Dynamic Analysis and Research on the Basis of College Students Enterprising

Liu Geng
Faculty of Science, Jiangsu University, Zhenjiang 212013,China

Abstract—At the age of innovation, more people focus highly on the entrepreneurship.This paper analyzes the factors that influence the success of college student enterprising in theory . And we build a dynamical model of college enterprising and discussed the equilibrium point , its stability and uniqueness, and the nonexistence of one period solution.Through making an analysis for the range and sensitivity of the key factors affecting on the success rate of the entrepreneurship that are the national support and the knowledge universality degree of entrepreneurship, making analysis for each factor on the stability of the equilibrium point ,and making simulation analysis for the college students enterprising,we could put forward some reasonable and controllable suggestions to improve the college students entrepreneurial success rate.

Keywords—college students enterprising; dynamical model; equilibrium point.

I. Introduction

Currently the employment situation is very grim in China[1].As a new approach to solve the employment problems , entrepreneurship becomes the focus in today's society.At present,there are varies of methods to resolve the college students enterprising.For example,government support policy[2].Others analyze data from the perspective of survey[3] and statistics[4].And there is also much literature analyzing through models[5,6].

However,a number of literature is limited to do elaboration for the current situation and do data processing and analysis,.All of above only made a qualitative analysis for the college students enterprising.As for the fundamental factors affecting the success rate of entrepreneurship,there makes no theoretical reasoning and quantitative analysis. So It is very important to doing the quantitative analysis for the influencing factors of college students enterprising improving the success rate of entrepreneurship.

This article, according to the idea of Infectious Disease Model[7-13],build a dynamics model about the entrepreneurial process of college students. Based on the entrepreneurial process, the college students are divided into three independent compartments to build dynamics model.By discussing the equilibrium existence, uniqueness, stability and the existence of periodic solutions of the model, we can obtain the threshold of affecting stability on positive equilibrium point.

II. Building the Dynamic Model of Entrepreneurship

In this paper, according to the entrepreneurial process,all of the college students are divided into unemployed college students $U(t)$,preparatory entrepreneurs $T(t)$ and successful entrepreneur $S(t)$ (Figure 1).

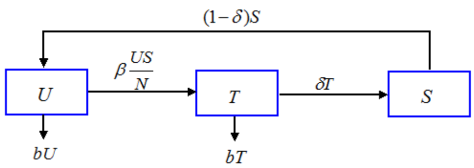

Figure 1 compartments model of college students' entrepreneurship

In figure 1, $U(t)$ represents all undergraduate students as unemployable; $T(t)$ represents the college students of full of entrepreneurial ideas preparing for the entrepreneurship; $S(t)$ represents all entrepreneurial college students succeed. b represents the proportion of the employment college students in the total number of university students; β represents the knowledge universality degree of entrepreneurship; N represents the total college students; $\beta\frac{US}{N}$ is a standard conversion rate of unemployed college students to entrepreneurial students; δ present the existing venture capital ratio of college students,where $\delta=\alpha+\gamma$; α represents the national support; γ represents the investment strength of entrepreneur; $m=1-\delta$ is the difference between venture capital maintenance of the required rate of venture capital and existing venture capital ratio.According to the ideas of the infectious disease model,we establish a dynamic model of college students' entrepreneurial process.

$$\begin{cases} \frac{dU}{dt}=mS-bU-\beta\frac{US}{N} \\ \frac{dT}{dt}=\beta\frac{US}{N}-bT-\delta T \\ \frac{dS}{dt}=\delta T-mS \\ N=U+T+S \end{cases} \quad \text{where } m=1-\delta \qquad (1)$$

III. THE EQUILIBRIUM POINTS AND PROPERTIES OF THE DYNAMIC MODEL

A. *Solving he equilibrium points*

Let the right side of the model (1) equals to zero,we obtain the following equations:

$$mS^* - bU^* - \beta\frac{U^*S^*}{N} = 0 \tag{2}$$

$$\beta\frac{U^*S^*}{N} - bT^* - \delta T^* = 0 \tag{3}$$

$$\delta T^* - mS^* = 0 \tag{4}$$

Since $N = U + T + S$, so we have

$$\frac{dN}{dt} = -bN + bS \tag{5}$$

Let $x = \frac{U}{N}$, $y = \frac{T}{N}$, $z = \frac{S}{N}$, then x, y, z represent the proportion of unemployed college students $U(t)$, preparatory entrepreneurs $T(t)$ and successful entrepreneurs $S(t)$ in all of the college students.

Then change system (1) is into

$$\begin{cases} \frac{dx}{dt} = mz - bxz - \beta xz \\ \frac{dy}{dt} = \beta xz - byz - \delta y \\ \frac{dz}{dt} = \delta y - mz + bz - bz^2 \end{cases} \tag{6}$$

The area

$\Lambda = \{(x, y, z) \mid x > 0, y > 0, z \geq 0, x + y + z = 1\}$ is invariant set of system (6) .

By calculation,we change (2) (3) (4) into the following form

$$\begin{cases} mz - bxz - \beta xz = 0 \\ \beta xz - byz - \delta y = 0 \\ \delta y - mz + bz - bz^2 = 0 \end{cases} \tag{7}$$

Since $x + y + z = 1$, so the last two equations of the system (6) can be written as

$$\begin{cases} \frac{dy}{dt} = -\beta z^2 - (b+\beta)yz + \beta z - \delta y \\ \frac{dz}{dt} = \delta y - mz + bz - bz^2 \end{cases} \tag{8}$$

It is easy to know the area

$$D = \{(y, z) \mid y > 0, z \geq 0, y + z < 1\}$$

is a positive invariant set of system (8).

