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Research on the Evolutionary Game Theory of Integrating Data Mining and Motivating Social Capital to Participate in the Sichuan Shaanxi Revolutionary Old Area under the Rural Revitalization Strategy

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Abstract

The rural revitalization strategy has become a key link for China to expand poverty alleviation achievements and achieve common prosperity. Taking the revolutionary old areas of Sichuan as an example, data mining techniques are used to analyze county-level cases. Based on evolutionary game theory, a game model is constructed for the participation of local government, social capital, and residents of the revolutionary old areas in evolution. In the context of rural revitalization, numerical simulation research is conducted on the three party strategies and evolution conditions, as well as the behavioral evolution process under different strategy combinations. Based on the emergence of a large number of cases, selectively integrating data mining techniques can provide corresponding countermeasures and suggestions for local governments to protect local resources and environment, and achieve sustainable green development under the premise of rural revitalization.

Keywords: Rural revitalization, social capital, evolutionary game, old revolutionary base areas in Sichuan and Shaanxi, data mining.

1. Introduction

The Chinese government pointed out in the conference report that it is necessary to comprehensively promote rural revitalization, adhere to the priority development of agriculture and rural areas, and accelerate the construction of an agricultural strong country [1]. At present, the rural revitalization strategy has become an important strategic deployment for China to solve the "three rural issues" and achieve rural modernization, and is a key link in consolidating and expanding the achievements of poverty alleviation and achieving common prosperity. The Sichuan Shaanxi Revolutionary Old Area, as one of the second largest old areas during the Land Revolution War, is also one of the 12 key revolutionary old areas designated by the country, involving three provinces (municipalities directly under the central government) [2]: Sichuan, Shaanxi, and Chongqing. In order to support the accelerated development, construction, and poverty alleviation efforts in the old revolutionary areas of Sichuan and Shaanxi, the National Development and Reform Commission, together with Chongqing City, Sichuan Province, Shaanxi Province, and other relevant departments, jointly studied and formulated the "Revitalization and Development Plan for the Old Revolutionary Areas of Sichuan and Shaanxi" in August 2016. The goal of this plan is to improve the infrastructure of revolutionary old areas, promote industrial transformation and upgrading, increase the income level of farmers, and comprehensively develop rural social governance and ecological environment protection [3].

The research on the issues related to rural revitalization in the revolutionary old areas of Sichuan and Shaanxi mainly focuses on the following aspects: firstly, the methods and strategies for rural revitalization. The characteristic of the revolutionary old areas in Sichuan and Shaanxi should belong to the characteristic tourism industry. Yang et al. proposed that characteristic tourism can drive the infrastructure construction, economic development, and employment of residents in the revolutionary old areas [4], thereby achieving rural revitalization; Zhang et al. proposed to deeply explore the characteristic resources of the revolutionary old areas in Sichuan and Shaanxi, vigorously develop characteristic tourism, develop the advantages of characteristic resources, and then drive the economic development of the revolutionary old areas; Secondly, to cultivate and strengthen the advantageous characteristic industries in the revolutionary old areas of Sichuan and Shaanxi, mainly agriculture and advanced manufacturing. Chen [5] divided the methods of rural revitalization into four major systems, namely the construction of modern agricultural industries, production, management, and agricultural socialized services. Scholars have also proposed optimizing the industrial structure through industrial transformation [6-7], resource linkage and combination, selecting industrial development projects according to local conditions, exploring local characteristic resources, strengthening infrastructure construction, and ultimately achieving rural revitalization. The second is the main participants in rural revitalization. There are two main views on the relationship between the government and the market. One is that the government should not intervene in the market [8]; another view is that the government should actively participate in the market, combining proactive government with efficient markets. The essence of the debate between the two perspectives is still the issue of the boundary between the government and the market [9]. The former denies the existence of market failure, but social capital is profit oriented. In areas with weak economic foundations such as revolutionary old areas, the early development of rural industries requires a large amount of resources to be invested [10], and may face the risk of not being able to obtain expected output or even zero output. The willingness of capital to enter is not strong, and relying solely on the market to promote rural revitalization is very difficult. Therefore, under the strategy of rural revitalization, the government undoubtedly needs to play a guiding role, mainly by tilting policies and providing financial subsidies to local governments in revolutionary old areas. Green et al. [11] analyzed the diversified development of agriculture and pointed out that the government plays an irreplaceable role in rural revitalization. However, a single government model will also face financial pressure [12-13], technological shortcomings, low efficiency, and other issues. Therefore, it is urgent to establish a market-oriented mechanism, with marketization as the main body, and the government taking on the role of guidance and supervision [14]. Therefore, many scholars have studied the rural revitalization strategy under the public-private partnership (PPP) model and found that this model plays a good promoting role in rural environmental governance and infrastructure. Feng [15] constructed an evolutionary game model of government and enterprise investment, and analyzed the dynamics of the decision-making of both parties in depth. At the same time, Zhang [16] found that government regulatory strategies are necessary for the market mechanism of PPP model, which can prevent social capital speculation and overcome market failure problems [17]. The above scholars mainly study the relationship between government and social capital. Some scholars believe that local residents are the direct beneficiaries of rural revitalization, and their behavior should also be considered in terms of the impact on the revitalization results [18]. For example, Liu et al. [19] included the government, tourism enterprises, and tourists in a tripartite game model, believing that the government needs to set reasonable subsidies and punishments to promote low-carbon tourism. Wang et al. [20] further constructed a game model of four stakeholders: local government, tourism enterprises, local residents, and tourists. They found that local governments need to improve their supervision and management mechanisms and land compensation systems to enhance the income of local residents while promoting tourism. The third is the problem of rural revitalization. Scholars such as Xu et al. [21] have found that inadequate government management, unclear main responsibilities, incomplete market mechanisms, unsuitable governance technologies and models, and weak environmental protection awareness among farmers are the main reasons for the existence of many problems in rural living environments. Zhu [22] pointed out that rural development has long been limited by the fixed thinking of prioritizing cities over rural areas, and rural revitalization is constrained by many institutional factors such as urban-rural talent mobility and public services. Li et al. [23] believe that the key element of rural revitalization is talent, and propose to strengthen the recruitment of outstanding talents, cultivate local talents, create a good talent environment, and also avoid talent loss through a series of government welfare policies; Rural revitalization and development still have a long way to go, and various situations such as

wastewater irrigation, exhaust gas emissions, and non-standard development can be found, posing huge hidden dangers to the local sustainable development. Therefore, rural revitalization and poverty alleviation cannot come at the cost of the environment. We must uphold the concept of green development and adhere to the principle of "green mountains and clear waters are as valuable as gold and silver".

In summary, scholars have conducted extensive research on the background, participants, and policy recommendations of rural revitalization, but there are still some shortcomings. Most literature considers the importance of rural revitalization, and any way of rural revitalization requires the participation of social capital. However, the entry of social capital has a dual nature, which may harm the local environment or waste resources while promoting local economic development. Most literature focuses on studying the economic benefits of social capital, with less discussion on the impact of social capital participation on the local environment and resources. Therefore, based on big data analysis, this article selects case studies of social capital county-level practices, and incorporates the regulatory role of local governments into the game system. At the same time, while modeling big data, the game system is also incorporated into the rural revitalization strategy. In order to construct a tripartite game model between local governments, social capital, and residents of revolutionary old areas, based on the evolutionary game theory of direct beneficiaries, namely residents of revolutionary old areas, and simulate the behavior strategy evolution process of the three in practice using MATLAB software, the cooperative game ideas between social capital, local governments, and residents of revolutionary old areas are explored, and suggestions for green and moderate development of revolutionary old areas under the rural revitalization strategy are proposed.

2. Model Assumptions and Construction

2.1 Problem description and hypotheses

In order to develop the game analysis between local government, social capital and residents of old revolutionary base areas, the following assumptions are made on the premise of ensuring the essence of the problem as much as possible:

Hypothesis 1: The subjects of the game pursue the maximization of their own benefits. There is incomplete information asymmetry in the game, and the three parties have limited rationality. The subjects involved in the decision making constantly learn and adjust the better strategy of expanding their own interests until the equilibrium state is reached.

