Evolutionary Game Analysis of Poor Households, Online Sales Platform and Government Behavior in the Internet Age

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Abstract—As the most direct and rapid poverty alleviation policy, the network poverty alleviation has brought certain hope to the remote areas and the deep poor areas, is the poverty alleviation work from the initial "Blood transfusion" to the present stage "Hematopoietic" poverty alleviation way, through information technology, digitization, and the traditional poverty alleviation way union, to fundamentally improve the quality of life in poor areas. In this paper, we use the three-party evolutionary game model to construct an evolutionary game model with poor households, the network sales platform, and the government as the main body. MATLAB software is used to carry out simulation analysis to study the influence of each subject's strategic behavior on network poverty alleviation in poverty-stricken areas. The findings suggest: The choice of strategies among the players is mainly influenced by the cost of the government and the online sales platform, The participation costs and benefits of the poor households, the fines paid by the poor households and the platform, the rewards from the online sales platform, the costs, and benefits of the platform promotion, the costs and benefits of the government supervision and the negative effects are all important factors that determine the stable state of evolution. Finally, put forward the corresponding solution countermeasure.

Keywords-poor households; online sales platform; government; internet poverty alleviation; three-party evolutionary game model

1. INTRODUCTION

In the era of big data, with the continuous improvement of Internet technology, China's poverty alleviation work has also emerged unprecedented challenges and opportunities [1]. The promotion of data-based poverty alleviation can improve the self-development ability of poor households and more employment opportunities, and fundamentally realize the poor households' Blood-making ability instead of Blood transfusion [2]. Network poverty

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alleviation refers to the comprehensive poverty alleviation work from five aspects: network facilities, mobile terminal, information content, e-commerce platform, and public service [3-4]. Network poverty reduction is the combination of data and entity poverty reduction, and uses the advantages of data to help poor areas to promote resource advantages and close the distance between poor areas and towns, fundamentally solving the survival problem of poor households [5-6].

As a part of the current and future development of poverty alleviation in China, network poverty alleviation also plays a vital role in the whole process of poverty alleviation [7]. The internet-based poverty alleviation is mainly based on the information service system established by the government, the market, the society, and the farmers to help the poverty-stricken areas achieve accurate poverty alleviation and make the poor households survive healthily is the rapid development of the local economy [8]. In the existing research, the problem of network poverty alleviation mainly focuses on the meaning of network poverty alleviation, the reasons for its implementation, as well as the influencing factors, ways and future development paths, etc., but to the poor household, the network sale platform and the government's game process research are few [9-10]. A few scholars have studied the game subjects of industrial poverty alleviation, educational poverty alleviation, and photovoltaic poverty alleviation [11-13]. Based on the existing literature, this paper analyzes the evolutionary game process and the decision-making behavior of poor households, the network sales platform, and the government. This paper puts forward some countermeasures and suggestions for the effective governance of network poverty alleviation.

2. THE CONSTRUCTION OF AN EVOLUTIONARY GAME MODEL FOR THE PRECISE POVERTY ALLEVIATION OF THE POOR HOUSEHOLDS UNDER THE NETWORK SALES PLATFORM

2.1 The definition of the players in the game

The main body of the network anti-poverty evolution game is divided into three parts: the poor households as participants, the network sales platform as promoters and the government as supervisors.

First of all, poor households through the network of digital technology and the characteristics of information-based communications use network media to systematically and purposefully promote products to the people in need, to enhance the visibility of their poor areas, the social attention, as well as obtains more benefits, seeks the network sale platform to plan for it, and carries on the propaganda to the product, realizes is advantageous to the poor household to successfully lift out of poverty the effect.

Secondly, the internet sales platform refers to the intermediary of poor households to push their products to outside consumers, taking advantage of the immediacy and openness of the internet, to plan, implement and effectively promote poor households and the platform to better sell products and obtain greater self-interest [14]. To plan the topic of the poor area,

propagandize the resources superiority of the area and the product characteristic and so on the main way, thus plays a certain influence.

Finally, the government as a supervisor mainly refers to the use of their rights to guide, supervise and regulate the platform. There may be negative information or a series of problems. The sales process of the poor households in the network platform needs the overall supervision of the supervisor, and the government has the responsibility to protect the rights and interests of the poor households by maintaining the order of the network sales platform.