B. *The existence and uniqueness of the equilibrium points*

Theorem 1 Let $R_0 = \frac{b}{m}$,there always exists an unsuccessful equilibrium point P_0 $(0,0)$ in system (8). At that time,there always exists a unique positive equilibrium point $P_+(y^*, z^*)$ of successful entrepreneurs in system (8) ,where $x^* = \frac{m}{b+\beta}$, $y^* = 1 - x^* - z^*$, z^* is determined by equations (8)(and $z^* \neq 0$).

Proof It's clear that there exists an unsuccessful equilibrium point P_0 $(0,0)$ in system (8) .

From the first equation of (7) ,we obtain $x^* = \frac{m}{b+\beta}$,as $z^* \neq 0$.

By simplifying (8) ,we get

$$(b+\beta)z^2 + (1-b-\beta)z + \delta\frac{m-b-\beta}{b+\beta} = 0$$

where $x^* + y^* + z^* = 1$ (9)

From (9) ,we know that the positive equilibrium point $P_+(y^*, z^*)$ in system (8) ,which satisfies solutions in the area D of the following equations

$$\begin{cases} (b+\beta)z^2 + (1-b-\beta)z + \delta\frac{m-b-\beta}{b+\beta} = 0 \\ \delta y - mz + bz - bz^2 = 0 \end{cases} \tag{10}$$

From $x^* = \frac{m}{b+\beta}$ and $x^* + y^* + z^* = 1$,we obtain

$$y^* = 1 - \frac{m}{b+\beta} - z^* \tag{11}$$

Then we substitute (11) into the second equation of(10) ,and obtain the unique solution z^*

$$z^* = \frac{b-m}{b} \tag{12}$$

Since $m = 1 - \delta$,then we can obtain

$$z^* = \frac{b+\delta-1}{\beta} . \tag{13}$$

Record $R_0 = \frac{b}{m}$ (14)

When $R_0 \le 1$, $z^* = \frac{R_0 - 1}{R_0} \le 0$,then the positive equilibrium point does not exist.Since z^* must be positive,so we get $R_0 > 1$,so there only exists the unsuccessful equilibrium point $P_0(0,0)$,as $R_0 \le 1$.

When $R_0 > 1$, $z^* = \frac{R_0 - 1}{R_0} > 0$,at this time , z^* exists the positive value ,and $y^* = \frac{m\beta}{b(b+\beta)}$, $x^* = \frac{m}{b+\beta}$.

In summary, when $R_0 \le 1$,the unsuccessful equilibrium point $P_0(0,0)$ is the unique equilibrium in the area D of the system (8) .When $R_1 > 1$,except the unsuccessful equilibrium point P_0 ,the unique positive equilibrium point $P_+(y^*, z^*)$ is included in system (8).

C. Analysis of the local stability of equilibrium points

Theorem 2 For system (8), when $R_0 \le 1$, the unsuccessful equilibrium point P_0 is locally asymptotically stable,as $b+\delta+\beta<1$;when $R_0 > 1$,the unsuccessful equilibrium point P_0 is unstable positive, the positive equilibrium point P_+ is locally asymptotically stable.

Proof *Jacobian* matrix of the unsuccessful equilibrium point P_0 in system (8) is

$$J(P_0) = \begin{vmatrix} -\delta & \beta \\ \delta & -m+b \end{vmatrix}. \tag{15}$$

Its characteristic polynomial is

$$|\lambda E - J(P_0)| = \begin{vmatrix} \lambda+\delta & -\beta \\ -\delta & \lambda+m-b \end{vmatrix} = 0.$$

Then we obtain

$$\lambda^2 + (\delta+m-b)\lambda - \delta(m-b) - \beta\delta = 0.$$

which is

$$\lambda^2 + (1-b)\lambda + \delta(m-b) - \beta\delta = 0. \tag{16}$$

It can be easily known by the *Vieta* theorem,

$$\lambda_1 + \lambda_2 = -(1-b) < 0.$$

$$\lambda_1\lambda_2 = \delta(m-b) - \beta\delta.$$

When $R_0 \le 1$,and $b+\delta+\beta<1$ $\lambda_1\lambda_2 \ge 0$,we can see the unsuccessful equilibrium point P_0 is locally asymptotically stable.When $R_0 > 1$, $\lambda_1\lambda_2 < 0$,then the unsuccessful equilibrium point P_0 is unstable.

Jacobian matrix of the positive equilibrium point P_+ in system (8) is

$$J(P_+) = \begin{vmatrix} -(b+\beta)z^* - \delta & -2\beta z^* - (b+\beta)y^* + \beta \\ \delta & -m+b-2bz^* \end{vmatrix} = 0$$

And from (11) (13) and $R_0 = \frac{b}{m}$, we obtain $z^* = \frac{R_0 - 1}{R_0}$, $y^* = \frac{m\beta}{b(b+\beta)}$

Therefore

$$J(P_+) = \begin{vmatrix} -(b+\beta)z^* - \delta & -2\beta z^* - (b+\beta)y^* + \beta \\ \delta & -m+b-2bz^* \end{vmatrix} = 0 \tag{17}$$

Its characteristic polynomial is:

$$|\lambda E - J(P_+)| = \begin{vmatrix} \lambda + (b+\beta)z^* + \delta & 2\beta z^* + (b+\beta)y^* - \beta \\ -\delta & \lambda + m - b + 2bz^* \end{vmatrix} = 0$$

Which is

$$\lambda^2 + [(b+\beta)z^* + \delta + m - b + 2bz^*]\lambda + [(b+\beta)z^* + \delta] (m - b + 2bz^*) + \delta[2\beta z^* + (b+\beta)y^* - \beta] = 0 \tag{18}$$

It can be easily known by the *Vieta* theorem,

$$\lambda_1 + \lambda_2 = -[(b+\beta)z^* + \delta + m - b + 2bz^*]$$

$$\lambda_1\lambda_2 = [(b+\beta)z^* + \delta](m - b + 2bz^*) + \delta[2\beta z^* + (b+\beta)y^* - \beta]$$

when $R_0 < 1$, $z^* = \frac{R_0 - 1}{R_0}\delta < 0$ is obviously not true, so the positive equilibrium P_+ does not exist and is pointless when $R_0 < 1$;

when $R_0 = 1$, $P_+ = P_0$,at this time,the positive equilibrium point becomes unsuccessful equilibrium point;

Since $\delta+m=1$,we have $\delta+m-b>0$,so $\lambda_1+\lambda_2<0$.