Hypothesis 2: Assuming that the government's strategic space includes "guiding" and "not guiding", the probability of the government adopting a "guiding" strategy is ,The probability of adopting "no guidance" is ,The probability that social capital will consider various factors such as policy support, investment scale, and risk return to choose "moderate development" for the construction of the Sichuan Shaanxi Revolutionary Old Area is ,The probability of adopting an "excessive development" strategy is ,The probability of residents in revolutionary old areas choosing to "participate" in social capital investment projects is ,The probability of "not participating" is ,among.

Hypothesis 3: For local governments, while providing basic public services, they will also implement resource allocation and public governance through various policies and management regulations. As managers, local governments hope to encourage the development of rural revitalization without damaging the existing ecological environment, in order to achieve targeted poverty alleviation and rapid economic growth in rural areas as soon as possible. Therefore, the government will strictly control the business nature of investment enterprises. The government needs to pay guidance costs when choosing guidance, this mainly includes examining the qualifications and operating methods of investment enterprises. At the same time, when guided by the government, on the one hand, it will promote local characteristics, publicly release relevant information on local policies and development related to rural revitalization, and provide more references for social capital investment. Assuming the degree of openness is ,On the other hand, the upper limit of subsidies for social capital and tax exemptions is ,The subsidy intensity is ,So the subsidy amount is ,In addition, the entry of social capital brings basic benefits to local governments ,If social capital adheres to sustainable development strategies, protects local resources, and other behaviors bring benefits to local governments ,And when guided by the government, the degree of information disclosure can affect the entry of social capital and construction efficiency, and local governments

will have additional benefits ,Superior departments will also incentivize the guidance behavior of local governments.

Hypothesis 4: Regarding social capital, choosing "moderate development" construction requires investment and construction costs, and the investment base income will be obtained as, the investment and construction benefits of social capital are related to the government's disclosure of local development information, Information disclosure can effectively reduce investment risks of social capital and improve investment returns. Therefore, when the government discloses information, the returns of social capital are ,If social capital investment enterprises choose to "overdevelop" the rural revitalization construction in the revolutionary areas of Sichuan and Shaanxi, the cost of overdevelopment will be incurred ,It will also gain excessive development investment returns ,among ,At the same time, the excessive development of social capital causes economic losses to local governments ,But at the same time, when the government guides, it will discover excessive development behaviors such as waste of social capital resources and environmental pollution, and impose regulatory penalties on violations of social capital ,the punishment intensity is , the maximum penalty limit is.

Hypothesis 5: For residents of revolutionary old areas, they are the direct beneficiaries of social capital entering. Social capital can drive local economic development and provide employment opportunities. Therefore, residents of revolutionary old areas can choose to participate in the construction of social capital or not participate in local project construction. The basic benefits brought by the entry of social capital to the local area are ,If residents of revolutionary old areas participate in the construction of social capital, they will receive additional benefits such as wages ,At the same time, it will also supervise the investment and development behavior of social capital, and the supervision cost and participation cost are comprehensively recorded as ,If excessive development of social capital is discovered, residents of revolutionary old areas will hinder the further development of social capital, causing losses to social capital ,If the local government is in a non-guiding strategy at this time, residents of revolutionary old areas will report the local government's dereliction of duty to higher-level departments, resulting in a decrease in the credibility of the local government and a comprehensive punishment from higher-level departments ,When the local government actively guides and the residents of revolutionary old areas actively participate in and supervise social capital projects, they will receive incentives from the local government ,It is also possible that residents of the revolutionary old areas in Sichuan and Shaanxi may choose not to participate in the construction of social capital projects due to concerns about the impact of social capital on the normal living environment, and residents of the revolutionary old areas can only obtain basic income.

According to the above assumptions, the parameters and their meanings are shown in the Table 1 below.

Table 1 parameters and meanings.

Parameter	Meaning
C_1	The guiding cost of the local government
C_2	Social capital and appropriate development of investment in construction costs
C_3	Social capital excessive development investment construction cost
C_4	The cost of supervision for the residents in the old revolutionary base areas
E_1	The participation of social capital brings the basic benefits to local governments
E_2	The basic income of the moderate development of social capital
E_3	The benefits of the excessive development of social capital
E_4	The basic income that social capital brings to the old revolutionary base areas
E_5	Additional benefits from the participation of residents in the old revolutionary base areas
T	Additional benefits from local government guidance
F_1	Punishment of local governments for the excessive development of social capital
F_2	The loss caused by the excessive development of social capital to the development of local governments
F_3	Punishment imposed by higher departments for not guiding local governments
F_4	The residents of the old revolutionary base areas hinder the excessive development of social capital and the loss of social capital
R_1	Tax relief and subsidy caps for government guidance
R_2	Incentive from higher departments to local governments
R_3	The reward limit of local governments for the "moderate development" of social capital
R_4	Local government incentives to the residents of the old revolutionary base areas
α	Local government subsidies are
β	The degree of information disclosure when local government guidance
γ	Local governments should punish the excessive development of social capital

2.2 Model construction

According to the assumptions in the above section, the payment matrix of local government, social capital and residents of old revolutionary base areas is shown in the following Table 2:

Table 2 Payment matrix of the tripartite game model of local government-social capital-residents of old revolutionary base areas.

		Local government			
		Guide (x)		No guidance (1 − x)	
		Social capital		Social capital	
		Moderate development (y)	Over development (1-y)	Moderate development (y)	Over development (1-y)
Residents of old revolutionary base areas	Support (z)	$E_1 + R_2 + (1+\beta)T - \alpha R_1 - C_1 - R_4$, $(1+\beta)E_2 + \alpha R_1 + \mu R_3 - C_2$, $E_4 + E_5 + R_4 - C_4$	$E_1 + R_2 + \gamma F_1 - C_1 - F_2 - R_4$, $E_3 - C_3 - \gamma F_1 - F_4$, $E_4 + E_5 + R_4 - C_4$	$E_1 - \alpha R_1 + T$, $E_2 + \alpha R_1 - C_2$, $E_4 + E_5 - C_4$	$E_1 - F_2 - F_3$, $E_3 - C_3 - F_4$, $E_4 + E_5 - C_4$
	Nonsupport (1-z)	$E_1 + R_2 + (1+\beta)T - \alpha R_1 - C_1$, $(1+\beta)E_2 + \alpha R_1 - C_2$, E_4	$E_1 + R_2 + \gamma F_1 - C_1 - F_2$, $E_3 - C_3 - \gamma F_1$, E_4	$E_1 - \alpha R_1 + T$, $E_2 + \alpha R_1 - C_2$, E_4	$E_1 - F_2 - F_3$, $E_3 - C_3$, E_4

2.3 Evolutionary game model analysis

From the game payment matrix in Table 2, the expected benefits U_{11} for local governments to choose guiding strategies, the expected benefits U_{12} for choosing non guiding strategies, and the average benefits $\overline{U_1}$ for the government can be calculated separately. The dynamic equation dx/dt is replicated, and the specific solution is as follows:

$$\begin{aligned} U_{11} &= yz(E_1 + R_2 + (1+\beta)T - \alpha R_1 - C_1 - R_4) + y(1-z)(E_1 + R_2 + (1+\beta)T - \alpha R_1 - C_1) \\ &+ z(1-y)(E_1 + R_2 + \gamma F_1 - C_1 - F_2 - R_4) + (1-y)(1-z)(E_1 + R_2 + \gamma F_1 - C_1 - F_2) \end{aligned} \tag{1}$$

$$\begin{aligned} U_{12} &= yz(E_1 - \alpha R_1 + T) + y(1-z)(E_1 - \alpha R_1 + T) \\ &+ z(1-y)(E_1 - F_2 - F_3) + (1-y)(1-z)(E_1 - F_2 - F_3) \end{aligned} \tag{2}$$

And then, from there $\overline{U_1} = xU_{11} + (1-x)U_{12}$. Then, you can get:

$$\begin{aligned} F(x) &= dx/dt = x(U_{11} - \overline{U_1}) \\ &= x(1-x)[(-\gamma F_1 + \beta T - F_3)y - R_4 z + \gamma F_1 - C_1 + R_2 + F_3] \end{aligned} \tag{3}$$

Similarly, the expected U_{21} return for moderate development of social capital is U_{22}, the expected $\overline{U_2}$ return for choosing excessive development is, the average expected return is, and the replication dynamic equation is dy/dt.

