The analysis of the public collaborative among the multi-agent of public management in China's Yangtze River delta region based on the signaling game model

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Abstract –In the description of the Yangtze River Delta area of public management in multi-agent collaborative process, it build a regional public administration based on the signaling game multiagent collaboration and enhance collaboration revenue model drawing on Bayesian signaling game model. The game equilibrium results show that the level of accumulation of knowledge and collaboration signals contribute to the acceleration of regional public administration multiagent collaborative between the different subjects.

Keywords –Model of signaling game; multiagent of public Administration; Coordination

1. Introduction

The signaling game model is the simple and important game model in the incomplete information dynamic game model, and it is initiated by Spence in 1974. There are many applications in the economic management field, and it could offer many important tools and means for the economic management and the decision. The applications and research for the signaling game model could further improve the game theory system knowledge structure; meanwhile, it could support a kind of strength research tool for the management area and other social studies.

For the signaling game model, there are two participants: i=1, 2.The one (i=1) is the signal leader, the other is the (i=2) is the signal follower. When the signal leader discrete sampling, it could forecast that the signal follower would be according to his signals generated in the correction of their types of judgment, so they would choose an optimal type dependence signal strategy; meanwhile, Participants 2 knew participant 1's choice which is a given type and taking the information effect under the condition of the optimal strategy, therefore the participants 1 will use Bayes' theorem to correction the judgment of participant's types of, then to choose the optimal action for themselves. The singling game model should satisfy the following three conditions:

①$a*(m) \in argm_a ax \sum \overline{p} (\theta|m) u_2 (m, a\theta)$;

②$a*(\theta) \in argm_m axu_1 (m, a^{**}\theta)$;

③the participant 2 got the $\overline{p}(\theta|m)$ according to the optimal strategy m^* of signal m and the participant 2 from the prior probability by using Bayes' theorem.

In the above three conditions: m（θ）is the type dependence signal strategy, a (m) is the action strategy of the participant 2, $\overline{p}(\theta|m)$ is the posterior probability.

From the above equilibrium condition we can know that: the main point of signaling game model is the parties according to the observed behavior of others to modify his about the latter type of "faith" (subjective probability), thus to choose a course of action.

2. The Evolutionary Game features of multi-agent in the process of regional integration in the Yangtze River Delta

Information is a key element of the game. In real life, due to incomplete information, some participants can only rely on the information collected to determine the type of the other participants. Game is a action of decision-making program, people need avoid the real information be recognized by others, the participant may send false signals to deceive the other participants, so the signal transfer and screening of each participant are extremely important, it is also the main aspects of the game model construction.

Yangtze River Delta region is constituted by different types and levels of administrations, there are the complex relationships between the interests of administrative subjects, contains a variety of conflicts of interest. Beginning in the 1980s, for the co-ordination of the

conflict of interest between the various economic agents, to enhance the overall regional competitiveness, the Yangtze River Delta region, the administrative body had many Game coordination processes. In 1982-1984, there are 22 games for the coordination of important issues. In 1992-2005, also up to 18 times. From the coordination path, about from four levels: the main central government-led regional coordination, consultation and coordination between various administrative regions main, the region of the administrative functions of the main coordination and coordination of civil society in the region. Therefore, the administrations of the Yangtze River Delta region not only have a significant path dependency but also the path selection is non-closure. Although the role of such coordination is also not enough, but the joint development of multi-agent path-dependent and non-latching process laid a solid foundation to establish a new cooperation mechanism between different subjects, improve collaboration revenue evolutionary.

Yangtze River Delta region is a new domestic investment and key areas of production capacity for the international industry gathering and also capital transfers area. Under the current administrative system, in the face of the rapid growth of information bureaucratic demand for products, the cooperation between the administrative subjects is more difficult, and the game evolves over time. The formation of this game features is impacted by the traditional socio-cultural, habits and psychological factors, but also the impact of the various administrative body absence and dislocation phenomena. Nevertheless, the conflict of the administrative body in the Yangtze River Delta region is still weak conflict, that the interests of all parties to achieve is not at the expense of the other party's biggest loss. Therefore, coordination mechanism that based on signing is very important for improving the region's overall level of collaboration and collaborative benefits and enhancing the overall competitiveness of the Chinese regional.

3. Model specification of the multi-agent synergy mechanism based on the signal game

First we assumption that the cooperation ability of every administrative subject have two possible levels, $\theta=$ 1(Low ability) and $\theta=2$ (High ability); the cooperation knowledge accumulation level of every administrative subject s is the time and the knowledge accumulation of every administrative subject participate in cooperation in the regional, and s is a continuous variable $s \in [o, \bar{s}]$. Assume that θ is a given administrative subject ability and s is the collaborative knowledge accumulation level, and then the administrative subject expectations collaboration performance function is:

$$y(\theta, s) = \begin{cases} s, & \theta = 1 \\ ks, & \theta = 2 \end{cases}$$

Including > 1, and k is a constant, that is to say, for the cooperation knowledge accumulation level of any given administrative subject s, high ability of administrative subject cooperation performance is the k

times of the low capacity. And if the cooperation ability θ of the administrative subject is given, the collaborative knowledge accumulation level will be higher, and then its collaboration performance expectations level will exceed. Make $u_\theta(w, s)$ is the utility function of the administrative subject which ability is θ, w is the cooperation revenue which the administrative subject is expected to get, we suppose that:

$$\partial U / \partial w > 0, \partial^2 U / \partial w^2 \leq 0;$$
$$\partial U / \partial s < 0, \partial^2 U / \partial s^2 < 0$$

