_{z1} - B_{w1} - \beta K \qquad d_3 = B_{z1} - B_{w1} - \gamma K$$

$$e_1 = -c_1 + s_1 \qquad f_1 = -c_1 + s_1 + F - (1-\mu)\delta mC$$
$$e_2 = -R_1 + P_1 + B_{w1} + D \qquad f_2 = -R_2 - P_2 + B_{w1} - F - (1-\mu)mC + \mu D$$
$$e_3 = -B_{w1} - D \qquad f_3 = (1-\mu)B_{z2} - B_{w1} - \mu D$$

$$g_1 = -c_2 - (1-\nu)\delta nC \qquad h_1 = -c_2 - \delta C$$
$$g_2 = -R_1 + P_1 + B_{w1} - (1-\nu)nC + \nu D \qquad h_2 = -R_2 - P_2 + B_{w1} - C$$
$$g_3 = (1-\nu)B_{z2} - B_{w1} - \nu D \qquad h_3 = B_{z2} - B_{w1}$$

MODEL ANALYSIS

3.1 Dynamic equation of replication

(1) Revenue expectation function and replication dynamic equation of local government

The expected return of local government choosing "strict regulation" strategy is U_x, and that of local government choosing "loose regulation" strategy is U_{1-x}, and the average expected return is $\bar{U}_x$, then

$$U_x = yza_1 + y(1-z)e_1 + z(1-y)b_1 + (1-z)(1-y)f_1$$
$$U_{1-x} = yzc_1 + y(1-z)g_1 + z(1-y)d_1 + (1-z)(1-y)h_1$$
$$U_x = xU_x + (1-x)U_{1-x}$$

The replication dynamic equation of local government is:

$$F(x) = \frac{dx}{dt} = x(U_x - \bar{U}_x) = x(1-x)(U_x - U_{1-x})$$

$= x(1-x)\{yz(\alpha m + \mu - n + n\nu + \beta n - \gamma)\delta C + y[-F + (n - \nu n - \mu)\delta C] + z(\gamma - \mu - \alpha m)\delta C + c_2 - c_1 + s_1 + \mu\delta C + F\}$（1）

(2) Revenue expectation function and replication dynamic equation of crowdfunding platform

The expected revenue of the crowdfunding platform choosing the "responsible operation" strategy is U_y, and that of the platform choosing the "not responsible operation" strategy is U_{1-y}, and the average expected revenue is $\bar{U}_y$, then

$$U_y = xza_2 + x(1-z)e_2 + z(1-x)c_2 + (1-x)(1-z)g_2$$
$$U_{1-y} = xzb_2 + x(1-z)f_2 + z(1-x)d_2 + (1-x)(1-z)h_2$$
$$U_y = yU_y + (1-y)U_{1-y}$$

The replication dynamic equation of the crowdfunding platform is:

$$F(y)=\frac{dy}{dt}=y(1-y)\{xz\left[\left((\beta-1+\nu)n+\alpha m+\mu-\gamma\right)+(\nu-1)D\right]+x[(1-\nu)nC+(1-\nu-\mu)D+\ F-\mu C]$$
$$+z\left[\left((1-\nu-\beta)n-(1-\gamma)\right)C-\ \nu D\right]+P_1+P_2+\nu D-R_1+R_2-[(1-\nu)n+1]C\}$$

（2）

(3) Revenue expectation function and replication dynamic equation of project promoter

The expected return of the project sponsor choosing the "credit financing" strategy is U_z, and that of the project sponsor choosing the "fraud financing" strategy is U_{1-z}, and the average expected return is $\overline{U}_z$, then

$$U_z=xya_3+x(1-y)b_3+y(1-x)c_3+(1-x)(1-y)d_3$$
$$U_{1-z}=xye_3+x(1-y)f_3+y(1-x)g_3+(1-x)(1-y)h_3$$
$$U_z=yU_y+(1-y)U_{1-y}$$

The replication dynamic equation of the project promoter is:

$F(z)=\frac{dz}{dt}=z(1-z)\{xy[Q+(\alpha+\beta-\gamma)K-(\mu+\nu-1)D-(\nu+\mu)B_{z2}]+\quad x[(\gamma-\alpha)K+\mu(B_{z2}+D)]+$

$y[(\gamma-\beta)K+\nu(B_{z2}+D)]+B_{z1}-B_{z2}-\gamma K\}$（3）

3.2.Stability analysis:

According to the above analysis, the duplicated dynamic equations of local government, crowdfunding platform and project sponsor are formed into a dynamic system. According to the solution method of evolutionary game equilibrium in Ritzberger and Weibull's research [10], equations (1), (2) and (3) are combined and set to 0, so as to obtain the equilibrium point of the system.

$$\begin{cases}F(x)=0\\F(y)=0\\F(z)=0\end{cases}$$（4）

Equation (4) is solved to obtain the equilibrium point. In order to study the stability of the crowdfunding system, the stability of the eight equilibrium points (0.0.0), (0.0.1), (0.1.0), (0.1.1), (1.0.1), (1.1.0), (0.0.1) and (1.1.1) is only needed to be discussed, and the remaining equilibrium points are non-asymptosive stable points. The asymptotic stability of the 8 points was obtained according to the jacobian matrix local stability analysis [11], and the Jacobian matrix of the system was as follows:

$$J=\begin{bmatrix}\frac{\partial F(x)}{\partial x} & \frac{\partial F(x)}{\partial y} & \frac{\partial F(x)}{\partial z}\\ \frac{\partial F(y)}{\partial x} & \frac{\partial F(y)}{\partial y} & \frac{\partial F(y)}{\partial z}\\ \frac{\partial F(z)}{\partial x} & \frac{\partial F(z)}{\partial y} & \frac{\partial F(z)}{\partial z}\end{bmatrix}=\begin{bmatrix}a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{bmatrix}$$

Among,

$a_{11}=(1-2x)\{yz(\alpha m+\mu-n+n\nu+\beta n-\gamma)\delta C+y[-F+(n-\nu n-\mu)\delta C]+\quad z(\gamma-\mu-\alpha m)\delta C+c_2-c_1+s_1+\mu\delta C+f\}$

$a_{12}=x(1-x)[z(\alpha m+\mu-n+n\nu+\beta n-\gamma)\delta C-F+(n-\nu v-\mu)\delta C]$

$a_{13}=x(1-x)[y(\alpha m+\mu-n+n\nu+\beta n-\gamma)\delta C+(\gamma-\mu-\alpha m)\delta C]$

$a_{21}=y(1-y)\{z[(\beta-1+\nu)n-\ \nu D+\alpha m+\mu-\gamma+(\nu-1)D]C+[(1-\nu)nC+F+\quad(1-\nu-\mu)D-\ \mu C]\}$

$a_{22}=(1-2y)\{xz\left[\left((\beta-1+\nu)n+\alpha m+\mu-\gamma\right)C+(\nu-1)D\right]+x[(1-\nu)nC+F-\quad\mu C+(1-\nu-\mu)D]+z\left[\left((1-\nu-\beta)n-(1-\gamma)\right)C-\ \nu D\right]+P_1+P_2+\nu D-R_1+R_2-\quad[(1-\nu)n+1]C\}$

$a_{23}=y(1-y)\{x\left[\left((\beta-1+\nu)n+\alpha m+\mu-\gamma\right)C+(\nu-1)D\right]+\left((1-\nu-\beta)n-(1-\quad\gamma)\right)C-\nu D\}$

a_{31}=$z(1-z)\{y[Q+(\alpha+\beta-\gamma)K-(\mu+\nu-1)D-(\nu+\mu)B_{z2}]+[(\gamma-\alpha)K+\quad \mu(B_{z2}+D)]\}$

a_{32}=$z(1-z)\{x[Q+(\alpha+\beta-\gamma)K-(\mu+\nu-1)D-(\nu+\mu)B_{z2}]+y[(\gamma-\beta)K+\quad \nu(B_{z2}+D)]\}$

a_{33} = $(1-2z)\{xy[Q+(\alpha+\beta-\gamma)K-(\mu+\nu-1)D-(\nu+\mu)B_{z2}]+\ x[(\gamma-\alpha)K+\quad \mu(B_{z2}+D)]+y[(\gamma-\beta)K+\nu Bz2+D+Bz1-Bz2-\gamma K\}$

According to Lyapunov's first theorem [12], the condition that the equilibrium point is asymptotically stable is that all eigenvalues $\lambda_i$of the Jacobian matrix of the equilibrium point are less than 0. The eigenvalues and stability analysis of each equilibrium point of the system are shown in Table 3.