$$\begin{aligned} U_{21} &= xz[(1+\beta)E_2 + \alpha R_1 + \mu R_3 - C_2] + x(1-z)[(1+\beta)E_2 + \alpha R_1 - C_2] \\ &+ z(1-x)(E_2 + \alpha R_1 - C_2) + (1-x)(1-z)(E_2 + \alpha R_1 - C_2) \end{aligned} \tag{4}$$

$$\begin{aligned} U_{22} &= xz(E_3 - C_3 - \gamma F_1 - F_4) + x(1-z)(E_3 - C_3 - \gamma F_1) \\ &+ z(1-x)(E_3 - C_2 - F_4) + (1-x)(1-z)(E_3 - C_3) \end{aligned} \tag{5}$$

$\overline{U_2} = yU_{21} + (1-y)U_{22}$ then, you can get:

$$\begin{aligned} F(y) &= dy/dt = y(U_{21} - \overline{U_2}) \\ &= y(1-y)[(\gamma F_1 + \beta E_2)x + F_4 z + \alpha R_1 + C_3 - C_2 + E_2 - E_3] \end{aligned} \tag{6}$$

Assuming that the residents of the revolutionary old areas choose to support the expected return U_{31}, choose not to support the expected return U_{32}, the average $\overline{U_3}$ return of the media, and replicate the dynamic equation as dz/dt

$$U_{31} = xy(E_4 + E_5 + R_4 - C_4) + x(1-y)(E_4 + E_5 + R_4 - C_4 \\ + y(1-x)(E_4 + E_5 - C_4) + (1-x)(1-y)(E_4 + E_5 - C_4) \quad (7)$$

$$U_{32} = xy(E_4) + x(1-y)(E_4) + y(1-x)(E_4) + (1-x)(1-y)(E_4) \quad (8)$$

$\overline{U_3} = zU_{31} + (1-z)U_{32}$ then, you can get:

$$F(z) = dz/dt = z(U_{31} - \overline{U_3}) = z(1-z)(R_4 x - C_4 + E_5) \quad (9)$$

2.4 Analysis of the tripartite evolution path

2.4.1 Analysis of local government evolution path

From the replication dynamic equation of the local government mentioned in the previous section, the game strategy adopted by the government has the following situations:

$G(y) = (-\gamma F_1 + \beta T - F_3)y - R_4 z + \gamma F_1 - C_1 + R_2 + F_3$

If $G(y) = 0$ so,then $y = y^* = \frac{-R_4 z + \gamma F_1 - C_1 + R_2 + F_3}{\gamma F_1 - \beta T + F_3}$

at this point,it means that regardless of which strategy the local government chooses,it belongs to a stable strategy and will not change over time,that is all x levels are evolutionary stable strategies (Evolutionarily Stable Strategy)ESS.

If $G(y) \neq 0, i.e. y \neq y^*, x_1 = 1 and x_2 = 0$ are two ESS,they can be further divided into the following situations:

(1) If $y^* < 0$, because $y \in [0,1]$, for any y, there exsist $G(y) < 0$, at that point $dF(x)/dx|_{x=0} < 0$,$x = 0$ is ESS and $y^* < 0$,At that time ,there was a relationship between the parameters,that is $-R_4 z + \gamma F_1 - C_1 + R_2 + F_3 < 0$, simple transformation $R_4 z + C_1 - \gamma F_1 - R_2 > F_3$ a can be obtained, indicating that, based on considering the selection strategy of local residents in the revolutionary old areas, the total cost of guidance and incentive costs for local governments to choose guidance was larger than the punishment imposed by higher-level departments when local governments did not guide. That is to say, for local governments, the benefits of choosing guidance were smaller than those of not guiding strategy. Therefore, local governments would choose not guiding strategy as an evolutionary stable strategy, which also confirms the conclusion of ESS. At this time, x=0 the lack of guidance from local governments, excessive development of social capital, and support from residents in revolutionary old areas are all ESS issues.

(2) If $0 < y^* < 1$ so, there are also two situations: one is that if $0 < y < y^*$, at this point $G(y) < 0$, $dF(x)/dx|_{x=1} < 0$ it is known, then $x = 1$it is ESS. At this point $R_4 z + C_1 - \gamma F_1 - R_2 < F_3$this situation is exactly opposite to the situation in (1). At this time, for local governments, the benefits of guiding are greater than those of not guiding the strategy. Therefore, $x = 1$ is local governments will choose guiding the strategy as an evolutionary stability strategy, hence ESS; Secondly, at that time $y^* < y < 1, dF(x)/dx|_{x=0} < 0$, $G(y) > 0, x = 0$ it is ESS. At the same time, $-\beta T - R_2 > -R_4 z - C_1$ use a simple transformation can be obtained $R_4 z + C_1 > \beta T + R_2$. The right side of R_2 the inequality represents the reward given by the superior department to the local government when guiding, and βT represents the additional benefits gained by the local government when disclosing information. The left side of the inequality represents the sum of the subsidy amount, reward amount, incentive and guidance costs for social capital when the local government chooses guidance strategies, which represents the total cost of the local government choosing guidance strategies. The left side of the inequality is greater than the right side, indicating that when the local government chooses guidance strategies, the expenditure

exceeds the income. Therefore, the local government is more inclined to choose non guidance strategies, which also $x = 0$ confirms the conclusion of ESS mentioned above.

(3) If $y^* > 1$, because $y \in [0,1]$, for any y, there exists $G(y) > 0$, at this point $dF(x)/dx|_{x=1} < 0$ $x = 1$. it is ESS. At this point According to the above analysis, the evolutionary phase diagram of local governments is as Figure 1 follows:

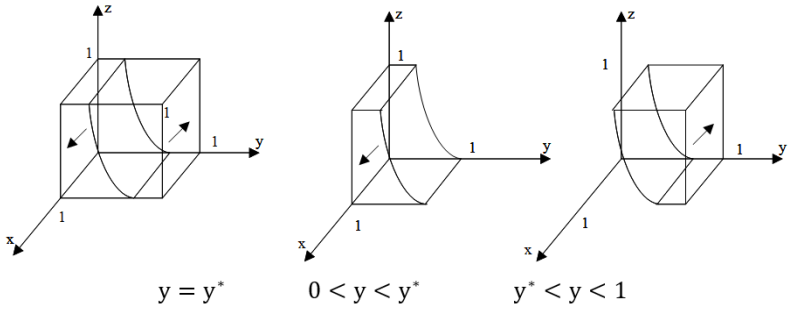


Figure 1 Evolution phase diagram of local governments

2.5 Analysis of the evolution path of social capital

According to the replication dynamic equation of social capital mentioned in the previous section $G(x) = (\gamma F_1 + \beta E_2)x + F_4 z + \alpha R_1 + C_3 - C_2 + E_2 - E_3$, the game strategies adopted can be divided into the following situations:

(1) If $G(x) = 0$, then $x = x^* = \frac{-F_4 z - \alpha R_1 + E_3 - E_2 + C_2 - C_3}{\gamma F_1 + \beta E_2}$, at this point $F(y) \equiv 0$, all y levels are ESS.

(2) If $G(x) \neq 0$, i.e.$x \neq x^*$, $y_1 = 1$ and $y_2 = 0$ are two ESS, they can be further divided into the following situations:

1) At that time $x^* < 0$, due to $x \in [0,1]$, For any x, there exists $G(x) > 0$,So at this point $dF(y)/dy|_{y=1} < 0$,$y = 1$, it was called ESS. And at that time $x^* < 0$, There is a relationship between parameters, namely $-F_4 z - \alpha R_1 + E_3 - E_2 + C_2 - C_3 < 0$,Simple deformation can be obtained $E_3 - C_3 - F_4 z < E_2 - C_2 + \alpha R_1$,This inequality indicates that when considering the support and supervision of residents in revolutionary old areas, the net benefit of social capital choosing excessive development is smaller than the net benefit of moderate development combined with the total subsidy from local governments. Therefore, social capital will choose moderate development as its evolutionary stability strategy, this also confirms the conclusion $y = 1$ of ESS.