While $y^*=\dfrac{m\beta}{b(b+\beta)}$, $z^*=\dfrac{b-m}{b}$,

So when $R_0=\dfrac{b}{m}>1$,we get $2bz^*+m-b=2(b-m)+m-b=b-m>0$,and

$$2\beta z^*+(b+\beta)y^*-\beta=2\beta\frac{b-m}{b}+\frac{m\beta}{b}-\beta$$
$$=\beta-2\beta\frac{m}{b}+\frac{m\beta}{b}=\beta(1-\frac{1}{R_0}).$$

So when $R_0>1$,we get $1-\dfrac{1}{R_0}>0$, then $\lambda_1\lambda_2>0$.

It shows that two characteristic roots are less than or equal to zero constantly, so the positive equilibrium point P_+ is locally asymptotically stable .

D. Analysis of the global stability of the equilibrium points

Theorem 3 For the system (6), when $R_0\le 1$,unsuccessful equilibrium point P_0 is globally asymptotically stable,when $R_0>1$,there has a positive equilibrium point P_+ which is globally asymptotically stable.

Proof when $R_0\le 1$, unsuccessful equilibrium point P_0 is globally asymptotically stable,when $R_0>1$,there has a positive equilibrium point P_+ which is globally asymptotically stable.So we can construct a $Liapunov$ function

$$V=U+T+S$$

We can obtain

$$\frac{dV(t)}{dt}=\frac{dU}{dt}+\frac{dT}{dt}+\frac{dS}{dt}=-bU-bT<0$$

Since $x=\dfrac{U}{N}$, $y=\dfrac{T}{N}$, $z=\dfrac{S}{N}$,we can get

$$E=\{\frac{dV}{dt}=0\}=\{x=0,y=0,z=0\}$$

By the $LaSalle$ in-variance principle,The paths of all equations （6） in the area of $\Lambda=\{(x,y,z)\,|\,x>0,y>0,z\ge 0,x+y+z=1\}$ all tend to E ,so $x\to 0.y\to 0,z\to 0$.

When $z\to 0$, the limit equation $\dfrac{dN}{dt}=-bN+bS$ of the（5）is

$$\frac{dN}{dt}=-bN \qquad (19)$$

For any solutions of the equations（19）, as long as the initial value $N_0>0$, there will be $N(t)\to 0$.

When $z\to 0, N(t)\to 0$, we can obtain a limit equation

$$\frac{dz}{dt}=-\delta y \qquad (20)$$

by the third equation of equation (6)。

So, for any solution of the system（6）,except the plane $N=0$,all tend to the equilibrium point $P_0(0,0)$ .Similarly ,when $U\to U^*, T\to T^*, S\to S^*$,there will be $N(t)\to N^*$,that is,when $x\to x^*, y\to y^*, z\to z^*$,all points,except the plane $N=N^*$,will trend to the equilibrium point $P_+(y^*,z^*)$. Thus the theorem 3 is proved.

E. Analysis and demonstration of the periodic solution of the equilibrium points

In order to prove that there is no periodic solutions in the system（6）,so the generalized $Bendixson-Dulac$ theorem[7] is given below.

Theorem 4 Let $\vec{f}:R^3\to R^3$ be the $Lipschitz$ continuous vector field ,and $\Gamma(t)$ be the boundary curve which has a smooth curved surface $\vec{S}\subset R^3$, it is closed and piece-wise smooth.If $\vec{g}:R^3\to R^3$ is smooth in certain neighborhood of $\vec{S}$,and for all t which is satisfied by

$$\vec{g}(\Gamma(t))\bullet\vec{f}(\Gamma(t))\le 0(\ge 0).$$

and there are also some points to meet $(Cur\lg)\bullet\vec{n}\ge 0(\le 0)$,if and only if they are on $\vec{S}$.

where $\vec{n}$ is the unit normal vector on the curved surface $\vec{S}$, so $\Gamma(t)$ can not be constituted by the paths of the system

$$\frac{dx}{dt}=f(x).$$

And the direction of $\Gamma(t)$ and $\vec{n}$ compose a right hand system.

Theorem 5[7] Let $\vec{S} \subset R^3$ be the directional smoothly curved surface. $\Gamma(t) \subset \vec{S}$ is an arbitrary smooth closed curve,and $\Gamma(t)$ is the boundary of the surface $\vec{S}' \subset \vec{S}$. If $\vec{f}: R^3 \to R^3$ meets *Lipschitz*, $\vec{f}$ and $\vec{g}$ meet

$$\vec{g}(\Gamma(t)) \bullet \vec{f}(\Gamma(t)) = 0.$$

$$(Cur\lg) \bullet \vec{n} > 0 (< 0).$$

where $\vec{n}$ is the unit normal vector on the curved surface $\vec{S}$, so $\Gamma(t)$ can not be the different place of the system

$$\frac{dx}{dt} = f(x).$$

Theorem 6 The system（6）does not exist the periodic solutions.

Proof Due to the area $\Lambda = \{(x,y,z) \mid x>0, y>0, z\geq 0, x+y+z=1\}$ is the invariant set of the system (6), and it can be easy to find that the boundary of the area Λ can not be periodic solutions of system (6). So as follows, it were discussed only in the area Λ.