Table 3 Stability analysis of equilibrium points

equilibrium	The eigenvalue	Stability conditon
（0.0.0）	$\lambda_1=c_2-c_1+s_1+\mu\delta C+F$ $\lambda_2=P_1+P_2+D-R_1+R_2-[(1-\nu)n+1]C$ $\lambda_3=B_{z1}-B_{z2}-\gamma K$	$\lambda_1<0$
（0.0.1）	$\lambda_1=(\gamma-\alpha m)\delta C+c_2-c_1+s_1+F$ $\lambda_2=\big((1-\nu-\beta)n-(1-\gamma)\big)C+P_1-R_1+R_2-[(1-\nu)n+1]C$ $\lambda_3=B_{z2}-B_{z1}+\gamma K$	$\lambda_2<0$ $\lambda_3<0$
（0.1.0）	$\lambda_1=-f+(n-\nu\nu)\delta C+c_2-c_1+s_1+F$ $\lambda_2=[(1-\nu)n+1]C-P_1-D+R_1-R_2-P_2$ $\lambda_3=(\gamma-\beta)K+\nu(B_{z2}+D)+B_{z1}-B_{z2}+\gamma K$	
（0.1.1）	$\lambda_1=c_2-c_1+s_1+\beta n\delta C$ $\lambda_2=\big((1-\nu-\beta)n-(1-\gamma)\big)C+[(1-\nu)n+1]C-P_1+R_1-R_2-P_2$ $\lambda_3=-(\gamma-\beta)K-\nu(B_{z2}+D)+B_{z2}-B_{z1}+\gamma K$	
（1.0.0）	$\lambda_1=-c_2+c_1-s_1-\mu\delta C-F$ $\lambda_2=-\mu D+F+\mu C+P_1+D-R_1+R_2-C+P_2$ $\lambda_3=-\alpha K+\ \mu(B_{z2}+D)+B_{z1}-B_{z2}$	
（1.1.0）	$\lambda_1=f-(n-\nu n)\delta C-c_2+c_1-s_1-F$ $\lambda_2=-(1-\nu)nC+\mu D-F-\mu C+[(1-\nu)n+1]C-P_1-D+R_1-R_2-P_2$ $\lambda_3=Q+D+B_{z1}-B_{z2}$	
（1.0.1）	$\lambda_1=-(\gamma-\alpha m)\delta C-c_2+c_1-s_1-F$ $\lambda_2=\alpha mC-\mu D+F+P_1-R_1+R_2+P_2$ $\lambda_3=-(\gamma-\alpha)K-\ \mu(B_{z2}+D)+B_{z2}-B_{z1}+\gamma K$	
（1.1.1）	$\lambda_1=-c_2+c_1-s_1-\beta n\delta C$ $\lambda_2=-\alpha mC+\mu D-F-P_1+R_1-R_2-P_2$ $\lambda_3=B_{z2}-Q-D-B_{z1}$	

THE SIMULATION DATA

4.1 Ideal steady state analysis:

According to the stability analysis of the system, the stability conditions of the 8 points in Table 3 are all different. Considering the healthy and reasonable development of the incentive-based crowdfunding market, we conducted simulation analysis on the ideal stability point (1.1.1). In order to make it possible for the model to evolve to the ideal stability point, namely the ideal stability strategy (strict supervision, responsible operation, honest financing), according to the stability conditions of this point, the parameters should be satisfied $-c_2+c_1-s_1-\beta n\delta C<0$、$-\alpha mC+\mu D-F-P_1+R_1-R_2-P_2<0$ 、 $B_{z2}-Q-D-B_{z1}<0$，set parameter value$c_1=20$， $c_2=17$， $s_1=6$，$R_1=37$，R_2 =20，$P_1=12$，P_2 =9，$B_{z1}=40$，$B_{z2}=52$，F=10，C=10，D=8，Q=5，K=45，$\alpha=0.1$，$\beta=0.3$，$\gamma=0.6$，$\mu=0.5$， $\nu=0.6$， $\delta=0.7$， $n=0.8$， $m=0.7$。The probability values x, y and z of initial strategy selection of local governments, crowdfunding platforms and project sponsors are 0.5, 0.5 and 0.5.

