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Research on the Strategy of Information Resource Sharing between Governments in the Perspective of Game Theory

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Abstract

In order to improve the operational efficiency, the government can realize the streamlining policy through the mode of government information resource sharing. By building government information resources sharing, the government breaks the inter-departmental data island. The government realizes the development direction and trend of "Internet government". This paper also takes the information resource sharing as the game process between the government management department and the information resource sharing body, and analyzes the policy and suggestion of the information resource sharing in the perspective of game theory by constructing the sharing model of the government information resource in the perspective of game theory.

Keywords

Government Information, Resource Sharing, Evolutionary Game, High Efficiency, Strategy Research

1. Introduction

In the network service management mode, the government information resource is the basic content. How to make the public data resources open, how to set up the information sharing platform, and how to build the digital barrier between the government departments and the departments is the urgent problem that all countries need to solve. It has aroused the great attention of all countries. The academic and political circles have studied this aspect deeply, but the level of information resource sharing of governments at all levels is not high, there are phenomena such as information black hole, Information Island and so

on. Therefore, local governments set up full-time management departments to manage information resource sharing. The interests and rights of both parties are maintained through the establishment of a long-term and effective mechanism. Therefore, the long-term mechanism of information resource sharing should be built according to the mode and current situation of information resource sharing among local governments and the profit and loss between the government management department and the sharing subject. This is not only the goal of the current stage, but also an important consideration at this stage.

2. Current Researches Status of Government Information Resource Sharing

At present, more and more experts and scholars have studied the government information resource sharing and formed some achievements. The existing research results mainly cover the analysis of the influencing factors of government information resource sharing and the shared implementation path: Research on influencing factors. On the one hand, from the theoretical research, the existing research mainly through the analysis of China's current situation and domestic and foreign related research on the impact of government information resource sharing factors mainly include dynamic factors, supporting factors, organizational factors, resource factors, cognitive factors, etc. [1] [2]. On the other hand, from the empirical research, scholars with the help of factor analysis, grey fuzzy theory, Sem Model and other methods on the basis of theoretical research on the government information resources to share the impact of empirical analysis, and further build the impact factor model [3] [4]: Research on shared paths. First, in the policy legislation level, the government information resources sharing needs to establish the corresponding policy and the legislation in the information public legislation, the information quality management, the information resources development and so on the effective safeguard [5]. Second, the existing research thinks that the information resource sharing standard system should cover five aspects. Five aspects include data element standard, information classification coding standard, User view standard, concept database standard and logical database standard [6]. Third, the implementation of strategic Research. Department analyzes the current situation of China, the author designs the corresponding management system, policy and regulation, market mechanism to speed up the sharing of government information resources [7]; Other scholars have studied the government information resource sharing strategy through the qualitative analysis framework such as electronic governance strategy and knowledge management concept [8] [9].

In addition, the current academic research based on theoretical empirical analysis has been heating up, the scope of research has been expanding; game theory has gradually begun to be used in the study of information sharing. However, the relevant research fields in information sharing are mainly distributed in library information resources. Source sharing, scientific and technolo-

gical resource are sharing and information are sharing among enterprises [8] [9], but the result of applying game theory to Government information resource sharing is not rich, so it needs to be further studied.

Combing the existing research achievements of the academic circle, we find that the research of government information resource sharing focuses more on policy regulation, sharing standard and current countermeasure, while there are some achievements in the design of shared mechanism, but these researches are based on the qualitative description of analytical framework. Lacking of the use of theoretical empirical analysis means to the government information resources sharing behavior in-depth analysis. At present, the empirical analysis of information sharing is generally based on game theory, while the application of evolutionary game theory in information sharing is more mature, but it has less application in Government information resource sharing. In view of this, this paper constructs a model of government information resource sharing from the perspective of evolutionary game, probes into the evolutionary stability strategy of government information resource sharing by establishing the corresponding dynamic copy equation, and puts forward some policy suggestions to promote the integration of government information resources.

3. The Foundation of Evolutionary Game Modeling

Under the assumption that both sides of the game are bounded rationality, the game between groups with a certain scale cannot be found by only one time. It needs to be improved and imitated until the most advantageous strategy is found. It is the basic idea of evolutionary game. Unlike the classical game theory, it is not necessary to assume that the participants are completely rational in the evolutionary game, nor does it assume that the game process occurs under complete information.