Proof by contradiction,suppose the system(6) has the periodic solutions

$\Psi(t) = \{x(t), y(t), z(t)\}$ in the area Λ ,and the plane area Π which is surrounded by the path Γ of $\Psi(t)$ is situated in the internal of Λ.

Let f_1, f_2, f_3 respectively be the right end of three equations of the system(6). $\vec{f} = (f_1, f_2, f_3)$, $\vec{g}(x,y,z) = \frac{1}{xyz}\vec{r} \times \vec{f}$,Among them $\vec{r} = (x,y,z)$,then $\vec{g} \bullet \vec{f} = \vec{0}$.

Let $\vec{g} = (g_1, g_2, g_3)$,

$$Cur\lg = (\frac{\partial g_3}{\partial y} - \frac{\partial g_2}{\partial z}, \frac{\partial g_1}{\partial z} - \frac{\partial g_3}{\partial x}, \frac{\partial g_2}{\partial x} - \frac{\partial g_1}{\partial y}),$$

then $\frac{\partial g_1}{\partial y} = \frac{\delta}{xz} + \frac{\beta z}{y^2}$, $\frac{\partial g_1}{\partial z} = -\delta \frac{y}{xz^2} - \frac{\beta}{y}$, $\frac{\partial g_2}{\partial x} = -\frac{mz}{x^2 y}$,

$\frac{\partial g_2}{\partial z} = \frac{\delta}{z^2} + \frac{m}{xy} - \frac{\beta}{y}$, $\frac{\partial g_3}{\partial x} = \frac{\beta}{y} - \frac{m}{x^2}$, $\frac{\partial g_3}{\partial y} = -\frac{\beta x}{y^2}$,

So in the area Λ,there exists

$$(Cur\lg) \bullet (1,1,1)^T = -\frac{\delta}{z^2} - \frac{m}{x^2} - \frac{m}{xy} - \delta\frac{y}{xz^2} - \frac{mz}{x^2 y} < 0$$

Suppose the direction of the plane area Π is up,and the direction of $\Gamma(t)$ and the direction of Π satisfy the right-hand rule.Since the vector $(1,1,1)$ is the normal vector of plane area Π, so by the theorem 4 ,theorem 6 is established, that is the system (6)does not have periodic solutions.

IV. CONTROLLABLE ANALYSIS OF INFLUENCE FACTORS

We have discussed the equilibrium point and its properties above and obtained $R_0 = \frac{b}{m}$,among them , $m = 1-\delta$ is regarded as the threshold value of college students enterprising. Through the control of the threshold value ,we can make equilibrium points stable,and the proportion of successful entrepreneurs increased, as well as the success rate of entrepreneurship raised.as follows, every factor to affect the threshold value will be analyzed and controlled.

A. Analysis the range of the main influence factors

The proportion of employment in the total number of college students will vary each year.The following The following will make a analysis of the impact that the proportion of employment in the total number of college students b and the national support α affect stability of the positive equilibrium point,and obtain the influence of b and α on the threshold R_0 .Then we consider whether fluctuations of uncertainty producing by b can be ignored.Thus it will be easier to make an analysis of controllable for the national support α.

In order to clearly reflect the influence of b and α on the threshold R_0 , that is the Influence of the stability of the equilibrium points, respectively, with the first order partial derivatives of b and α are:

$$R_0 = \frac{b}{m} = \frac{b}{(1-\alpha-\gamma)}$$

$$\frac{\partial R_0}{\partial b} = \frac{1}{m} \quad (21)$$

$$\frac{\partial R_0}{\partial \alpha} = \frac{b}{m^2} \text{ (where } m = 1-\delta\text{)} \quad (22)$$

When α is constant, that is, the existing venture capital rate unchanged.The influence of b on the stability of equilibrium points is linear,and the knowledge universality degree of entrepreneurship is less than 0.01, so the value range of β is from 0.01 to 1.

When the positive equilibrium point is stable, that is $R_0 > 1$, then $b > m$, so

$$\frac{b}{m^2} > \frac{1}{m} \quad (23)$$

Then for (21) we get

$$\frac{\partial R_0}{\partial b} = \frac{1}{m} < \frac{b}{m^2} \quad (24)$$

For (22) we get

$$\frac{\partial R_0}{\partial \alpha} > \frac{\partial R_0}{\partial b} \quad (25)$$

So when $R_0 > 1$, then $\frac{\partial R_0}{\partial \alpha} > \frac{\partial R_0}{\partial b}$, that is when the positive equilibrium point is stable, there is always the effect of α on the stability of the equilibrium point was greater than that of b.

To make α, b and R_0 have a relationship function graph is as Figure 2(see Appendix A) :

By R_0 and figure 2, when $b \in [0,1]$, $\alpha \in (0, 0.22)$, $R_0 > 0$, $\alpha \in (0.22,1]$, and the above conditions for b, when $R_0 > 1$, there is no solution by linear programming, that is, when $\alpha \in (0.22,1]$, $R_0 \le 0$ and $b+\delta+\beta<1$ hold, the unsuccessful equilibrium point is stable and is the global asymptotic stability.Although the R_0 is a single function, so when the $\alpha \in (0.22,1]$ show that the government is over support, $R_0 \le 1$ constant, that is, the proportion of non successful entrepreneurs achieve a stable equilibrium state, which is not the result of the national expectations, and government funding has been below 2%, so the value of α is 0.02 to 0.22.

When the value is γ, when the condition is $\alpha \in (1-\gamma, 1]$, the $R_0 \le 0$ is set up, and when $\alpha > 1-\gamma$, which shows that it is over support, the α value ranges from 0.02 to $1-\gamma$. So, when $\gamma = 0.78$, and $\alpha \in [0.02, 0.22)$, α will have an impact on the threshold R_0, which affects the stability of the positive equilibrium point, and therefore, the positive equilibrium point is $\alpha \in [0.02, 0.22)$.