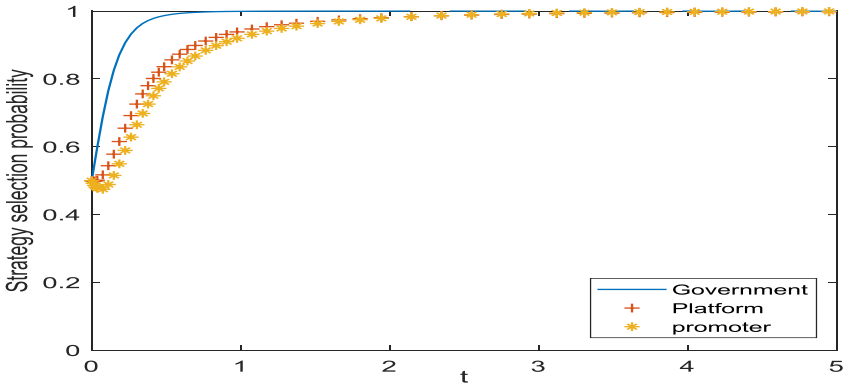


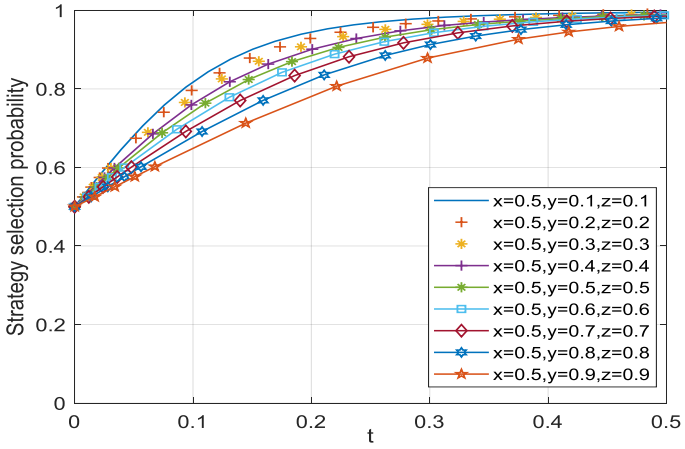
Figure 1. Evolution path of policy combination (1.1.1)

When the sum of the extra social benefits s_1 of the local government's strict regulation cost c_1 and strict regulation is greater than the sum of the loose regulation cost c_2 and the risk cost $\beta n \delta C$ brought by the bankruptcy of the crowdfunding project, Local governments have opted for strict regulation; When the sum of the difference in supervision cost（$R_1 - R_2$） and the possible economic benefits μD brought by taking charge of supervision is greater than the sum of the risk cost $\alpha m C$ and the possible punishment F for not taking charge of supervision, the platform chooses to take charge of supervision.When the sum of the benefit obtained by the project promoter in honest financing and the wisdom benefit of the masses is greater than the sum of the benefit obtained by the promoter in fraudulent financing and the penalty received by the promoter in fraudulent financing, the promoter chooses honest financing. At this point, the evolution path of the crowdfunding system is (1.1.1).That is, the strategy combination (strict supervision, responsible operation, credit financing) is the evolution of the stable strategy of the system.

4.2The influence of each agent's initial value on system policy evolution:

(1) Evolution curve of local government strategy selection probability under y and z changes

Only the specific parameters of the study were changed, and the values of other parameters were fixed (the same below). Given that the initial value of x is 0.5, the values of y and z are 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9 respectively. The evolution of local government's game is shown in Figure 2. According to the figure, the change of the initial value of y and z does not affect the path of local government's strategy selection, but only affects the speed at which local government approaches the choice of strict regulation strategy. The higher the probability that the crowdfunding platform will choose "irresponsible operation" and the higher the probability that the project sponsor will choose "fraudulent financing", the higher the probability that the local government will choose "strict supervision". However, the evolution path will eventually trend to 1, that is, the local government will choose the strict supervision strategy.



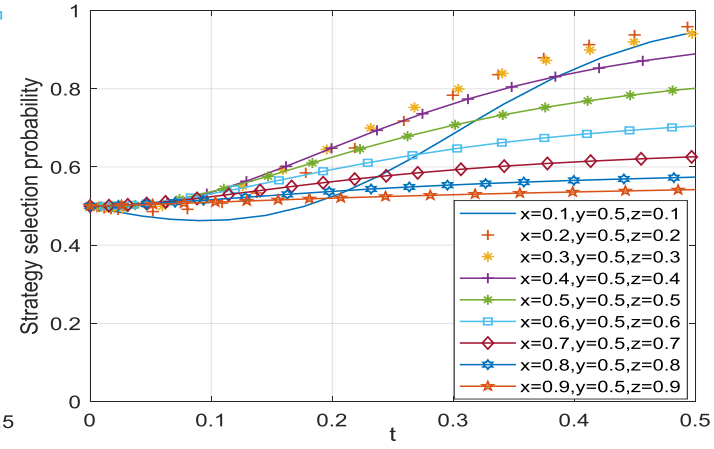


Figure. 2 Influence of changes in y and $z$on $x$evolution

Figure. 3 Influence of changes in x and z on y evolution

(2) Evolution curve of strategy selection probability of crowdfunding platform under x and Z changes