2.2 The strategy choice and probability assumption of the players in the game

Poor households to sell their products to obtain corresponding profits and choose to participate in the network sales platform (participation), can also rely on their own ability to sell products and not to participate in the network sales platform (non-participation); Suppose that the probability of poor households choosing the participation strategy is x, then the probability of poor households choosing the non-participation strategy is 1-x. Network sales platform to obtain more benefits and more opportunities for cooperation and accept the commission of poor households (promote), can also possibly choose not to accept the entrustment of the poor households to avoid the large cost caused by the participation of more poor households(non-promote); The probability of Internet sales platform choosing push strategy is y, and the probability of internet sales platform choosing no push strategy is 1-y. The government supervises and manages the whole sales process to create a better supply chain formed by online sales(supervise). It can also choose to let the whole process of online sales self-management rather than to monitor the entire sales process(non-supervise); The probability that the government chooses the supervisory strategy is z, then the probability that the government chooses the non-supervisory strategy is 1-z.

2.3 Game profit-cost parameter setting and game payment matrix

- The establishment of profit and loss variable of the main body in the game

The cost of participation of poor households in online sales platform: C_1^1.

Cost to poor households when not participating in online sales platforms: C_1^2.

The cost of an online sales platform to drive strategy: C_2^1.

The cost of an online sales platform when it does not drive strategy: C_2^2.

The costs incurred by the government in choosing a strategy of supervision: C_3.

Benefits to poor households when they do not participate in online sales platforms: R_1^1.

The income of the poor households when they participate and the Internet sales platform chooses the promotion strategy: R_1^2.

When the poor households choose to participate in the strategy but the network sales platform does not promote, the income of the poor households: R_1^3 .

Revenue from online sales platforms choosing promotion strategies: R_2 .

The benefits to the government when it chooses its oversight strategy: R_3 .

The reward of Internet sales platform when poor households choose to participate and internet sales platform chooses to promote strategy: W .

Government online sales platform for the sale of non-poor households, the platform was punished: K_1 .

The government penalizes poor households for providing harmful products: K_2 .

Poor households should be punished by the government when they breach the contract of Internet sales platform: K_3 .

The government to the network sales platform because the poor household gains the obvious income to raise the agency expense, the network sales platform receives the penalty: K_4 .

The negative impact of the government's decision not to supervise: E .

- The establishment of game income matrix

According to the above game strategy combination, the three-party game revenue matrix is shown in Table I.

3. THE EQUILIBRIUM ANALYSIS OF THE EVOLUTION GAME AMONG THE POOR HOUSEHOLDS, THE NETWORK SALES PLATFORM AND THE GOVERNMENT

3.1 Construction of expected revenue function

- The expected return of the poor households

Suppose U_{11} is the expected return of the poor households when they choose the participation strategy, U_{12} is the expected return of the poor households when they do not choose the participation strategy, and $\overline{U_x}$ is the average return of the poor households when they adopt the two strategies, then:

TABLE I. GAME INCOME MATRIX OF POOR HOUSEHOLDS, INTERNET SALES PLATFORM AND GOVERNMENT

Game player				Government	
				Supervise（z）	Non-supervise（$1-z$）
Poor households	Participation（x）	Online sales platform	Promote（y）	$-C_1^1+R_1^2-W+K_2+K_3$, $-C_2^1+R_2+W-K_1-K_4$, $-C_3+R_3+K_1+K_2+K_3+K_4$	$-C_1^1+R_1^2-W$, $-C_2^1+R_2+W$, $-E$
			Non-promote（$1-y$）	$-C_1^1+R_1^3$, $-C_2^2$, $-C_3+R_3$	$-C_1^1+R_1^3$, $-C_2^2$, $-E$
	Non-participation（$1-x$）	Online sales platform	Promote（y）	$-C_1^2+R_1^1$, $-C_2^1+R_2-K_1-K_4$, $-C_3+R_3$	$-C_1^2+R_1^1$, $-C_2^1+R_2$, $-E$
			Non-promote（$1-y$）	$-C_1^2+R_1^1$, $-C_2^2$, $-C_3+R_3$	$-C_1^2+R_1^1$, $-C_2^2$, $-E$