2) If $0 < x^* < 1$, there are two situations: the first,when $0 < x < x^*$,$G(x) < 0$,here $dF(y)/dy|_{y=0} < 0$,Then $y = 0$ is ESS.At the same time, it can be known that $E_3 - C_3 - F_4 z > E_2 - C_2 + \alpha R_1$,At this point, the situation is exactly opposite to the situation in ① above, indicating that the net benefit of social capital choosing excessive development is greater than the net benefit of choosing moderate development strategy. Therefore, social capital will choose excessive development as the final evolutionary stability strategy, At the same time, it also confirms $y = 0$ that ESS.Secondly, when $x^* < x < 1$, $G(x) > 0$,here $dF(y)/dy|_{y=1} < 0$,Then $y = 1$ is ESS.Furthermore, it can be inferred that $-F_4 z + E_3 - E_2 + C_2 - C_3 < \gamma F_1 + \beta E_2 + \alpha R_1$,After transformation, it can be obtained that $E_2 - C_2 + \beta E_2 + \alpha R_1 > E_3 - C_3 - \gamma F_1 - F_4 z$,The above equation indicates that, considering the behavior of local governments and residents in revolutionary old areas, the net benefit of social capital choosing moderate development and the total benefit of local government subsidies are greater than the net benefit of the difference between the benefit and punishment when choosing excessive development. In short, the net benefit of social capital choosing moderate development is greater than the net benefit when choosing

excessive development. Therefore, social capital will choose moderate development behavior as its evolutionary stability strategy, at the same time, it also confirms that $y = 1$ ESS.

3) If $x^* > 1$, because $x \in [0,1]$, for any x, there exists $G(x) < 0$, at this point, it is ESS. At this point $dF(y)/dy|_{y=0} < 0$, $y = 0$ is the ESS of the game system is actively guided by local governments and the excessive development of social capital.

According to the above analysis, the evolutionary phase diagram of social capital is shown as Figure 2 follows:

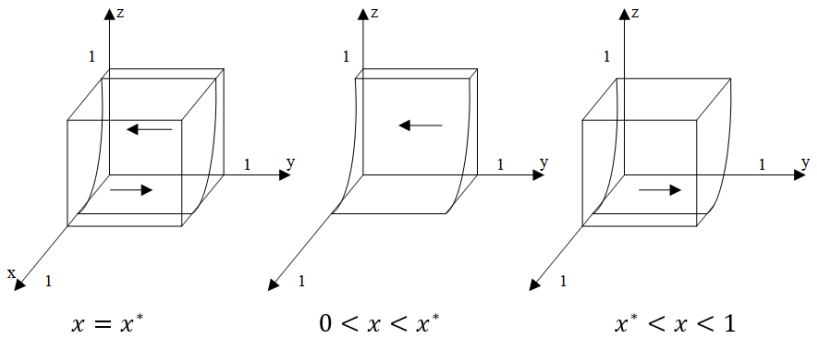


Figure 2 Phase diagram of the evolution of social capital

2.6 Analysis of the Evolutionary path of the old revolutionary base areas

According to the replication dynamic equation of the public, $G(x)=R_4 x-C_4+E_5$ there are several game strategies that the public can adopt:

(1) If $G(x) = 0$, then $x = x^* = \frac{C_4 - E_5}{R_4}$, at this point $F(z) \equiv 0$, it means that regardless of which strategy the public chooses, it belongs to a stable strategy and will not change over time, that is, all z levels are evolutionary stable strategy ESS.

(2) If $G(x) \neq 0$, i.e., $x \neq x^*$, $z_1=1$ and $z_2=0$ are two ESS, they can be further divided into the following situations:

1) If $x^* < 0$, because $x \in [0,1]$, for any x, there exists $G(x) > 0$, at this point $dF(z)/dz|_{z=1} < 0$, here $z = 1$is ESS. And at that time $x^* < 0$, there was a relationship between the parameters, $C_4 < E_5$,indicating that residents of revolutionary old areas chose to participate in social capital development projects with benefits greater than their participation costs. Therefore, they chose to participate in social capital project strategies, which also verified $z = 1$ ESS.

2) If $0 < x^* < 1$,there are two situations, the first one $0 < x < x^*$, that at that time $G(x) < 0$, $dF(z)/dz|_{z=0} < 0$,it is known that $z = 0$ is ESS, which is exactly the opposite of the situation in ①, that is, the cost for residents of revolutionary old areas to choose to participate is higher. Therefore, the evolutionary stability strategy for residents of revolutionary old areas is not to participate in social capital projects; The second type, when $x^* < x < 1$, at that time$G(x) > 0$, $dF(z)/dz|_{z=1} < 0$,$z = 1$ is ESS, and it can be inferred from a simple transformation that $R_4 > C_4 - E_5$, on the basis of considering $R_4 + E_5 > C_4$,the reward policies of local governments, the benefits of participating in social capital projects for residents of revolutionary old areas are greater than their participation costs. Therefore, revolutionary old areas are more inclined to choose participation strategies, which also confirms the conclusion of $z = 1$ESS mentioned above.

3) At that time, $x^* > 1$, due to $x \in [0,1]$, for any x, there exists $G(x) > 0$, so at this point $dF(z)/dz|_{z=0} < 0$, z=0 was called ESS. At this time $R_4+E_5<C_4$, social capital is moderately developing and the revolutionary old areas do not support.

According to the above analysis, the evolutionary phase diagram of the old revolutionary base area is shown as Figure 3 follows:

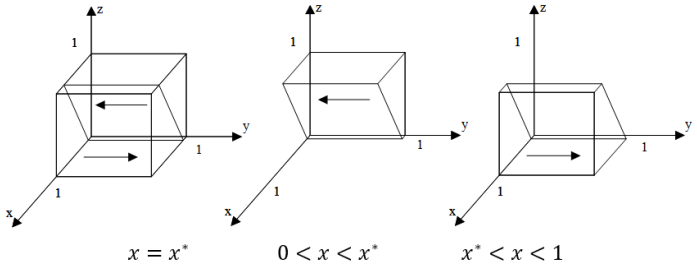


Figure 3. Evolution phase diagram of resident strategies in revolutionary old areas

3. Analysis of Stable and Equilibrium Points

From $F(x) = 0, F(y) = 0, F(z) = 0$, it can obtain the system equilibrium point as follows:

$E_1(0,0,0), E_2(1,0,0), E_3(1,1,0), E_4(0,0,1), E_5(0,1,1), E_6(0,1,0), E_7(1,0,1), E_8(1,1,1)$ and $E_9(x^*, y^*, z^*)$, Among them, E_1— E_8 is a pure strategy,$E_9(x^*, y^*, z^*)$ just a hybrid strategy that satisfies $F(x) = 0, F(y) = 0, F(z) = 0$. According to the copied dynamic equation $F(x)$、$F(y)$、$F(z)$, the Jacobian matrix can be obtained as follows:

$$J = \begin{bmatrix} \frac{\partial F(x)}{dx} & \frac{\partial F(x)}{dy} & \frac{\partial F(x)}{dz} \\ \frac{\partial F(y)}{dx} & \frac{\partial F(y)}{dy} & \frac{\partial F(y)}{dz} \\ \frac{\partial F(z)}{dx} & \frac{\partial F(z)}{dy} & \frac{\partial F(z)}{dz} \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \tag{10}$$

The values in the matrix that can be calculated are respectively:

$a_{11} = (1 - 2x)[(-\gamma F_1 + \beta T - F_3)y - R_4 z + \gamma F_1 - C_1 + R_2 + F_3]$

$a_{12} = x(1 - x)(-\gamma F_1 + \beta T - F_3)$

$a_{13} = x(1 - x)(-R_4)$

$a_{21} = y(1 - y)(\gamma F_1 + \beta E_2)$

$a_{22} = (1 - 2y)[(\gamma F_1 + \beta E_2)x + F_4 z + \alpha R_1 + C_3 - C_2 + E_2 - E_3]$

$a_{23} = y(1 - y) \cdot F_4$

$a_{31} = z(1 - z) \cdot R_4$

$a_{32} = 0$

$a_{33} = (1 - 2z)(R_4 x - C_4 + E_5)$

According to the first rule of Lyapunov, all eigenvalues of the Jacobian have a negative real part, then the equilibrium point is a gradual stability point; if the eigenvalue of the Jacobian has a positive real part, the equilibrium point is an unstable point; the other cases cannot determine the stability of the equilibrium point. The eigenvalues and stability judgment of each equilibrium point are shown in Table 3.