B. Control range and sensitivity analysis of influence factors

Since the threshold $R_0 = \frac{b}{m} = \frac{b}{(1-\alpha-\gamma)}$, respectively to b, α for the second derivatives of he threshold R_0, through the second derivatives to make analysis of the impact of b, α on the equilibrium points, there is

$$\frac{\partial^2 R_0}{\partial b^2} = 0 \quad (26)$$

$$\frac{\partial^2 R_0}{\partial \alpha^2} = \frac{2b}{m^3} \quad (27)$$

From (26) (27) ,we know that $\frac{\partial^2 R_0}{\partial \alpha^2} > \frac{\partial^2 R_0}{\partial b^2}$ is permanent establishment, so it is clear that national efforts to support the stability of the balance point is the greatest.The initial value $\gamma = 0.78$, when $\alpha \in [0.02, 0.22)$, $b \in [0,1]$, $\beta \in [0.01,1]$ is calculated by the linear programming lingo making it the minimum fluctuation as b, we know when $R_0 = 1$ and $b+\delta+\beta \ge 1$, we obtain $\alpha = 0.03875$, $b = 0.18125$, $\beta = 1$.

From now on the knowledge universality degree of entrepreneurship ,it is low. From the original 0.01 to 0.1, it makes equilibrium points of successful entrepreneurs stable by an increase of 99 times. However,the national support is the original 0.02, it needs to 0.03875, an increase of only 0.9375 times,the positive equilibrium point stable.While The proportion of employment in the total number of college students didn't change.Therefore it can be seen that this proportion makes minimal impact on the stability of the equilibrium point,so the fluctuations of b can be ignored,that is he value of b remains0.18125.While the national support plays a key role and the regulation of the national support than the knowledge universality degree of entrepreneurship has high sensitivity about the stability of equilibrium points, thus that needs to provide more benefits and financial to support college students venture.

For the sensitivity and control of α β, when $\alpha \in [0.02, 0.22)$, $\beta \in [0.01,1]$,

threshold $R_0 > 1$, the maximum proportion of successful entrepreneurs is 100% and by dynamic programming,we gets $\alpha = 0.219999$, $\beta = 1$, $R_0 = 716942.1 >> 1$.

Making the relationship between the success rate with the the national support and the universality degree of knowledge,which are shown in picture 3:(see Appendix A).

As can be seen from figure 3 the state to support venture capital plays a key role. The national support is close to 0.1293750, the proportion of successful entrepreneurs is already high and over 50%,at the same time,the knowledge universality degree of entrepreneurship almost unchanged. As long as support for national investment funds can make a small percentage of fund,the success rate will be increased many-fold, while the knowledge universality of entrepreneurship is far less than the effect.

The following factors will determine the control range and optimum control point of the impact factors α , β .

(1)the control range and optimum control point of the knowledge universality degree of entrepreneurship

In the case of the three countries support in the $\alpha \in [0.02, 0.22)$ random value,taking $\alpha = 0.02$, $\alpha = 0.11$, $\alpha = 0.2199$,obtaining $\gamma = 0.78$, $b = 0.18125$, $\beta \in [0.01, 1]$

Making the proportion relationship of the knowledge universality degree of entrepreneurship β and the success rate is shown(the success rate is non-negative ,Form the figure 4(see Appendix A) ,the proportion of negative value represents equilibrium point,at this time, to a zero value stably):

From figure 4 ,we can see,when $\alpha = 0.02$,the curve is negative ,which shows that within the scope of the knowledge universality degree of entrepreneurship,the positive equilibrium does not exist,only exist unsuccessful equilibrium point which is globally asymptotically stable.With the knowledge universality degree of entrepreneurship change from 0.1 to 1,the success rate change stably,that is the stability of equilibrium points change hardly.and the proportion of entrepreneurial winners have increased significantly.When the value of β is greater than 0.1,the success rate change stability without fluctuation.And the national support has no significant effect on trend of the success rate.In constantly,the value γ has no affect on the trend of the success rate with the Interval $[0.01, 0.1]$ of β .So,the control range of β is $[0.01, 0.1]$ .the best control point of the knowledge universality degree of entrepreneurship is 0.1.

(2)When the knowledge universality degree of entrepreneurship is minimum,that is $\beta = 0.01$,we take the initial value $b = 0.18125$, $\gamma = 0.78$,and $\alpha \in [0.02, 0.22)$,when the knowledge universality degree of entrepreneurship makes the the best control point $\beta = 0.1$,making the proportion relationship of the national support α and the success rate is shown within the influence of the scope $[0.02, 0.22)$,and at this time,the relationship between the success rate is shown (the success rate is non-negative ,Form the figure 5(see Appendix A) ,the proportion of negative value represents equilibrium point,at this time, to a zero value stably):

It can clearly be seen from Figure 5, with strengthening the nation support, the success rate also increased, and with the value of β increases, the success rate is also increased.

So when $\beta = 0.1$ and $\alpha = 0.2199999$,the highest success rate is 99.9999804% ,at this time,the threshold $R_0 = 9999999.005 >> 1$,the positive equilibrium is globally asymptotically stable.

While for the initial value $b = 0.18125$, $\gamma = 0.78$,when $\beta = 0.01$, $R_0 = 1.0000000001 > 1$ and $\alpha = 0.03875 \in [0.02, 0.22)$ .When the positive equilibrium point is stable,the lowest success rate is 0.00000019125% ,and the positive equilibrium point remains global asymptotically stable.

So, when the knowledge universality degree of entrepreneurship is minimum control point $\beta = 0.01$.,the regulation of the national support α still make the minimum positive equilibrium point $\alpha = 0.03875$ global asymptotically stable.So the control range of the national support is $[0.03875, 0.2199999]$,And the the best control point of the national support is 0.2199999.