$$U_{11} = -yzK_2 - yzK_3 - yR_1^3 + yR_1^2 - yW - C_1^1 + R_1^3 \tag{1}$$

$$U_{12} = R_1^1 - C_1^2 \tag{2}$$

$$\overline{U_X} = xU_{11} + (1-x)U_{12} \tag{3}$$

- The expected revenue of network sales platform

Suppose U_{21} is the expected payoff of the push strategy for the network sales platform, U_{22} is the expected payoff of the network sales platform when it does not choose the push strategy, and $\overline{U_y}$ is the average payoff of the network sales platform when it adopts two strategies, then:

$$U_{21} = -zK_1 - zK_4 + xW - C_2^1 + R_2 \tag{4}$$

$$U_{22} = -C_2^2 \tag{5}$$

$$\overline{U_y} = yU_{21} + (1-y)U_{22} \tag{6}$$

- The government's expected return

Suppose U_{31} is the expected return of the government when it chooses the supervisory strategy, U_{32} is the expected return of the government when it does not choose the supervisory strategy, and $\overline{U_z}$ is the average return of the government when it adopts the two strategies, then:

$$U_{31} = xy(K_1 + K_2 + K_3 + K_4) + R_3 - C_3 \tag{7}$$

$$U_{32} = -E \tag{8}$$

$$\overline{U_z} = zU_{31} + (1-z)U_{32} \tag{9}$$

3.2 Replication dynamic equation in three-way game

The corresponding replication dynamic equation can be derived from the expected payoffs generated by the above players.

- Replication dynamic equation of poor households:

$$\begin{aligned} F(x) = x(1-x)(&-yzK_2 - yzK_3 - yR_1^3 + yR_1^2 - yW \\ &- C_1^1 + R_1^3 - R_1^1 + C_1^2) \end{aligned} \tag{10}$$

- Replication dynamic equation of online sales platform:

$$\begin{aligned} F(y) = y(1-y)(&-zK_1 - zK_4 + xW - C_2^1 \\ &+ R_2 + C_2^2) \end{aligned} \tag{11}$$

- Replication dynamic equation of government:

$$\begin{aligned} F(z) = z(1-z)(&xyK_1 + xyK_2 + xyK_3 + xyK_4 \\ &+ R_3 - C_3 + E) \end{aligned} \tag{12}$$

3.3 Analysis on the stability strategy of three-party game

- The stability analysis of the poor households

When $F(x)=0$,

$x_1=0, x_2=1, y_1=\dfrac{C_1^1-R_1^3-R_1^1+C_1^2}{-zK_2-zK_3-R_1^3+R_1^2-W}$ is the solution.

When I take the derivative of x in $F(x)$, I get:

$$F'(x)=(1-2x)[-y(zK_2+zK_3+R_1^3 - R_1^2+W)-C_1^1+R_1^3-R_1^1+C_1^2] \tag{13}$$

From the stability theorem of the replication dynamic equation we can see that:

When $y=y_1$, $F(x)=0$ set up, this means that the situation is in a stable state, poor households will not change over time.

In the case of $y \neq y_1$ and $x_1=0, x_2=1$, there are two stable points:

① When $y>y_1$, there is $F'(x)\big|_{x=1}<0, F'(x)\big|_{x=0}>0$, that is, $x=1$ is the evolutionary game equilibrium point, that is, poor households choose to participate in the strategy of behavior, and take the initiative to pay fines and services, and then get the maximum benefit.

② When $y<y_1$, there is $F'(x)\big|_{x=1}>0, F'(x)\big|_{x=0}<0$, that is, $x=0$, the evolutionary game equilibrium point, that is, the poor households choose not to participate in the strategic behavior, and will pay a large number of labor remuneration to the network sales platform, they will also be subject to fines under the supervision of government departments, so that poor households do not participate in online sales platforms to sell their products.

According to the analysis above, the strategy choice of the poor households is related to the network sales platform and the government's strategy choice, which is the result of the game among the three parties.

- Stability analysis of network sales platform

When $F(y)=0$,

$y_1=0, y_2=1, z_1=\dfrac{-xW+C_2^1-R_2-C_2^2}{-K_1-K_4}$ is the solution.