Evolutionary stability strategy in evolutionary game (Evolutionarily Stable Strategy, ESS) and Replication Dynamics (Replicator Dynamics) is the core of the basic concept. In evolutionary game, the dynamic equation is the most popular choice mechanism.

The basic definition is as follows.

If is an evolutionary stability strategy:

1) S^* To form a Nash equilibrium. $U(s^*,s^*) > U(s^*,s)$;

2) If $S^* \neq s$ Meet $U(s^*,s^*) = U(s^*,s)$, you have $U(s^*,s) > U(s,s)$.

In order to satisfy the frequency or frequency needed to describe a strategy being adopted in a group, the dynamic differential equation is called the copy dynamic equation:

$$F(k) = \frac{Dx}{3} = \left[U(k,s) - U(s,s) \right], K = 1,2,3,\cdots,K \ DT$$

which: x_k Adopt strategies for a group K Proportion of; $U(k,s)$ To adopt a policy K Adaptive degree of time; $U(k,s)$ For the average fitness degree; K For different strategies, K Is the total number of policies.

4. An Evolutionary Game Analysis of Government Information Resources Sharing

4.1. The Basic Hypothesis of Evolutionary Game Model

The Government information resource sharing is a highly complex system, from a broader perspective. While sharing is both the subject and the subject of management, the management subject and the shared subject are separated. The management, supervision and rewards and punishments are carried out by the Special Administrative department on the shared behavior between the subjects of information resources sharing. Therefore, this research combines the basic mode of government information resources sharing management, and abstracts the participants in the Government information resource sharing game as the government management department.

That is, the participant A and information resources sharing subject the participant B, in which participants were A. To strengthen the Government information resources sharing management, supervision and set up a full-time department, with information resources to share the subject of management, supervision and reward and punishment rights; People involved B refers to the Department participating in information resource sharing. In this evolutionary game model, the two sides can further abstract into two bounded rational game subjects, both of which are confronted with different strategies in the game process. The study assumes that participants A the set of policies you can select is active supervision and negative regulation; People involved B Policy set is with active sharing and negative sharing. Assuming that the game is carried out under incomplete information, both of the games are limited rationality, so it is necessary to find the optimal strategy through repeated games.

According to the above assumptions, the participant's profit and loss assumption in the Government information resource sharing game is as follows.

Assume 1: Set up participants A Regulatory costs are required to take active supervision C_1, the use of passive regulation does not bear the cost of regulation; People involved B When you take a negative sharing policy, you can get π The normal benefits, while The shared costs to be paid for active sharing are C_2.

Assume 2: Set as participant A when adopting an active regulatory strategy, if the reference with people B Negative effects can be generated by adopting a passive sharing strategy—μ (such as participants A Of punishment, criticism, etc.), and the participants A get a certain amount of revenue while paying the cost of regulation (such as fines, etc.); If the reference With people B Shared costs and additional benefits are required to take active sharing strategies π (such as participants A Financial rewards, etc.), at which time participants A Will gain a greater social benefit.

Assume 3: Set as participant A when adopting a negative regulatory strategy, If the reference with people B when you choose to take a negative sharing strategy, you get only normal benefits, at which time participants A It also has to bear the negative effects of passive regulation. Gamma If the reference with people B

shared costs is required to actively share a strategy, and participants are now A Will gain a greater social benefit.

Assume 4: Set up participants A There will be a probability of X The possible adoption of an active regulatory strategy, corresponding to the probability of a $(1 - X)$, the possibility of adopting a negative regulatory strategy. The same assumes that the participants are B There is a probability of Y May take a positive share of the strategy, the corresponding will have the probability of $(1 - Y)$, the possibility of a passive shared strategy.

4.2. The Construction of Evolutionary Game Model

Through the concept definition and model hypothesis, the paper constructs the evolutionary game model of the Government Management department and the information resources sharing subject, and uses the game tree to express the game process. On model hypothesis and game model, the income matrix of game participant is determined, such as Table 1 as shown.