Due to all parameters in the model being greater than 0 and assuming that the equilibrium point E_1, E_4, E_5, E_7, E_3does not satisfy Lyapunov stability theory, it can be directly excluded. So, by analyzing the stability of the equilibrium point below E_2, E_6, E_8, the following situations can be obtained:

Condition A: When $\gamma F_1 - C_1 + R_2 + F_3 > 0, \gamma F_1 + \beta E_2 + \alpha R_1 + C_3 - C_2 + E_2 - E_3 < 0, R_4 + E_5 - C_4 < 0$, there are stable points $E_2(1,0,0)$ in the tripartite evolution system.

Table 3 System equilibrium point eigenvalues and stability judgments.

Equantequation	Eigenvalue$(\lambda_1, \lambda_2, \lambda_3)$	Result	Condition for stability
$E_1(0,0,0)$	$\gamma F_1 - C_1 + R_2 + F_3$, $\alpha R_1 + E_2 - C_2 - (E_3 - C_3)$, $E_5 - C_4$	Instability	\
$E_2(1,0,0)$	$-(\gamma F_1 - C_1 + R_2 + F_3)$, $\gamma F_1 + \beta E_2 + \alpha R_1 + C_3 - C_2 + E_2 - E_3$, $R_4 + E_5 - C_4$	ESS	A
$E_3(0,1,0)$	$\beta T - C_1 + R_2$, $E_3 - C_3 - (E_2 - C_2) - \alpha R_1$, $-C_4 + E_5$	Instability	\
$E_4(0,0,1)$	$-R_4 + \gamma F_1 - C_1 + R_2 + F_3$, $F_4 + \alpha R_1 + E_2 - C_2 - (E_3 - C_3)$, $C_4 - E_5$	Instability	\
$E_5(1,1,0)$	$C_1 - R_2 - \beta T$, $-(\gamma F_1 + \beta E_2 + \alpha R_1 C_3 - C_2 + E_2 - E_3)$, $R_4 - C_4 + E_5$	Instability	\
$E_6(1,0,1)$	$R_4 - \gamma F_1 + C_1 - R_2 - F_3$, $\gamma F_1 + \beta E_2 + \alpha R_1 + F_4 + C_3 - C_2 + E_2 - E_3$, $C_4 - R_4 - E_5$	ESS	B
$E_7(0,1,1)$	$\beta T - C_1 + R_2 - R_4$, $E_3 - C_3 - (E_2 - C_2) - F_4 - \alpha R_1$, $C_4 - E_5$	Instability	\
$E_8(1,1,1)$	$C_1 + R_4 - R_2 - \beta T$, $-(\gamma F_1 + \beta E_2 + \alpha R_1 + F_4 + C_3 - C_2 + E_2 - E_3)$, $C_4 - R_4 - E_5$	ESS	C
$E_9(x^*, y^*, z^* z^*)$		Saddle point	Any condition
Condition A:$\gamma F_1 - C_1 + R_2 + F_3 > 0, \gamma F_1 + \beta E_2 + \alpha R_1 + C_3 - C_2 + E_2 - E_3 < 0, R_4 + E_5 - C_4 < 0$;			
Condition B:;$R_4 - \gamma F_1 + C_1 - R_2 - F_3 < 0$, $\gamma F_1 + \beta E_2 + \alpha R_1 + F_4 + C_3 - C_2 + E_2 - E_3 < 0, C_4 - R_4 - E_5 < 0$			
Condition C:$C_1 + R_4 - R_2 - \beta T < 0, \gamma F_1 + \beta E_2 + \alpha R_1 + F_4 + C_3 - C_2 + E_2 - E_3 > 0, R_4 - C_4 + E_5 > 0$.			

Proof: According to Table 3, when only the parameters in condition A have this relationship, the corresponding three eigenvalues of the Jacobian matrix are all less than 0, so $E_2(1,0,0)$ is an evolutionary stable equilibrium point.

From condition A, w*h*en $\gamma F_1 - C_1 + R_2 + F_3 > 0$ then, Simple deformation $F_3 > C_1 - R_2 - \gamma F_1$, It means that the higher authorities will impose greater penalties when they do not guide the local government, Greater than the guiding cost of the guidance of the local government minus the subsidy amount of the higher department and deducting the net cost of the penalty for the excessive development of social capital, So local governments will tend to choose guiding strategies; For social capital,$\gamma F_1 + \beta E_2 + \alpha R_1 + C_3 - C_2 + E_2 - E_3 < 0$, Which can be transformed $\beta E_2 + \alpha R_1 + E_2 - C_2 < E_3 - C_3 - \gamma F_1$The left side of the inequality shows that the net income of social capital when it chooses moderate development plus the total income such as local government subsidies is less than the net income of excessive development after the local government penalties it, That is, the net income of the excessive development of social capital is greater than the net income of the moderate development, So the social capital chooses the over-development strategy; For the old revolutionary base areas, $R_4 + E_5 - C_4 < 0$, Indicating that the cost of participating in the revolutionary old areas is relatively high, Greater than the benefits of its participation and the rewards from the local government, So it will eventually choose not to participate in the strategy. The stability point $E_2(1,0,0)$ is proved to be.

Condition B: When $R_4 - \gamma F_1 + C_1 - R_2 - F_3 < 0, \gamma F_1 + \beta E_2 + \alpha R_1 + F_4 + C_3 - C_2 + E_2 - E_3 < 0, C_4 - R_4 - E_5 < 0$, there were stable points $E_6(1,0,1)$ existing in the tripartite evolution system.

Proof: According to Table 3, the eigenvalue of the Jacobian matrix is less than 0 only when the parameters in condition B have this relationship, so it is an evolutionary stable equilibrium point $E_6(1,0,1)$.

From condition B, it can be seen that at that time $R_4 - \gamma F_1 + C_1 - R_2 - F_3 < 0$, that is $C_1 + R_4 - R_2 - \gamma F_1 < F_3$, it can be seen that the punishment amount of the superior department for not guiding the local government is relatively large, which is greater than the punishment for excessive development of social capital when the government chooses to guide, as well as the net cost of income obtained from rewards from the superior department. Therefore, the stability strategy of the local government is the guiding strategy; As for social capital, at that time $\gamma F_1 + \beta E_2 + \alpha R_1 + F_4 + C_3 - C_2 + E_2 - E_3 < 0$, after transformation $\beta E_2 + \alpha R_1 + E_2 - C_2 < E_3 - C_3 - \gamma F_1$, it can be concluded that when social capital chooses excessive development, its net income is greater, so social capital will choose excessive development strategies; For residents of revolutionary old areas, at that time $C_4 < R_4 + E_5$, participating in social capital investment projects on behalf of revolutionary old area residents had higher returns, so revolutionary old area residents would choose participation strategy as a stable strategy. Stable point E_6 (1,0,1) has been proven.

Condition C: At that time, $C_1 + R_4 - R_2 - \beta T < 0, \gamma F_1 + \beta E_2 + \alpha R_1 + F_4 + C_3 - C_2 + E_2 - E_3 > 0, R_4 - C_4 + E_5 > 0$ there were stable points existing in the tripartite evolution system $E_8(1,1,1)$.

Proof: According to Table 3, it can be seen that only when the parameters in Condition C have this relationship, the corresponding Jacobian matrix E_8 eigenvalues are all less than 0, so $E_8(1,1,1)$ is an evolutionary stable equilibrium point.

From condition c, it can be seen that at that time $c_1 - r_2 + r_4 - \beta t < 0$, after transformation $c_1 + r_4 < r_2 + \beta t$, it can be concluded that the total additional benefits represented by the superior's incentives for local government guidance behavior and the disclosure of policy information are relatively large, which is greater than the cost of choosing guidance strategies and the sum of rewards for residents of revolutionary old areas. Therefore, local governments choose guidance strategies; as for social capital, when $\gamma f_1 + \beta e_2 + \alpha r_1 + f_4 + c_3 - c_2 + e_2 - e_3 > 0$, it can be further inferred $\alpha r_1 + (1+\beta)e_2 - c_2 > e_3 - c_3 - \gamma f_1$ that the left side of the inequality represents the moderate development net benefit obtained by deducting the moderate development cost from subsidies and rewards provided by local governments under the guidance of local governments, while the right side represents the net benefit obtained by subtracting the punishment imposed by local governments from the benefits obtained during excessive development of social capital. It can be inferred that the net benefit of moderate development of social capital is greater than that of excessive development. Therefore, social capital will ultimately choose a moderate development strategy; for residents of revolutionary old areas, at that time $r_4 - c_4 + e_5 > 0$, a simple transformation $r_4 + e_5 > c_4$ indicates that the benefits and rewards from local governments when choosing to participate in social capital investment projects are greater than the cost of participation. Therefore, residents of revolutionary old areas tend to choose participation strategies. Stable point $e_8(1,1,1)$ has been proven.