When I take the derivative of y in $F(y)$, I get:

$$F'(y) = (1-2y)(-zK_1 - zK_4 + xW - C_2^1 + R_2 + C_2^2) \tag{14}$$

From the stability theorem of the replication dynamic equation we can see that:

When $z = z_1$, $F(y) = 0$ set up, this shows that the situation is in a stable state, network sales platform will not change over time.

When $z \neq z_1$ and $y_1 = 0, y_2 = 1$, there are two stable points, which are:

① When $z > z_1$, there is $F'(y)|_{y=1} < 0, F'(y)|_{y=0} > 0$, that is, $y = 1$ is the evolutionary game equilibrium point, which means that the network sales platform receives the income from the poor households, and the network sales platform can get a huge income. Network sales platforms can accept the wishes of poor households and choose to promote strategic behavior, network sales platform use formal channels to sell the products provided by poor households.

② When $z < z_1$, there is $F'(y)|_{y=1} > 0, F'(y)|_{y=0} < 0$, that is, $y = 0$ is the evolutionary game equilibrium point, the network sales platform choose not to promote the strategy. The network sales platform bears a large number of fines caused by government supervision as well as the expenses caused by the negative effects, the loss is greater than the income, the income can not offset the costs and risks it faces, so consider their own interests, network sales platform choice does not promote strategy.

According to the above analysis, the network sales platform gains income and enhances the government's punishment dynamics, the network sales platform strategy choice relates with the poor household, and the government's strategy choice, is the tripartite mutual game result.

- Stability analysis of government

When $F(z) = 0$,

$z_1 = 0, z_2 = 1, x_1 = \dfrac{-R_3 + C_3 - E}{yK_1 + yK_2 + yK_3 + yK_4}$ is the solution.

When it take the derivative of z in $F(z)$, it get:

$$F'(z) = (1-2z)(xyK_1 + xyK_2 + xyK_3 + xyK_4 + R_3 - C_3 + E) \tag{15}$$

According to the stability theorem of the replication dynamic equation:

When $x = x_1, F(z) = 0$ is established, it indicates that the situation is in a constant state of stability and that the government will not change over time.

When $x \neq x_1, z_1 = 0, z_2 = 1$, there are two stable points, which are:

① When $x > x_1$ has $F'(z)|_{z=1} < 0, F'(z)|_{z=0} > 0$, that is, $x = 1$, it is the evolutionary game equilibrium point. It means the government's behavior of choosing the supervision strategy while providing a good network environment for the poor households and the network sales platform, there will also be a certain amount of penalty income, these penalties can make up for a certain amount of supervision costs.

② When $x < x_1$ has $F'(z)|_{z=1} > 0, F'(z)|_{z=0} < 0$, that is, $x = 0$, it is the equilibrium point of evolutionary game, government supervision will produce a lot of costs at the same time, and has not achieved the expected benefits, while avoiding a lot of costs, the government's choice not to oversee the strategy.

According to the above analysis, reducing the cost of government supervision and increasing certain benefits, improve the government's supervision. The strategy choice of the government is related to the strategic choice of poor households and the network sales platform, which is the result of the game among the three parties.

3.4 Model stability analysis

According to the replication dynamic equation, the network anti-poverty game model is constructed in order to better analyze and verify whether the equilibrium point is the equilibrium point. Through the definition of Jacobian matrix, the local stability of the above equilibrium points is analyzed as follows:

$$J = \begin{bmatrix} J_{11} & J_{12} & J_{13} \\ J_{21} & J_{22} & J_{23} \\ J_{31} & J_{32} & J_{33} \end{bmatrix} = \begin{bmatrix} \frac{dF(x)}{dx} & \frac{dF(x)}{dy} & \frac{dF(x)}{dz} \\ \frac{dF(y)}{dx} & \frac{dF(y)}{dy} & \frac{dF(y)}{dz} \\ \frac{dF(z)}{dx} & \frac{dF(z)}{dy} & \frac{dF(z)}{dz} \end{bmatrix} \tag{16}$$

$$\begin{aligned} DetJ &= J_{11}(J_{22}J_{33} - J_{23}J_{32}) + J_{12}(J_{31}J_{23} - J_{21}J_{33}) \\ &+ J_{13}(J_{31}J_{22} - J_{21}J_{32}) \end{aligned} \tag{17}$$