4.3. The Solution of Evolutionary Game Model

1) People Involved A Dynamic Equation for Regulatory Replication

People involved A to participants B The expected return on supervision is E_1 (*Positive*). The expected return without supervision is E_1 (*Negative*), participants A. The expected income is E_1.

$$E_1(Positive)$$
$$= y(\Delta p - C_1) + (1 - Y)(Lambda - C_1) E_1(Negative)$$
$$= Y\delta p + (1 - Y)(-Gamma) E_1$$
$$= XE_1(Positive) + (1 - X) E_1(Negative)$$

The participant A The replication dynamic equation for monitoring information resource sharing is

$$F(x) \overset{Dx}{=} x(E_1(Positive) - E_1)$$
$$= x\{E_1(Positive) - [E_1(Positive) + (1 - x) E_1(Negative)]\} DT$$
$$= x(1 - x)(E_1(Positive) - E_1(Negative))$$
$$= x(1 - x)[Lambda - C_1 + \gamma - (\lambda + \gamma)Y]$$

When $Y = \dfrac{\lambda - c_1 + \gamma}{\lambda + \gamma}$, When $F(x) \equiv 0$, which means that at this point all X The level of all is ESS;

Table 1. The income matrix of each participating subject.

People involved A \ People involved B	Actively share	Negative sharing
Active supervision	$(\Delta p - C_1, Pi - C_2 + \delta\pi)$	$(\lambda - C_1, Pi - \mu)$
Negative regulation	$(\Delta p, Pi - C_2)$	$(-Gamma, \pi)$

When $Y \neq \dfrac{\lambda - c_1 + \gamma}{\lambda + \gamma}$, When, make $F(x) = 0$ Get $x = 0$ Or $x = 1$ is two Ess. At this time the $F(x)$ To make a derivative:

$$F(x)' \overset{Df(x)}{=} (1 - 2x)\left[Lambda - C_1 + \gamma - (\lambda + \gamma) \right] Y$$

Can be divided into two kinds of state discussions at this time:

a) When $Y < Lambda - C^1 + \gamma$, When $Df(x) > 0$, $Df(x) < 0$, so at this time $x = 1$ is ESS;

When the participating people B Share probability below a certain level Continuous reduction hours Participation.

A Choose Tube Rate is increasing, the ultimate positive regulation becomes its optimal strategy.

b) When $Y > Lambda - C^1 + \gamma$, When $Df(x) < 0$, $Df(x) > 0$, so at this time $x = 0$ is ESS;

When the participating people B Share overview

Rate above a certain level and $\underset{goon}{x + y}$ Increase time $\overset{Dx}{}$, Participation $\underset{people}{x = 0}$

A The probability $\underset{reduce}{dx} \underset{reduce}{x = 1}$ Small, final negative regulation becomes its optimal strategy.

People involved A The dynamic trend of supervision is as shown 2 as shown (**Map 1**).

2) People Involved B Replication Dynamic Equation for Sharing

People involved B The expected benefits of actively sharing information resources E_2 (*Positive*), the expected benefits of negative sharing are E_2 (*Negative*), participants B The expected income is E_2.
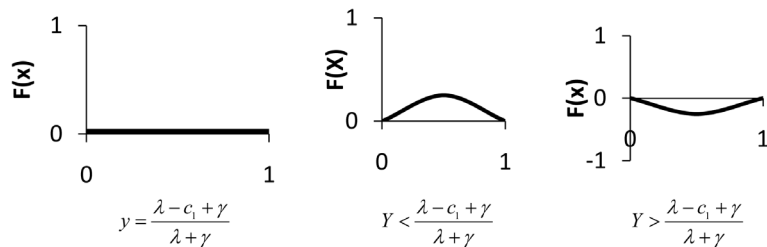
$$E_2(Positive) = X(Pi - C_2 + \delta\pi) + (1 - X)(Pi - C_2);$$
$$E_2(Negative) = X(Pi - M) + (1 - X)\pi;$$
$$E_2 = YE_2(Positive) + (1 - Y)E_2(Negative)$$

The participant B The replicated dynamic equation for sharing is

$$F(y) \overset{Dy}{=} Y\left(E_2(Positive) - E_2\right)$$
$$= y\left\{E_2(Positive) - \left[E_2(Positive) + (1 - Y)E_2(Negative)\right]\right\} DT$$
$$= y(1 - Y)\left(E_2(Positive) - E_2(Negative)\right)$$
$$= y(1 - Y)\left[x(Pi - M) - C_2\right]$$

Map 1. Dynamic replication phase diagram of government regulatory department.