Given that the initial value of y is 0.5, the values of x and z are 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9 respectively. The game evolution of crowdfunding platform is shown in Figure 3. By figure, y, z initial value change on the raised platform strategy choice has distinct effect on the evolution path, beginning of x value is low, local governments choose loose supervision probability is big, the platform raised speculation may choose not to run, but was found to be punished by the government, and choose to run, so, in front of the curve has a tendency to approaching zero, behind the rapidly approaching 1 again. With the increase of z, the probability of project sponsors choosing credit financing increases. In order to save operation supervision cost, the curve gradually smooths and finally stabilizes at 0.5, that is, the platform chooses to be responsible for operation but reduces supervision cost.

(3) Evolution curve of strategy selection probability of crowdfunding platform under changes of x and y

Given that the initial value of z is 0.5, the values of x and y are 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9 respectively. The evolutionary changes of the game played by project sponsors are shown in Figure 2. By the figure, when x and y values is small, the local governments choose loose regulation, the probability of the raised platform chose not to run, the early stage of the curve has a tendency to approaching zero, the probability of the originator speculation choose deceive financing, increase with the value of x, y, namely, local governments choose strictly regulated, increases the probability of the raised platform choice is responsible for the operation, supervision strength increase, due to the platform The curve approaches 1, that is, the project sponsor will choose the credit financing strategy.。

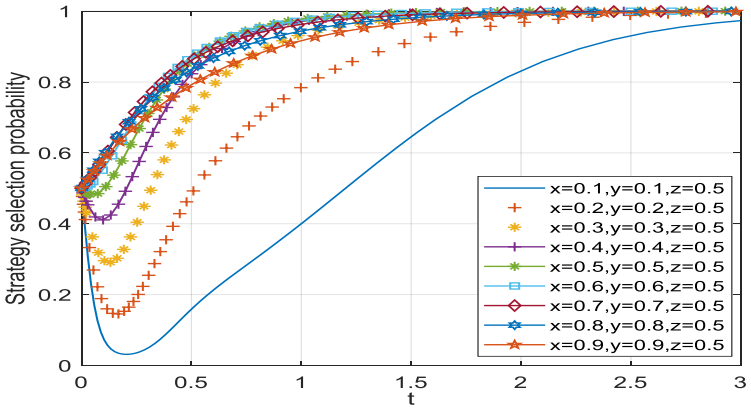


Figure. 4 Influence of x and $y$changes on z evolution

4.3Analysis of main influencing factors:

The game model shows that there are many factors that can affect the game parties evolution path, we only analyze main of game strategy choice of the main influence factors, and other parameters are fixed initial values, given different values to impact factor, carries on the simulation, to observe the effects of the different situation, only the specific parameters of the change, other parameters fixed.

(1) The influence of social benefit on the evolution of local government

Value of s_1 respectively 1, 10, 20, local governments game system evolution changes as shown in figure 5, the figure, the size of the social benefit change will not affect the general trend of probability strategy of local government, local government's policy choice probability x are approaching 1, social benefit to change the policy of local government only to the ideal size stable point approximation rate, Social benefits are directly proportional to the probability of strict supervision by local governments.