Among them:

$$\begin{aligned} J_{11} &= \frac{dF(x)}{dx} = (1-2x)(-yzK_2 - yzK_3 - yR_1^3 \\ &+ yR_1^2 - yW - C_1^1 + R_1^3 - R_1^1 + C_1^2) \end{aligned} \tag{18}$$

$$J_{12} = \frac{dF(x)}{dy} = x(1-x)(-zK_2 - zK_3 - R_1^3 + R_1^2 - W) \tag{19}$$

$$J_{13} = \frac{dF(x)}{dz} = x(1-x)(-yK_2 - yK_3) \tag{20}$$

$$J_{21} = \frac{dF(y)}{dx} = y(1-y)W \tag{21}$$

$$J_{22} = \frac{dF(y)}{dy} = (1-2y)(-zK_1 - zK_4 + xW - C_2^1 + R_2 + C_2^2) \tag{22}$$

$$J_{23} = \frac{dF(y)}{dz} = y(1-y)(-K_1 - K_4) \tag{23}$$

$$J_{31} = \frac{dF(z)}{dx} = z(1-z)(yK_1 + yK_2 + yK_3 + yK_4) \tag{24}$$

$$J_{32} = \frac{dF(z)}{dy} = z(1-z)(xK_1 + xK_2 + xK_3 + xK_4) \tag{25}$$

$$\begin{aligned} J_{33} = \frac{dF(z)}{dz} &= (1-2z)(xyK_1 + xyK_2 + xyK_3 \\ &+ xyK_4 + R_3 - C_3 + E) \end{aligned} \tag{26}$$

According to the above analysis, the equilibrium point of the system is: (0,0,0), (0,0,1), (0,1,0), (0,1,1), (1,0,0), (1,0,1), (1,1,0), (1,1,1).

Firstly, we analyze the equilibrium point (0,0,0), where the Jacobian matrix is:

$$J = \begin{bmatrix} -C_1^1 + R_1^3 - R_1^1 + C_1^2 & 0 & 0 \\ 0 & -C_2^1 + R_2 + C_2^2 & 0 \\ 0 & 0 & R_3 - C_3 + E \end{bmatrix} \tag{27}$$

We can get the eigenvalues:

$$\lambda = \begin{bmatrix} -C_1^1 + R_1^3 - R_1^1 + C_1^2 \\ -C_2^1 + R_2 + C_2^2 \\ R_3 - C_3 + E \end{bmatrix} \tag{28}$$

Similarly, we can get the eigenvalues of the Jacobian matrix by substituting the other seven equilibria into the Jacobian matrix, as shown in Table II.

According to the Evolutionary game theory, the equilibrium point is the stable point of the system when all the eigenvalues of the Jacobian matrix are negative. So, assuming that the point (0,0,0) is an asymptotically stable point.

$$\begin{cases} -C_1^1 + R_1^3 - R_1^1 + C_1^2 < 0 \\ -C_2^1 + R_2 + C_2^2 < 0 \\ R_3 - C_3 + E < 0 \end{cases} \tag{29}$$

In the same way, the asymptotic stability of the other seven equilibrium points can be obtained as Table III.

To sum up, in the three-party evolutionary game model of poor households, network sales platform, and government, there are three points (0,0,0), (0,0,1), (1,1,1) which are asymptotic stable points. The formation of the equilibrium point depends on the income of the poor households and the online sales platform, as well as the costs of both and the fines paid for violating the correct behavior. It also depends on the strength of the government's supervision and the benefits it gains in the process, as well as the negative impact of the policy of choosing not to supervise.

4. SIMULATION AND ANALYSIS

To prove the accuracy of the game model with poor households, the network sales platform, and the government as the main body, this paper analyzes the influence of the relevant parameters on the evolutionary game and uses the MATLAB software to carry out the numerical simulation analysis, to observe the evolution path and the influence of the players.

By establishing the parameters of the evolutionary game model, the simulation analysis of the above evolutionary game is carried out, assuming the initial time is 0, the termination time is 2, the step length is 0.1. Poor households, online sales platforms, and the government's initial strategic choice-value were (0.5,0.5,0.5).