Next we will give the sensitivity analysis of impact factor α and β :

From the above results we get that $\alpha \in [0.03875, 0.2199999]$,the the best control point of the national support is 0.2199999,the control range of β is $[0.01, 0.1]$,and the the best control point of the knowledge universality degree of entrepreneurship is 0.1.

When $\beta = 0.01$,and α take minimum control point $\alpha = 0.03875$,the threshold $R_0 = 1.0000000001 > 1$,the lowest proportion of successful entrepreneurs recorded

$z^*_{\min}(\alpha) = 0.00000019125\%$ .But when $\alpha = 0.2199996$,the Threshold $R_0 = 478592.9 >> 1$,the highest proportion of successful entrepreneurs recorded $z^*_{\max}(\alpha) = 99.99999\%$,and we get the positive equilibrium point,and the equilibrium point is global asymptotically stable.

Record

$$z^*_{\alpha} = \left| z^*_{\max}(\alpha) - z^*_{\min}(\alpha) \right| = 99.99998981\% \qquad (28)$$

When $\alpha = 0.03875$,and β take minimum control point $\beta = 0.01$,the threshold $R_0 = 1.0000000001 > 1$,at this time,the lowest proportion of Successful entrepreneurs marked $z^*_{\min}(\beta) = 0.00000019125\%$ .when β take the best control point $\beta = 0.1$, the threshold $R_0 = 1$,and the highest proportion of successful entrepreneurs recorded $z^*_{\max}(\beta) \approx 0.00000019126\%$ .And we get the positive equilibrium point which is global asymptotically stable.

Recorded

$$z^*_\beta = |z^*_{\max}(\beta) - z^*_{\min}(\beta)| = 0.00000000001\% \qquad (29)$$

If record the control range of the national support α length is $|\alpha|$,then

$$|\alpha| = 0.02199999 - 0.03875 = 0.1812499 \qquad (30)$$

Recorded the length of the control range of the knowledge universality degree of entrepreneurship β is $|\beta|$,then

$$|\beta| = 0.1 - 0.01 = 0.99 \qquad (31)$$

Recorded the control range of sensitivity of the national support α is Ψ_α ,then

$$\psi_\alpha = \frac{z^*_\alpha}{|\alpha|} \qquad (32)$$

The control sensitivity of the knowledge universality degree of entrepreneurship β is Ψ_β ,then

$$\psi_\beta = \frac{z^*_\beta}{|\beta|} \qquad (33)$$

We put the(28) (29) (30) (31) into (32) (33)respectively,then we get

$$\Psi_\alpha = 551.7243861 \qquad (34)$$

$$\Psi_\beta = 1.0101 \times 10^{-11} \qquad (35)$$

Through(34)and(35)is clearly,the regulation of the national support α much higher than the sensitivity of the knowledge universality degree of entrepreneurship β ,and the sensitivity of α is β nearly 5.46207×10^{13} times.So β will not be controlled.

V. CONCLUSION

In this paper,college students can be divided into three independent compartments including the unemployed, the preparatory entrepreneurs and the successful entrepreneurs.In addition, we established the dynamic model. Through the analysis of the dynamic model, which gives the threshold value $R_0 = \frac{b}{m}$, and verifies the existence and uniqueness in equilibrium points and the system of periodic solutions don't exist. When $R_0 \le 1$ and $b + \delta + \beta < 1$, by *Jacobian* Matrix,it proved unsuccessful equilibrium point is locally asymptotic stability,and through constructing *Lyapunov* function, it proved all of unsuccessful equilibrium point is globally asymptotically stable.when $R_0 > 1$,with using the same way,we proved the positive equilibrium point is not only local asymptotically stable but also global asymptotically stable. Combined with the actual situation in our country, the data analysis of the college students' entrepreneurship gets the factors affecting college students' entrepreneurial stable equilibrium points, which are b , α , γ , β . The scope of influence of α , β are $\alpha \in [0.02, 0.22)$ and $\beta \in [0.01, 1]$,the scope of control of control factor α is $[0.03875, 0.2199999]$,the the best control point for the national support is at 0.2199999, the scope of control of control factor β is $[0.01, 1]$. At the same time, it also gets the sensitivity of control factory within the scope of control $\Psi_\alpha = 551.7243861$, $\Psi_\beta = 1.0101 \times 10^{-11}$ .And the knowledge universality degree of entrepreneurship β almost no effect on the success rate of entrepreneurship.Therefore β will not be controlled,the value of β is still 0.01.so regulation of the nation support be the fastest way to improve the success rate of entrepreneurship. By simulation, we know unsuccessful equilibrium points are global asymptotically stable without fluctuation when $b = 0.18125$, $\alpha = 0.03$, $\gamma = 0.78$, $\beta = 0.01$,the lower threshold value $R_0 = 0.95394737 < 1$, $b + \delta + \beta = 1.00125 > 1$ in China at present. This result is accordant with the actual situation of entrepreneurial success of the our country. So if we want to change the status that entrepreneurial success rate is very low in our country,we should strengthen the national support and strengthen the national support to 9% at least.

ACKNOWLEDGMENT

This research is partially supported by the National Nature Science Foundation of China (71271103, 71371087).The authors are grateful to the reviewers for their helpful comments and valuable suggestions.

REFERENCES

[1] WangJian,Research of the key Aspects of entrepreneurial success for College Student,East China University of Science and Technology, 2013.

[2] Jock Collins,Cultural diversity and entrepreneurship: policy responses to immigrant entrepreneurs in Australia,Entrepreneurship & areaal Development,2003,15(02):137-149.

[3] Tang Yaoping,The Entrepreneurship Support Policy of College Students in Guangdong Province:Implement,Evaluation and

Improvement,South China University of Technology,2011.