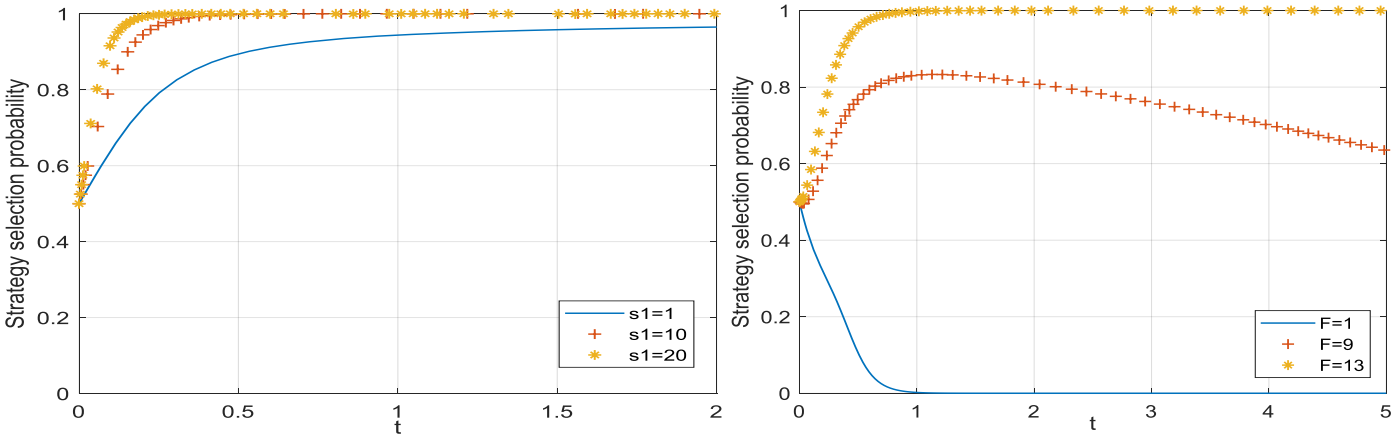


Figure.5 Influence of s_1 change on evolution of local government

Figure.6 Influence of F change on evolution of incentive crowdfunding platform

(2) The impact of local government censorship and punishment on the evolution of crowdfunding platforms

F is set to 1, 10 and 20 respectively, and the game evolution path changes of crowdfunding platforms are shown in FIG. 6. The figure shows that the local government violation penalties on the raised platform strategy choice evolution trend has obvious effect, the punishment is very small, the raised platform for interest orientation, strategy choice tend to be responsible for operation, with the increase of punishment strength, platform strategy selection will tend to run, penalties and the choice of platform strategy is proportional to the wishes of the "run".

(3)The influence of censorship penalty intensity of crowdfunding platform on the evolution of project sponsors

Values of D are 1, 10 and 20 respectively, and the strategy evolution path of the project sponsor is shown in Figure 7. The figure shows that the raised platform review penalties to the project sponsor strategy choice evolution has obvious effect, when the penalties is small, deceive the financing can get huge gains, the originator of the strategy choice probability tends to zero, ie financing, with the increase of penalties, the evolution trend of the sponsor to approach 1, namely the credit financing.

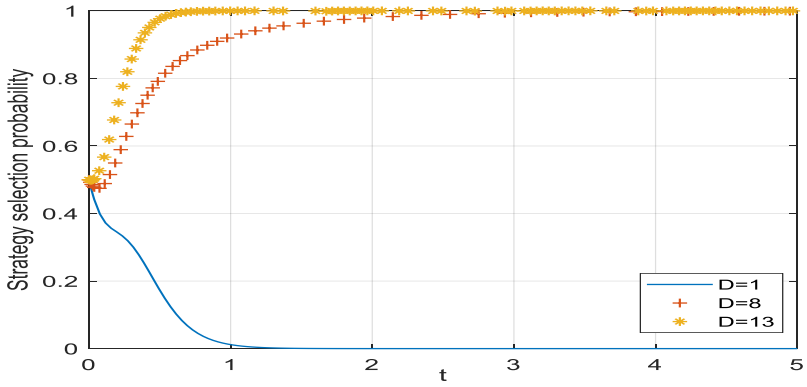


Figure. 7 The impact of D changes on the evolution of project sponsors

(4) The influence of the success rate of crowdfunding platform supervision μ, ν on the evolution of project sponsors

The values of μ and ν are 0.1, 0.5 and 0.9, respectively. The evolution of the strategy selection of the project sponsor is shown in Figure 8 (note: b1=μ and b2 =ν in the figure). As can be seen from the figure, when the platform is in charge of operation, when the success rate of supervision is low, the evolution path of the sponsors is tortuous. Due to the platform's censorship punishment, in most cases, they will choose honest financing, but sometimes they tend to be induced by interests, or they may choose fraudulent financing. In this case, the platform's censorship punishment becomes particularly important. The success rate of supervision increases to a certain extent. With the increase of the success rate of supervision, the evolution speed of sponsors to credit financing strategy is accelerated. When the platform is not responsible for operation, the curve only affects the evolution

speed of the sponsors to the credit financing strategy, and the success rate of supervision ν is directly proportional to the evolution speed of the sponsors to the credit financing strategy.。