In equilibrium (0,0,0) , that is,{ the poor households do not participate actively, the network sales platform does not actively promote, the government does not monitor } stable state.

TABLE II. EIGENVALUES OF JACOBIAN MATRICES

Equilibrium Point	Eigenvaluesλ_1	Eigenvaluesλ_2	Eigenvaluesλ_3
(0,0,0)	$-C_1^1+R_1^3-R_1^1+C_1^2$	$-C_2^1+R_2+C_2^2$	R_3-C_3+E
(0,0,1)	$-C_1^1+R_1^3-R_1^1+C_1^2$	$-K_1-K_4-C_2^1+R_2+C_2^2$	$-R_3+C_3-E$
(0,1,0)	$R_1^2-W-C_1^1-R_1^1+C_1^2$	$C_2^1-R_2-C_2^2$	R_3-C_3+E
(0,1,1)	$-K_2-K_3+R_1^2$ $-W-C_1^1-R_1^1+C_1^2$	$K_1+K_4+C_2^1-R_2-C_2^2$	$-R_3+C_3-E$
(1,0,0)	$C_1^1-R_1^3+R_1^1-C_1^2$	$W-C_2^1+R_2+C_2^2$	R_3-C_3+E
(1,0,1)	$C_1^1-R_1^3+R_1^1-C_1^2$	$-K_1-K_4+W$ $-C_2^1+R_2+C_2^2$	$-R_3+C_3-E$
(1,1,0)	$-R_1^2+W+C_1^1$ $+R_1^1-C_1^2$	$-W+C_2^1-R_2-C_2^2$	$K_1+K_2+K_3+K_4$ $+R_3-C_3+E$
(1,1,1)	$K_2+K_3-R_1^2$ $+W+C_1^1+R_1^1-C_1^2$	K_1+K_4-W $+C_2^1-R_2-C_2^2$	$-K_1-K_2-K_3$ $-K_4-R_3+C_3-E$

TABLE III. STABILITY ANALYSIS OF JACOBIAN MATRIX CORRESPONDING TO EQUILIBRIUM POINTS

Equilibrium Point	Eigenvalue symbol	Stability
(0,0,0)	$R_1^3-C_1^1<R_1^1-C_1^2$, $C_2^1-R_2>C_2^2$, $C_3-R_3>E$	Asymptotically stable point
(0,0,1)	$R_1^3-C_1^1<R_1^1-C_1^2$, $K_1+K_4-R_2+C_2^1>C_2^2$, $C_3-R_3<E$	Asymptotically stable point
(0,1,0)	$R_1^2-W-C_1^1<R_1^1-C_1^2$, $C_2^1-R_2<C_2^2$, $C_3-R_3>E$	Unstable Point

(0,1,1)	$\mathrm{R}_1^2 - W - K_2 - K_3 - C_1^1 < R_1^1 - C_1^2,$ $K_1 + K_4 - R_2 + C_2^1 < C_2^2,$ $C_3 - R_3 < E$	Unstable Point
(1,0,0)	$\mathrm{R}_1^3 - C_1^1 > R_1^1 - C_1^2,$ $C_2^1 - W - R_2 > C_2^2,$ $C_3 - R_3 > E$	Unstable Point
(1,0,1)	$\mathrm{R}_1^3 - C_1^1 > R_1^1 - C_1^2,$ $K_1 + K_4 - W + C_2^1 - R_2 > C_2^2,$ $C_3 - R_3 < E$	Unstable Point
(1,1,0)	$\mathrm{R}_1^2 - W - C_1^1 > R_1^1 - C_1^2,$ $C_2^1 - W - R_2 < C_2^2,$ $-K_1 - K_2 - K_3 - K_4 - R_3 + C_3 > E$	Unstable Point
(1,1,1)	$\mathrm{R}_1^2 - W - K_2 - K_3 - C_1^1 > R_1^1 - C_1^2,$ $K_1 + K_4 - W + C_2^1 - R_2 < C_2^2,$ $-K_1 - K_2 - K_3 - K_4 - R_3 + C_3 < E$	Asymptotically stable point

Suppose C_1^1=10, C_1^2=5, C_2^1=15, C_2^2=5, C_3=25, R_1^1=10, R_1^2=30, R_1^3=5, R_2=8, R_3=10, W=2, K1=5, K2=5, K3=5, K4=5, E=1. The simulation results are shown in Figure 1.