[4] Liyan Wang,A Study on Innovation Performance Measurement of College Students' Venture Enterprise Based on SFA Model,Journal of Computers, 2012, 07 (08):1974-1981.

[5] Chen Qing-sheng,The Rule of Undergraduate Venturing Based on Timmons Models——Taking Zhejiang Wanli University as An Example,Zhejiang Wanli University,2013,26(05):109-112.

[6] Li Min,Luo Jiali,Meng Qingyao,Guo Yan,An Analysis of Timmons Model of The Self — Employed Factors For University Students,Journal of Shandong Youth University of Political Science,2013,29(163):55-59.

[7] Ma Zhi-en,Zhou Yi-cang,Wang Wen-di,Mathematical modeling and research of infectious disease dynamics,sciencepress,2004:141-142.

[8] Shang Ning-ning,Wang Hui,Hu Zhi-xing,Liao Fu-cheng,Bifurcation Analysis of an SIR Epidemic Model with Saturated Incidence Rate and Saturated Treatment Function,Journal of Kunming University of Science and Technology (Natural Science Edition),2015,40(03):139-148.

[9] Yang Junxian,Yan Ping,Analysis of a Delayed SEIR Epidemic Model with Saturation Incidence,Acta Scientiarum Naturalium Universitatis Sunyatseni,2015,54(03)：51-55.

[10] Enatsuy,Nakatay,Muroyay,Global stability of sirs epidemic models with a class of nonlinear incidence rates and distributed delays,Acta Mathematica Scientia,2012,32(03) : 851—865.

[11] Guo P,Yang Z C,The stability of SIRI model with nonlinear incidence rate,Journal of chong qing Normal University,2011,28(04) : 35—39.

[12] Zhou T T,Zhang W P,Lu Q Y, Bifurcation analysis of an SIS epidemic model with saturated incidence rate and saturated treatment function,Applied Mathematics and Computation,2014,226(01) : 288—305.

[13] Hu Z X,Ma W B,Ruan S G, Analysis of SIR epidemic models with nonlinear incidence rate and treatment,Mathematical Biosciences,2012,238(01) : 12—20.

Appendix A:

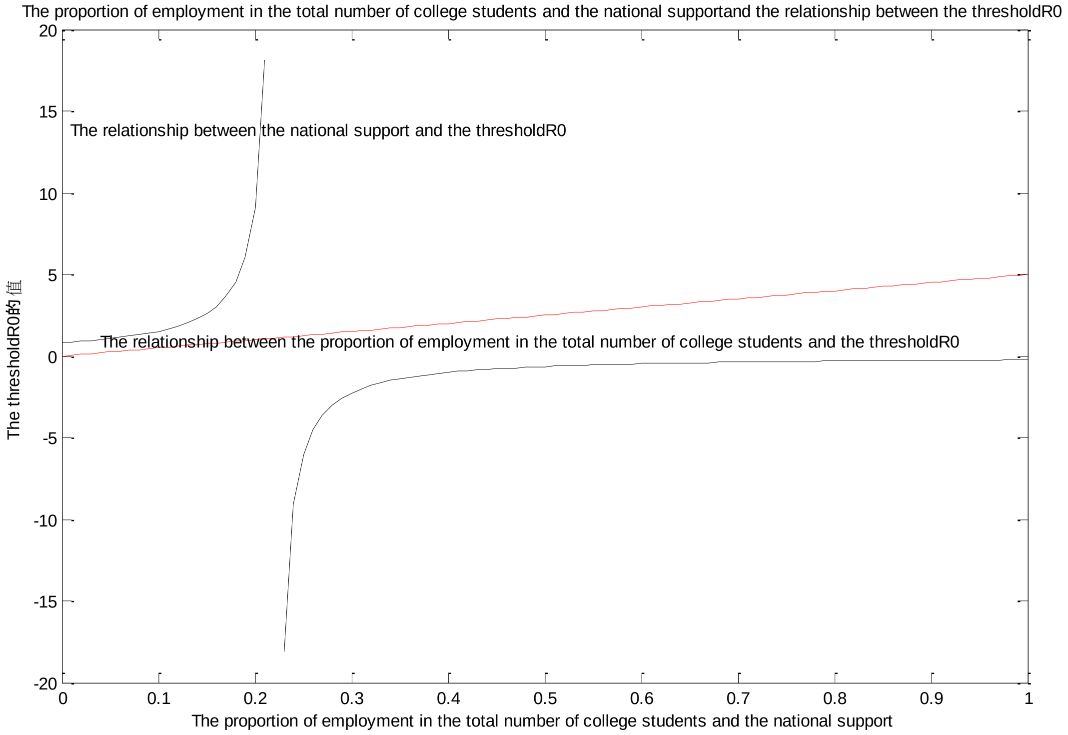

Figure 2 The proportion of employment in the total number of college students b and the national support α and the relationship between the threshold R_0

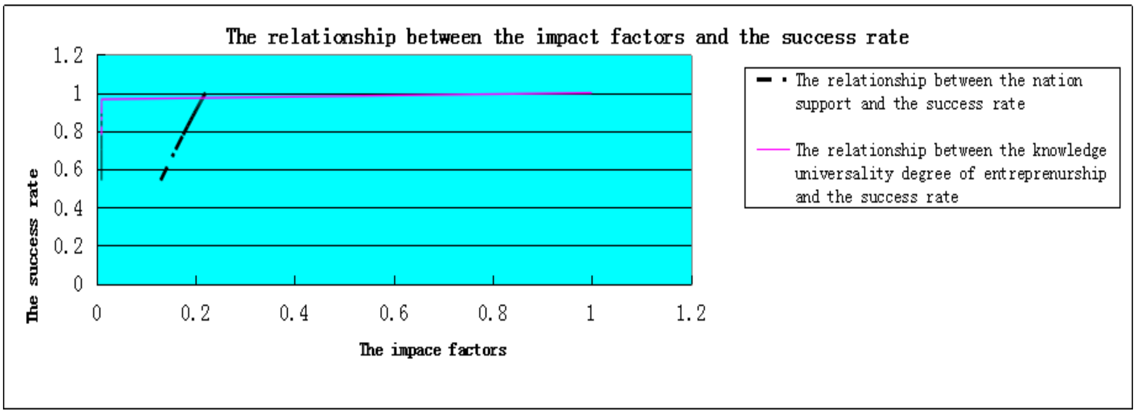

Figure 3 The relationship between the impact factors α , β and the proportion of the successful entrepreneurs