4. Simulation Analysis

4.1 Initial assignment of the parameter

The above only from the theoretical analysis of the model cannot directly reflect how the parameters in the game affect the evolutionary stability of the system, so to verify the effectiveness of the evolutionary stability analysis, combined with relevant literature [12] $\alpha, \beta, \gamma \in \Omega(0.2,0.5,0.8)$, The article sets the local government subsidy, information disclosure and punishment at three levels of low, medium and high, and the corresponding parameters. On this basis, combined with the policy documents released by the government and expert opinions, the parameters in the model are assigned specific values, and carries out numerical simulation using Matlab 2016a. The initial assignment is shown in the Table 4 below:

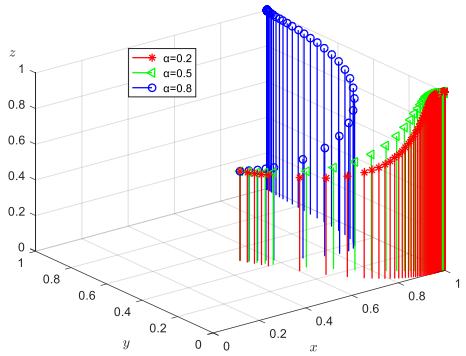
Table 4 Parameter assignment table

Parameter	E_2	E_3	E_5	R_1	R_2	R_3	R_4	C_1	C_2	C_3
Assignment	10	30	3	10	9	10	7	8	5	8
C_4	F_1	F_3	F_4	T	α	β	γ	x	y	z
6	5	4	4	15	0.5	0.5	0.5	0.5	0.5	0.5

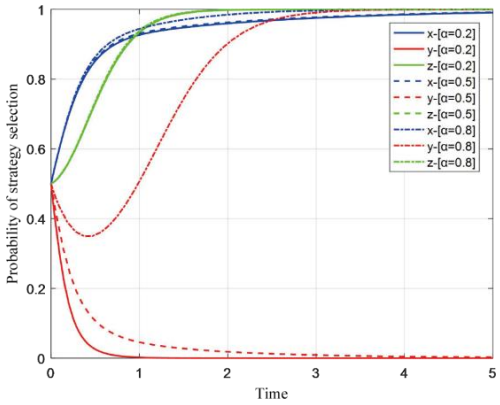
4.2 Sensitivity analysis

(1) The influence of local government subsidies α on the game results

The values of α are 0.2,0.5 and 0.8 respectively correspond to the subsidies of local governments for social capital, and the corresponding evolutionary game results are shown in the Figure 4 below:



(A) The systematic evolution path of local government subsidies α



(B) Sensitivity analysis chart of local government subsidy intensity α

Figure 4 Analysis chart of the intensity of local government subsidies to enterprises α

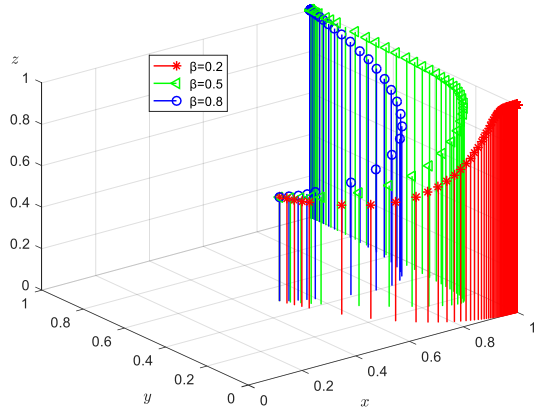
As shown in Figure 4 (B) above blue characteristic and green represent the strategic evolution process of the local government, social capital and the residents of the old revolutionary base areas, respectively. As can be seen, The intensity of local government subsidies has the greatest impact on the strategic choice of social capital, When the intensity of local government subsidies α for social capital investment is 0.2 or 0.5, The probability of strategy selection of social capital gradually evolved from the initial 0.5 over time to 0, This means that the ultimate evolutionary stability strategy of social capital is an overdevelopment strategy, This is because local governments provide low subsidies for the moderate development of social capital, And social capital chooses excessive development with a large profit space, Even on the basis of the local government penalties for its overdevelopment, The net income from overdevelopment is still greater than the income from moderate development, So it will choose an overdevelopment strategy, The system evolutionary stability points (1, 0,1) at this time are shown in Figure 4 (A); And if the policy environment is good, Local governments to improve their rural revitalization strategies, And greater subsidies for social capital, When the subsidy is 0.8, It can be found that the strategy selection probability of social capital gradually evolves from 0.5 to 1, This means that the ultimate evolution and stability strategy of social capital is a moderate development strategy, And the government's ultimate evolutionary stability strategy is also to actively guide the entry of social capital, At this point, judging

from Figure 4 (A), The system evolution and stabilization strategy is (1, 1,1). At the same time, also can be further found from the Figure 4, local government subsidies α maximum 0.5 compacharacteristic to 0.2, the evolution of social capital to excessive development strategy is longer, and evolution to the rate of excessive development is slower, this is because local government subsidies directly affect the social capital investment income, the corresponding subsidies, the better, the social capital can comply with the local policy moderate development, on the other hand, social capital to capital as soon as possible will choose violence development, excessive development, so for social capital, take action to implement excessive development strategy, it also accord with the actual cognition.

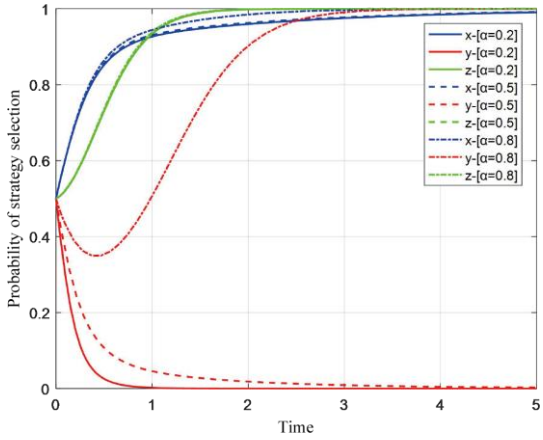
The final evolutionary strategy of the place can be seen by the blue line, For the local governments, When the subsidies for the moderate development of social capital are 0.2,0.5 and 0.8, The probability of strategy choice of local governments is all changed from 0.5, Over time and gradually evolved to 1, This shows that the final evolutionary stability strategy of local government under the three subsidies is to guide social capital to invest and develop old revolutionary base areas, Also, it can be seen that, At the maximum subsidy level of 0.8, Local governments tend to guide them for the shortest time, The fastest rate, That is, the intensity of subsidies is in proportion to the time when local governments choose the guidance strategy, This is because local governments also assume regulatory responsibility when guiding, When the subsidies are strong, Local governments pay a large cost in rural revitalization projects, So it is even more necessary to strictly regulate the development mode of social capital, So it tends to guide strategies faster.

(2) The influence of local government information disclosure β on the game results

The values of β 0.2,0.5 and 0.8 respectively correspond to the local government publicity and information disclosure intensity, and the corresponding evolutionary game results are shown in the Figure 5. below:



(A) Systematic evolution path of local government information disclosure β intensity



(B) Sensitivity analysis of local government information disclosure β intensity

Figure 5 Analysis chart of the intensity of local government information disclosure β

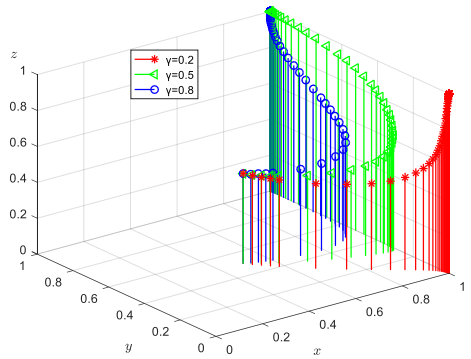
As shown in Figure 5 (A) above, the information disclosure intensity β of local governments has a great impact on the final stability strategy of the evolutionary game system. When the information disclosure intensity is low to 0.2, the system evolution stability point is (1,0,1), with the guidance of local government, excessive development of social capital and the participation of residents of old revolutionary base areas; while the information disclosure intensity of local government is 0.5 or 0.8, the evolution stability point of the system is (1,1,1), when the local government guidance, social capital development and the residents of old revolutionary base areas participate in the social capital project.