When $-C_1^1 + R_1^3 - R_1^1 + C_1^2 < 0, -C_2^1 + R_2 + C_2^2 < 0, R_3 - C_3 + E < 0$ is satisfied, the evolutionary game strategy tends to reach a stable state at point (0,0,0).

In equilibrium (0,0,1), that is,{the poor households do not participate actively, the network sales platform does not actively promote, the government monitor} stable state, Suppose C_1^1=10, C_1^2=5, C_2^1=15, C_2^2=5, C_3=20, R_1^1=10, R_1^2=30, R_1^3=5, R_2=8, R_3=10, W=2, K1=5, K2=5, K3=5, K4=5, E=10. The simulation results are shown in Figure 2.

When $\mathrm{R}_1^3 - C_1^1 < R_1^1 - C_1^2, K_1 + K_4 - R_2 + C_2^1 > C_2^2, C_3 - R_3 < E$ is satisfied, the evolutionary game strategy approaches to point (0,0,1), and point (0,0,1) is the stable strategy of the evolutionary game model.

In equilibrium (1,1,1), that is, {the poor households participate actively, the network sales platform actively promote, the government monitor} stable state, Suppose C_1^1=10, C_1^2=5, C_2^1=15, C_2^2=20, C_3=20, R_1^1=10, R_1^2=30, R_1^3=5, R_2=8, R_3=10, W=2, K1=5, K2=5, K3=5, K4=5, E=10. The simulation is shown in Figure 3.