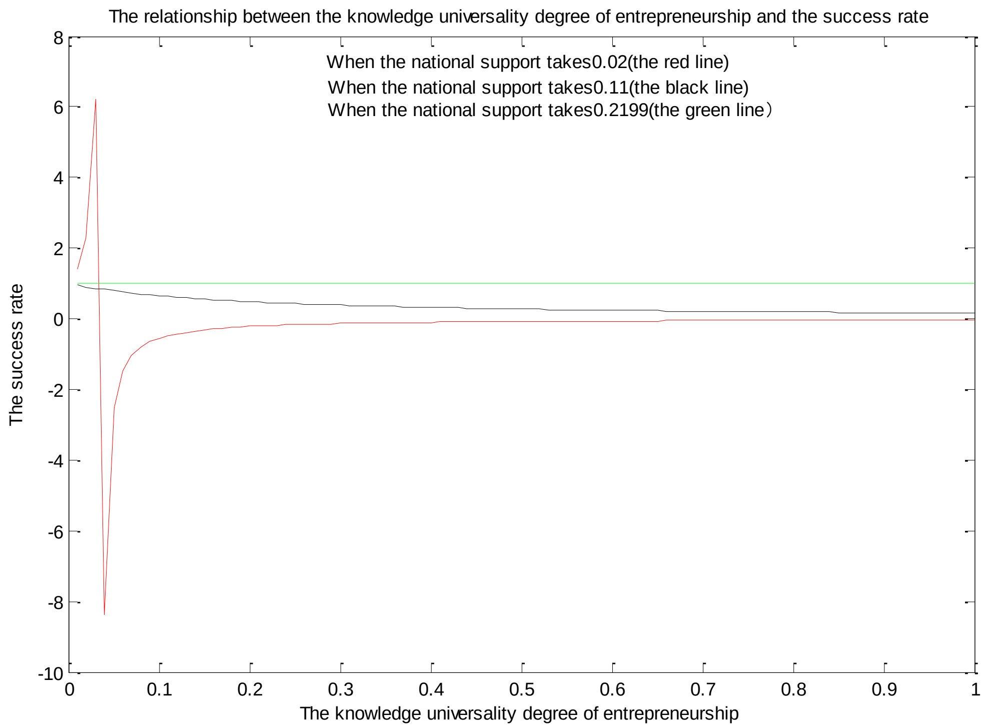

Figure 4 The relationship between the knowledge universality degree of entrepreneurship β and the success rate,when α takes different values

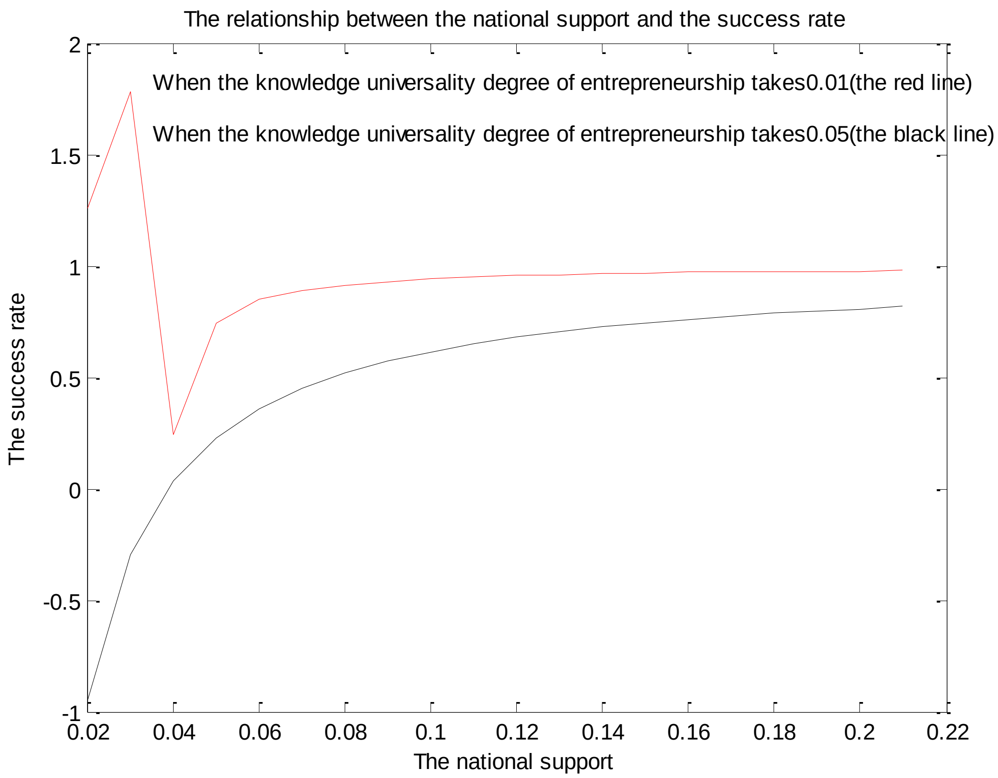

Figure 5 The relationship between the national support α and the success rate.