When $x = \dfrac{c^2}{\pi - M}$, When $F(y) \equiv 0$, which means that at this time all Y The level is all Ess.

When $x \neq \dfrac{c^2}{\pi - M}$, When, make $F(y) = 0$ get $y = 0$ or $y = 1$ is two Ess. At this time the $F(y)$ To make a derivative: $F(y)' = Df(Y)$, $X > c^2$ When $Df(y) > 0, Df(y) < 0$, so at this time $Y = 1$ is ESS; When the participating people A The choice of regulatory.

Probability reaches a certain $\overset{\pi\ -\ \mu}{\text{Degree}}$ and continues to add big time, $\overset{Y=0}{}$ People involved B enjoy the rate is increasing, the most Finally, active sharing becomes its optimal strategy. The dynamic trend of sharing the subject of information resources is shown as below (**Map 2**).

3) People involved A with participants B the replication dynamics and its stability

Combined with the above analysis, we can get the system 4 Saddle points are respectively $A(0,0), B(1,0), C(1,1), D(0,1)$.

According to analysis, Can see: When the initial state of the game falls to $(x,y) \in \left[(0,0), \dfrac{\lambda - c_1 + \gamma}{\lambda + \gamma} \right]$, which is in the area, the game converges to $B(1,0)$ Point, namely {Active supervision, negative sharing}; When the initial state of the game falls to (X, Y) $\left[\left(\dfrac{c_2}{\pi - u} \right), \left(1, \dfrac{\lambda - c_1 + \gamma}{\lambda + \gamma} \right) \right]$, which is in the area, the game converges to $C(1,1)$ Point, namely {Actively monitor and actively share};

When the initial state of the game falls to $(x,y) \in \left[\left(\dfrac{c_2}{\pi - u}, \dfrac{\lambda - c_1 + \gamma}{\lambda + \gamma} \right), (1,1) \right]$, which is in the area, the game converges to $D(0,1)$.

Pointly, namely {Negative regulation, Active sharing}; When the initial state of the game falls to $(x,y) \in \left[\left(0, \dfrac{\lambda - c_1 + \gamma}{\lambda + \gamma} \right), \left(\dfrac{c_2}{\pi - u}, 1 \right) \right]$, which is in the area, the game converges to $A(0,0)$ Point, namely (Negative regulation, negative sharing).

5. On the Equilibrium Solution of Evolutionary Game

Analysis of the above four kinds of initial states distribution, we find that the
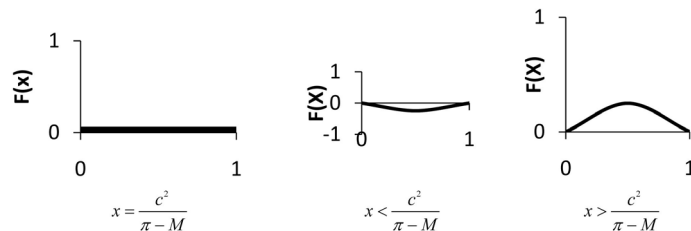
Map 2. A dynamic replication phases diagram for sharing the subject of information resource sharing

initial state of the game is different, the final equilibrium result is different, and the choice of the final strategy is closely related to the initial state when the game occurs. Therefore, the parameters of the return function can make the game converge to different results. In order to increase the level of government information resources sharing, the Government management Department should actively supervise and share the information resources, so we should enlarge the initial state of the game and fall in the region The probability that can be expanded by the region the scope of the implementation, get the following conclusions.

Conclusion 1: Reducing the regulatory costs of government administrations when adopting active regulatory strategies, while other factors are unchanged C_1 can increase $\frac{\lambda - c_1 + \gamma}{\lambda + \gamma}$, thus increasing the initial state of the game into the region The probability that the government management department will have a greater likelihood select into an active supervision.