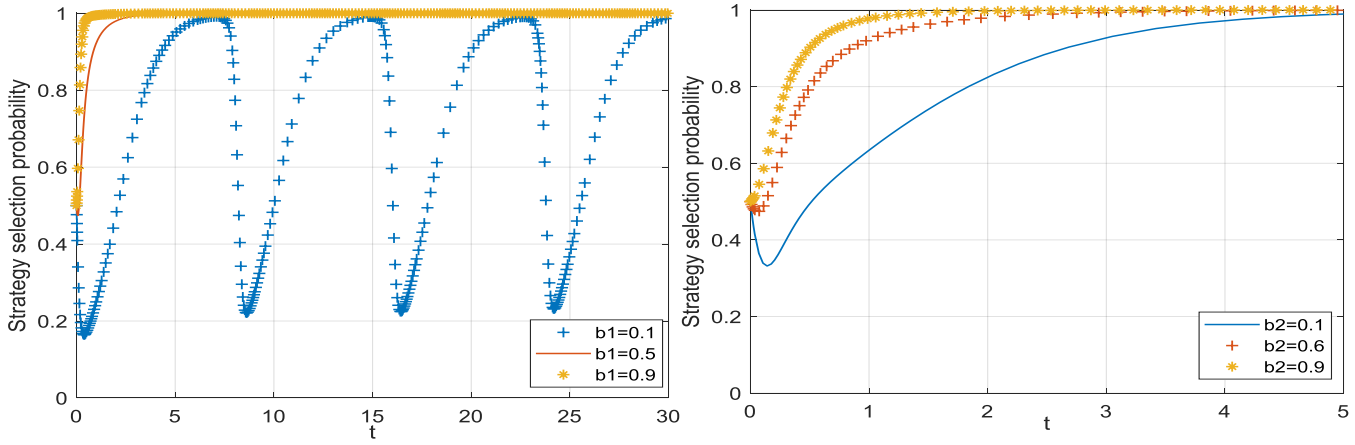


Figure. 8 Influence of μ and ν changes on the evolution of project sponsors

CONCLUSION

Based on evolutionary game theory, this paper constructs the local government, the raised platform, the project sponsors tripartite game system, the dynamic evolution process of the raise system are analyzed, and through the numerical simulation for the processes of the ideal stable point, the interaction between the game parties selection strategy and main influence factors are analyzed, the following conclusions.

(1) The evolution path of a game subject in the crowdfunding system is affected by the probability of other subjects' initial strategy selection. In actual situations, the initial strategy willingness of each player can be adjusted according to different situations to make the game system evolve towards an ideal and stable state.

(2) Local governments play a very important role in the crowdfunding system and play a leading role in the evolution of the system path. The higher the probability that the crowdfunding platform will choose "irresponsible operation" and the higher the probability that the project sponsor will choose "fraudulent financing", the higher the probability that the local government will choose "strict supervision", among which the supervision cost, social benefits and punishment intensity are all factors affecting the probability of local government's strategy selection.

(3) The strategic choice of the project sponsor is greatly influenced by the choice of the other two game parties. The initial intention of the project sponsor determines whether the crowdfunding project can be successfully financed. Therefore, whether the local government chooses "strict supervision" and the crowdfunding platform chooses "responsible operation" are important factors affecting the healthy development of the crowdfunding market.

Based on the above analysis, the following suggestions are put forward to promote the healthy development of the crowdfunding market.

(1) Establish and improve relevant laws and regulations, and strictly enforce project evaluation and review standards to prevent crowdfunding platforms from breeding opportunism and irresponsible operation, and prevent project sponsors from cheating investors and platforms by taking advantage of loopholes in laws and regulations and practicing fraudulent financing;

(2) Improve the credit investigation system, improve management efficiency, and increase punishment so that local governments and incentive platforms can conduct timely supervision and accurate review, so that crowdfunding platforms and project promoters are responsible for operation and honest financing due to high penalties imposed after violations.

(3) Popularize the concept of crowdfunding, improve the public's awareness of rights protection, and enable the public to identify the authenticity of crowdfunding projects as far as possible. Meanwhile, the public can timely report to the platform and relevant departments when they find violations of the projects, so as to safeguard their own rights and interests.

Acknowledgement. This research was financially supported by the National NaturalScience
Foundation of China (Grant NO.12061065 and Grant NO.12061066).

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