As shown in Figure 5 above, The degree of policy information disclosure of local governments to local old revolutionary base areas directly affects the strategic choice of local governments, Under three different levels of information disclosure, The strategy selection probability all evolves from 0.5 over time to 1, This represents the final evolutionary stabilization strategy of local government as the guided strategy, While it can further be found that, The greater the information disclosure βefforts made by local governments, Which tends to shorter the time to choosing the guide strategy, The faster the rate is, This is because, on the one hand, the policies of information disclosure in old revolutionary base areas affect the benefits of local governments, The greater the information disclosure β is, The greater the benefits of local government, So it will choose the guide strategy faster, on the other hand, The information disclosure is too large, The more transparent the information is, the more conducive to the "opportunistic" behavior of social capital, So local governments need to actively guide and regulate the development mode of social capital, In order to avoid the excessive development of social capital behavior.

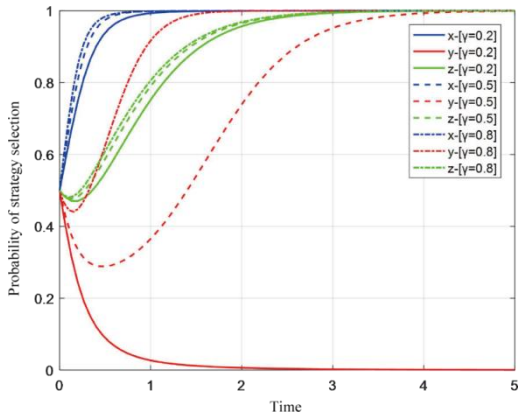
For the social capital, The information disclosure intensity of the local government has a great influence on the strategy choice of the social capital, It can be found that when the local government information disclosure intensityβ is lower than 0.2, Social capital gradually evolves from an initial probability of 0.5 to 0 over time, This represents that social capital ultimately chooses the over-development strategy, As local governments more publicize local policies and investment information in old revolutionary base areas, Social capital has gradually evolved to a moderate development strategy, And the greater the intensity of local government information disclosure β is, The shorter the time when social capital tends to moderate development, The faster the rate is, It can also be seen from the Figure 5. that even when the intensity of information disclosure is 0.5 or 0.8, There was still a trend towards overdevelopment strategy, This is because the openness of local governments on local investment and subsidy policies directly affects the returns of social capital, Even if the disclosure of information is high, But the interests of violent exploitation, excessive development are high, So social capital was still initially more inclined to choose overdevelopment strategies, So local governments don't just disclose information and provide subsidies, And more of a regulatory role, To punish the excessive development of social capital, As a deterrent effect, Eventually, social capital will evolve to a moderate development strategy. For the old revolutionary base areas residents, the local government information disclosure influence on the final strategy choice, but affect the stability of the stable strategy selection rate, from the old revolutionary base areas evolution path can be found, the greater the local government information disclosure, the old revolutionary base area residents choose to participate in the social capital project rate the faster, From the evolutionary path of the revolutionary old areas in Figure 5 (B), it can be observed that, this is because the old revolutionary base areas residents are the direct beneficiaries of social capital investment, information publicity, the probability of social capital choice moderate development also bigger, so the local residents will support social capital project, actively participate in the project. The stability strategies of the local government and the residents of the old revolutionary base area are the guiding strategy and the participation in the project construction, respectively. From Figure 5 (A), the stability point of the system evolution at this time is (1,0,1).

(3) The impact of the local government's punishment γ for the excessive development of social capital on the game results

The values of γ are 0.2,0.5 and 0.8 respectively will correspond to the punishment intensity of local governments for the excessive development of social capital, and the corresponding evolutionary game results are shown in the Figure 6 below:



(A) Systematic evolution path of local governments' penalties γ for excessive development of social capital



(B) Sensitivity analysis of the punishment intensity γ of local governments for the excessive development of social capital

Figure 6 Analysis chart of local governments' penalties γ on social capital

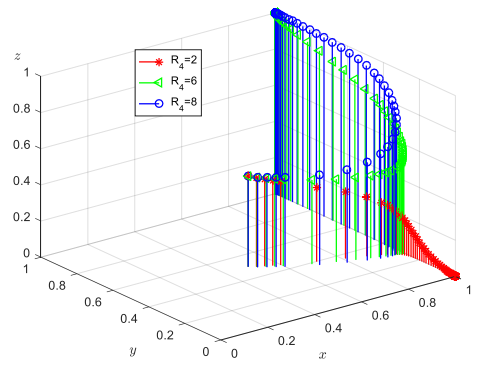
As shown in Figure 6 (A) above, when the penalty of local government $\gamma$for excessive development of social capital is 0.2, the stability point of the system is (1,0,1), showing the guidance of local government, excessive development of social capital and the participation of the old revolutionary base area; As the penalty increases to 0.5 or 0.8, the stability point of the system is (1,1,1), at this time the local government guidance, the moderate development of social capital, and the participation of residents of the old revolutionary base areas in social capital projects.

For Figure 6 (B), For the local governments, Although the punishment of local governments for excessive development of social capital has little impact on their own final strategy, But also affects the rate of its tendency to be an evolutionary stabilization strategy, As it can be found, Under three different levels of penalties γ, The final strategy choice of local governments is all guiding strategies, But the greater the penalty γ, The faster local governments tend to choose a guided strategy, This is because penalties γ for excessive development of social capital also affect the benefits of local governments, The greater the start effort, The greater the penalty for social capital, At the same time, the greater the benefits of local government, So it will choose a guide policy faster. For the social capital, The severity of the local government's punishment for its excessive development has an obvious impact on its final strategy choice, Mainly reflected when the penalty is small at 0.2, The probability of strategy selection of social capital gradually evolves from 0.5 over time to 0, The final strategy representing social capital was chosen for violent development, Over development strategies, This is because the penalties $\gamma$for excessive development of social capital are small, It means that social capital, taking into account being punished by local governments, Profit margins are still very large, So it will take the risk of over development; When local governments raise the penalties γ for the excessive development of social capital to 0.5 or 0.8, The final strategy selection probability of social capital tends to be 1, That is, to choose moderate development; And it can further be found that, The greater the penalties γ of local governments for the excessive development of social capital,

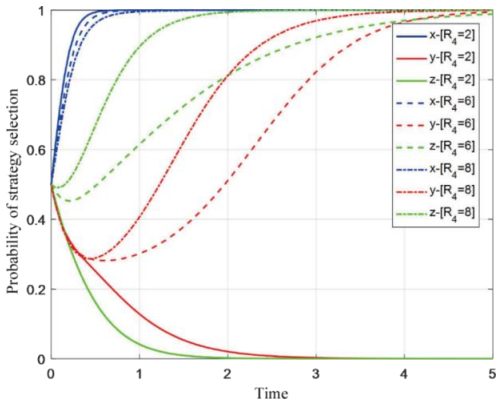
Social capital has evolved to 1, That is, the shorter the time to choose moderate development, The faster the rate is, This is because the penalties γ of local governments on social capital will directly affect the profits of social capital, Higher penalties γ will certainly compress the profit margins for the excessive development of social capital, So the greater the penalty is, The shorter the time that social capital tends to choose moderate development, This is also a practical phenomenon. For the residents of the old revolutionary base areas, the punishment of the local government on the excessive development of social capital has little impact on the choice of the final strategy. As can be found from the Figure 6, when the punishment is 0.2,0.5 or 0.8, the ultimate evolution and stability strategy of the residents of the old revolutionary base areas is to participate in the social capital project.