Conclusion 2: With other factors unchanged, the Government's administration has increased the extra benefits of adopting a proactive regulatory strategy by increasing the level of punitive measures can increase $\frac{\lambda - c_1 + \gamma}{\lambda + \gamma}$, thus increasing the initial state of the game into the region the probability of making the government administration department. The door will have a greater likelihood of choice for active regulation.

Conclusion 3: In the case of other factors, the negative effect of government departments' negative supervision by enlarging the passive sharing of information resource sharing subject can increase $\frac{\lambda - c_1 + \gamma}{\lambda + \gamma}$, thus increasing the initial state of the game into the region The probability that makes the political government management departments will have a greater chance of active regulation.

Conclusion 4: In the case of other factors, reduce sharing information of information resources shared subject Cost of resources C_2 can reduce $Pi - M$ value, thereby increasing the initial state of the game into the region, so that the subject of information resource sharing will have more potential to share actively.

Conclusion 5: In the case of other factors, the government management department adopts more funds supported and fund reward to increase the information.

The additional benefit that a resource shares subject receives for sharing can reduce $Pi - M$ value, thereby increasing the initial state of the game into the region The overview $Pi - M$, so that the information resource sharing subject will be more likely to choose active sharing.

Conclusion 6: In the case of other factors, the government management department adopts more punitive means to increase the sharing of information resources.

Body Penalty loss due to negative sharing being investigated can reduce $Pi - M$ value, thereby increasing the initial state of the game into the region $Pi - M$. Therefore, the subject of information resource sharing will be more likely to choose to share actively.

6. Conclusions and Policy Recommendations

On the basis of the conclusion of this study, we can put forward relevant policy suggestions from the following aspects.

6.1. Speeding up the Construction of Government Information Resources Sharing Platform

The current Government information resources sharing and supervision more rely on manual operation, low efficiency cost, so need to use the government information resources sharing platform to change the existing sharing and supervision mode. To speed up the Government information resource sharing platform, we should base on the basic database such as population, legal person, natural resources and spatial geography, and rely on the Internet to carry out the collection, integration and sharing of government information resources. The main tasks of this process include the unified catalogue of government information resources, the establishment of standards, the infrastructure construction of interconnection of information resources among departments, and the development of relevant key technologies.

6.2. Perfecting the System of Government Information Resources Sharing the Relevant System of Government

Information resources sharing management is to guarantee the opening of information resources of government departments, standardize the collection, integration and sharing of government information resources, define the scope of responsibility of the management department and the shared subject, and provide the system guarantee for the sharing of government information resources. The main task of perfecting Government information resource sharing system is to standardize the organization implementation mechanism of government information resource sharing, the design of shared process mechanism, the enactment of laws and regulations, and the establishment of standard system.

6.3. Perfecting Government Information Resources Sharing Incentive and Punishing Mechanism

In order to promote the active supervision of the management department and share the subject actively, we need to perfect the rewards and punishments mechanism in order to increase the incentive for both sides to adopt the positive strategy and the punishment when adopting the negative strategy, to improve the Government information resources sharing assessment mechanism, and to improve the incentive mechanism based on this. As for the subject of information resource sharing, it can be subsidized when actively sharing, and giving

priority to use other departments to share information, meanwhile, it can participate in the market operation of information resources shared by the Department, and arouse its sharing enthusiasm. In negative sharing, the penalty is increased by means of fines and reduction of departmental performance. For the shared Management department, active supervision is the responsibility, so we should start with the negative utility of the negative management, which can reduce the department performance and increase the exposure intensity.

By constructing the evolutionary game model between the Government management department and the Information resources Sharing Department, this paper analyzes the profit and loss of the game subject in the information resource sharing, and solves the evolutionary stability strategy of the model with the help of the copy dynamic equation, and the equilibrium solution to explore Further study of the equilibrium state of evolutionary game, found that the government management departments to reduce supervision costs, increase punishment to obtain additional benefits, increase the negative effect of passive regulation can make it more likely to choose a positive regulatory strategy; Sharing the subject of information resources Reducing shared costs and increasing rewards and penalties can make it possible to choose actively shared strategies with greater probability. The relevant conclusions of this study are of great practical significance to promote the sharing of government information resources, and to increase the participation of both sides to actively supervise and share the probability.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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