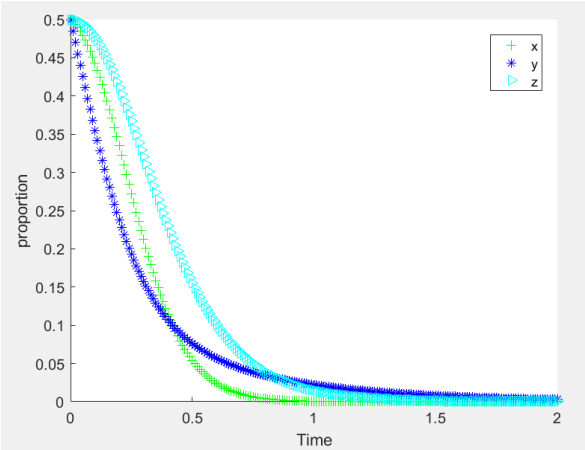

Figure 1: Equilibrium Point (0,0,0) simulation time-probability diagram

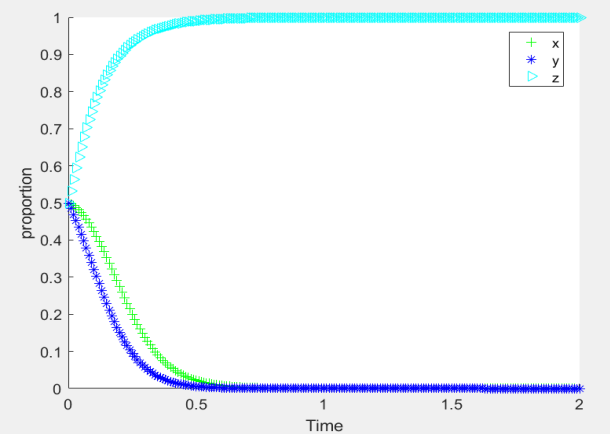

Figure 2: Equilibrium Point (0,0,1) simulation time-probability diagram

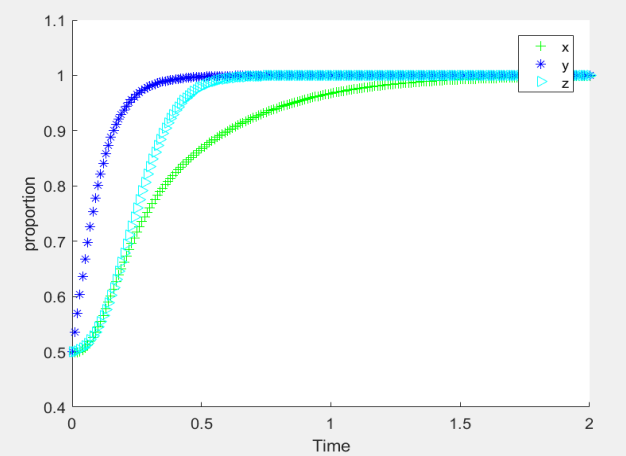

Figure 3: Equilibrium Point (1,1,1) simulation time-probability diagram

When $\begin{matrix} \mathrm{R}_1^2 - W - K_2 - K_3 - C_1^1 > R_1^1 - C_1^2, K_1 + K_4 - W + C_2^1 - R_2 \\ < C_2^2, -K_1 - K_2 - K_3 - K_4 - R_3 + C_3 < E \end{matrix}$ is satisfied, the strategy of the three-party evolutionary game eventually tends to point (1,1,1), and thus achieves a relatively stable state.

5. CONCLUSIONS AND RECOMMENDATIONS

According to the above evolutionary game simulation analysis, the behavior subject of the evolutionary game model, the poor households, the network sales platform, and the government adjust the strategy of each subject according to the change of the external factors, the change of external factors will affect the overall strategy choice, so that the three-party game evolved into a stable state. Based on the three-party evolutionary game model constructed in this paper, the following conclusions can be drawn from the data simulation analysis of stable points.

Firstly, in terms of all the evolutionary game stability strategies in this paper, the strategy choice of the main body of the evolution model is changed mainly by the change of the cost when the government chooses the strategy of supervision and the change of the cost when the network sales platform does not promote actively.

Secondly, for the poor households, when the poor households participate actively but do not promote the network sales platform, the income generated is smaller than the poor households do not participate in the income, the poor households tend to choose not to participate actively in the strategy; When the net income of the poor households is greater than the income generated when the poor households do not participate, the poor households tend to choose the strategy of active participation. If the choice probability is more than 50%, then choose the active participation strategy, if less than 50%, then more inclined to choose the non-active participation strategy.

Thirdly, as for the network sales platform, the potential losses caused by the active promotion of the network sales platform are compared with the costs incurred when the network sales platform does not actively promoted, when the poor households actively participate, if the loss is greater than the cost of no promotion, the network sales platform is more inclined to choose the strategy of no active promotion; otherwise, the strategic choice of the network sales platform should consider the rewards given by the poor households and the fines paid when violating the regulations. When the total potential loss is less than the cost when the network sales platform does not actively promote, it is more likely to choose the network sales platform to actively promote the strategy.

Fourthly, for the government, the cost of the government's choice of supervision determines the government's strategic choice. When the cost of government is less than the benefit and the positive influence, the government chooses the active supervision strategy, otherwise, the government chooses the secondary supervision strategy.

To sum up, any change in the main body of the evolutionary game model can only bring about some changes in evolution, and only when the changes are made jointly by the three parties can a win-win stable state be achieved, that the poor families were lifted out of poverty. Based on the analysis in this article, here are a few suggestions:

First of all, to reduce the cost of government supervision and the impact it has on society, most of the government's supervision costs include special poverty alleviation funds, etc.. The government should increase its policy-oriented support. Instead of providing subsidies, the government needs to fundamentally give poor households the opportunity to work, control the difference between the cost and the benefit of supervision, and conduct comprehensive assessments of different poor households, avoid mistakes.

Next, the network sales platform mainly acts as an intermediary between poor households and the market. Under the conditions of the market economy, the network helps the poor more by using big data to guide the poor households to share their advantages, can be better integrated with the Internet, so that the network to help the poor Pratt & Whitney in the poor, improve the poor and network sales platform between the interests of the mechanism. Ensure that the network sales platform and poor households sign a fair and just contract. At the same time, we can solve the employment problem of the poor people by selling the products of the poor areas and helping them from various angles.

Finally, poor households are the main part of the network to help the poor. At present, some people in poor areas do not have a strong sense of participation and do not fully grasp the ability of information technology. Therefore, to enhance the ability and awareness of the poor households, and the poor households to carry out professional technical training, improve the overall participation, and ultimately make the poor households better participate in the process of network poverty reduction.

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