(4) The influence of the local government's reward $\boldsymbol{R_4}$ amount to the residents in the old revolutionary base areas on the game results

The values of R_4 are 2,6 and 8 respectively correspond to the local government rewards to the residents of the old revolutionary base area, and the corresponding evolutionary game results are shown in the Figure 7 below:



(A) Evolutionary path diagram of local government rewards R_4 to residents in old revolutionary base areas



(B) The sensitivity analysis of local governments to the rewards $\boldsymbol{R_4}$ of residents in old revolutionary base areas

Figure 7 Analysis of the rewards $\boldsymbol{R_4}$ of residents in old revolutionary base areas

As shown in Figure 7 (A) above, when the reward R_4 amount of the local government to the residents is 2, the stability point of the system is (1,0,0), which shows the local government guidance, excessive development of social capital and no participation of the residents of the residents to 6 or 8, the stability point of the system is (1,1,1), when the local government guidance, social capital develops moderately, and the residents of the old revolutionary base areas participate in the social capital project.

For Figure 7 (B), for local governments, under the three different rewards R_4 of residents in old revolutionary base areas, the final strategy choice of local governments is the guiding strategy, but the smaller the reward amount, the faster the local government tends to choose the guidance strategy. For social capital, the local government of the old revolutionary base areas residents reward R_4 influence on the final strategy choice is more

obvious, mainly reflected in when the reward R_4 is small for 2, social capital strategy selection probability from 0.50 as time changes to evolve, on behalf of the social capital final strategy choice for violence development, excessive development strategy. When the local government award for residents in the old revolutionary base areas is raised to 6 or 8, The final strategy selection probability of social capital tends to be 1, That is, to choose moderate development, And it can further be found that, The greater the local government awards to the residents of the old revolutionary base areas, Social capital has evolved to 1, That is, the shorter the time to choose moderate development, The faster the rate is, This is because local government incentives to residents in old revolutionary base areas can effectively increase residents' willingness to participate, At the same time, the residents of the old revolutionary base areas will also be consider characteristic as regulators when they participate, If it is found that the excessive development of social capital will hinder its development, Cause certain losses to social capital, So the greater the reward R_4 for the residents of the old revolutionary base areas, The shorter the time that social capital tends to choose moderate development, This is also a practical phenomenon. For the residents of the old revolutionary base areas, The amount of rewards R_4 from local governments for their active participation in social capital projects directly affects their earnings, Therefore, great influence on its final strategy choice, As can be seen from the Figure 7, When the reward R_4 amount was small to 2, Residents in the old revolutionary base area, while considering the cost of participation, The final evolutionary stabilization strategy is the non-participation strategy, As the reward R_4 amount gradually increases to 6 or 8 hours, The income of residents in old revolutionary base areas choosing to participate in social capital projects has increased, So its ultimate evolutionary stability strategy is to participate in social capital projects, At the same time, the greater the local government award amount, Residents in the old revolutionary base area tend to choose the shorter time and faster rate of the participation strategy.

5. Conclusion and Policy Recommendations

This paper uses the evolutionary game theory to analyze the strategy selection and evolution conditions of the local government, social capital and residents in old revolutionary base areas under the rural revitalization strategy, and applies Matlab for a numerical simulation study on the behavioral evolution process of the three parties under the combination of different strategies, and then draws the following conclusions.

(1) Local government subsidy policy for social capital plays an important role in the sustainable and moderate development of social capital. Social capital to the old revolutionary base areas investment risk, and local government subsidies to social capital can effectively characteristicuce the investment risk, promote the survival and development of investment projects, so social capital does not need violence development, excessive development, at the same time, local government subsidy policy can improve the enthusiasm of local residents to participate in the project, for the Sichuan-shan old revolutionary base areas development retain more backbone and the development of talent. On the other hand, if the local government subsidies are small, the investment risk of social capital is large, and the initial income cannot be guaranteed, the development and production will be illegal, causing damage to the local environment and waste of resources, and the improper development mode also characteristicuces the enthusiasm of local residents, resulting in the brain drain.

(2) The publicity of local governments on the old revolutionary base areas in Sichuan and Shaanxi and the disclosure of relevant rural revitalization policies can not only promote the entry and moderate development of social capital, but also promote the enthusiasm of local residents. The opening of local governments to local rural revitalization information improves the understanding of social capital on investment projects, and thus characteristicuces its investment risks. At the same time, the publicity of old revolutionary base areas can improve the local tourism economy, create a better market atmosphere, and promote the enthusiasm of local residents to participate.

(3) the local government of excessive development of social capital penalties can not only improve the enthusiasm of the moderate development of social capital, also to a certain extent, to promote the evolution of social capital, is conducive to social capital to the correct investment of Sichuan old revolutionary base areas, avoid high pollution, high waste environment adverse enterprises to enter, and the greater the punishment of local government, the faster the speed of the moderate development of social capital, for local residents participation

enthusiasm also play a role in promoting. However, if the local government has a weak supervision, less punishment for excessive development of social capital or dereliction of duty, and chooses not to guide strategies, social capital will produce "opportunism" behavior due to the high interests of excessive development, and then damage the resources and environment of the old revolutionary base areas in Sichuan and Shaanxi, which is not conducive to long-term sustainable development.

(4) The incentive of local governments to the residents of the old revolutionary base areas to actively participate in projects is not only an important factor to promote the residents of the old revolutionary base areas to participate in social capital investment projects, but also plays an important role in promoting the selection of appropriate development strategies of social capital. Reward the greater the more is conducive to retain local talents to participate in the construction of social capital, the old revolutionary base areas residents is not only the direct beneficiaries of the construction of social capital investment, but also a powerful supervisor of social capital development, so the old revolutionary base areas residents to participate in social capital project will also supervise its development mode, promote the moderate development of social capital. On the contrary, it not only leads to the loss of local talents, but also social capital will choose the excessive development strategy due to the lack of powerful supervisors.

According to the above research conclusions, this paper puts forward the following suggestions for the rural revitalization and development of Sichuan-Shaanxi old base areas.

(1) Local governments should strengthen the financial and tax policy support for social capital investment. As an important factor of the development of social capital, although the bigger the more conducive to social capital investment and moderate development, but high subsidies will increase the financial pressure of local government, so local governments should avoid direct fiscal subsidies or tax breaks, adhere to the market adjustment strategy, can guide the national policy Banks within the scope of risk control, maximum give special bonds of old revolutionary base areas social capital or ccharacteristicit business support, and set up industrial development funds, establish financing guarantee system, for the development of social capital investment provide financial services.

(2) Local governments should raise the publicity cost of the old revolutionary base areas in Sichuan and Shaanxi, improve the transparency of rural revitalization subsidies, taxes and other related policies, further attract the investment of social capital, promote their overall evaluation of the investment projects in the old revolutionary base areas, and then choose the appropriate development mode. At the same time, we should also believe that "good wine fragrance is afraid of deep alley". In the Internet era, we should vigorously enhance the publicity of the old revolutionary base areas of Sichuan and Shaanxi, create a unique rural brand effect, promote the economic development of the old Sichuan and Shaanxi revolutionary base areas, and further accelerate the speed of rural revitalization.

(3) Local governments should provide subsidies for social capital, A single subsidy policy or a single punishment measure is too unilateral for local governments, Local government subsidies will partly increase the enthusiasm of the development of social capital, But a single subsidy also breeds the "opportunism" of social capital, So it should be regulated and regulated by punishment strategies, Increasing penalties for the excessive development of social capital, Improve the punishment mechanism and timely eliminate traditional enterprises such as high pollution and high waste, To improve the overall quality of social capital in the old revolutionary base areas in Sichuan and Shaanxi, So that the residents of the old revolutionary base areas can live and work in peace and contentment, Slowing down the brain drain.

(4) Residents of the old revolutionary base areas are not only beneficiaries of rural revitalization, but also indispensable participants in the social capital investment and development projects, and also powerful supervisors of the development mode of social capital. So the local government to improve the participation of the old revolutionary base areas residents income, increase rural revitalization policy and social capital investment propaganda work, improve the participation of old revolutionary base areas residents, and perfect incentives, help to characteristicuce the loss of talent, promote the young and middle-aged stay in old revolutionary base areas local development, and improve the participation and encourage its supervision responsibility, and constraint the

development of social capital, at the same time also help to characteristicuce the regulatory pressure of local government regulation.

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