Then the cooperation revenue of administrative subject will produce positive utility, whose marginal utility is diminishing (or constant); The cooperation knowledge accumulation level of Administrative subject will produce negative utility, whose marginal cost (or marginal utility cost) is increasing. So in (w, s) space, if we want get the indifference curve whose slope is positive and increasing, a key hypothesis is that: The cooperation knowledge accumulation costs of the low ability administrative subject is higher than the cooperation knowledge accumulation costs of the high ability administrative subject, namely $\partial U_1 / \partial s > \partial U_2 / \partial s$. This means that, in the geometry, the indifference curve of the low ability administrative subject is steeper than the high ability administrative subject in all respects. This shows that in order to keep the given utility level, when the collaborative knowledge accumulation level increase each unit, the compensation benefit which low ability administrative subject needed is higher than the compensation benefit which high ability administrative subject needed. Therefore, there is only one point of intersection in the indifference curves of high capacity and low ability administrative subject is only one focus, as shown in figure 1.

For the different administrative subject in the regional integration, given the expected cooperation revenue w, choose collaborative knowledge level s, maximize utility function (w, s), in the condition of complete information, the game between the administrative subject makes balanced cooperation benefit equals collaboration performance, and the optimization conditions is:

Low ability team-worker : $\frac{\partial w_1}{\partial s} = \frac{\partial y_1}{\partial s} = 1 = \frac{\partial U_1}{\partial s} / \frac{\partial U_1}{\partial w}$

High capacity team-worker : $\frac{\partial w_2}{\partial s} = \frac{\partial y_2}{\partial s} = k = -\frac{\partial U_2}{\partial s} / \frac{\partial U_2}{\partial w}$

That is the optimal solution is the tangent point of indifference curve and cooperation performance curve (the marginal rate of substitution is equal to the marginal rate of transformation), as shown in figure 2. In figure 2, A and B respectively is the equilibrium of the low capacity administrative subject and the high ability of administrative subject: The collaborative knowledge accumulation level selected by the low ability administrative subject of is $\widehat{s_1}$, and the cooperation revenue is $\widehat{w_1}$; The collaborative knowledge accumulation level selected by the high ability administrative subject of is $\widehat{s_2}$, and the cooperation revenue is $\widehat{w_2}$. 。 In the complete information state,

cooperation can improve the performance of the administrative subject, so all of the administrative subjects will make great efforts to improve the coordination level of knowledge accumulation. High capacity administrative subject only promote the practice of the cooperation between administrative subjects more actively, then it can obtain more collaborative knowledge level than the low capacity administrative subject.
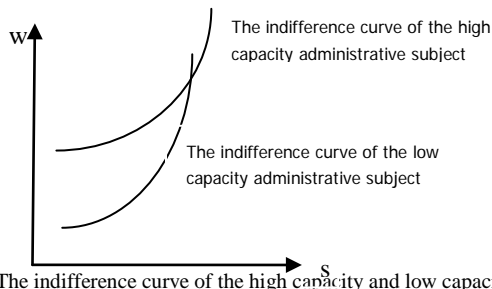

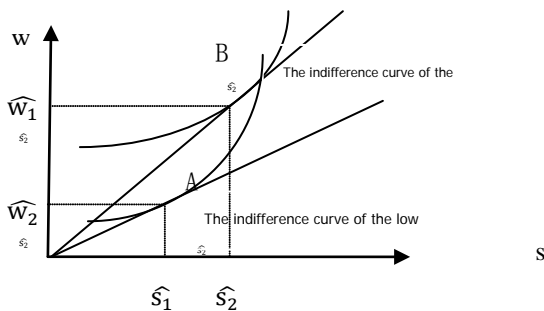**Figure 1.**The indifference curve of the high capacity and low capacity administrative subject

Figure 2. The equilibrium state $\hat{s}$ n under the complete information

But in the incomplete information conditions, A and B cannot reach the equilibrium. Because if low ability administrative subject expected that the administrative subject whose collaborative knowledge level is $\hat{s_2}$ have acquired a high cooperation benefits $\widehat{w_2}$, even if the low cooperation ability administrative subject will also choose accumulate more cooperation level(the utility level of the indifference curve from A point is higher than the indifference curve from B point).

Assume that the prior probability which a certain administrative subject belongs to low ability and high ability is equal, and make $\mu(s) = \mu(\theta = 1|s)$ for the posteriori probability when the low ability administrative subject select the cooperative knowledge level s, then the posteriori probability is $1-\mu(s)$ when the high ability administrative subject select the cooperative knowledge level s. So, in asymmetric information situation, refined bayesian equilibrium is defined as follows: There is expected cooperation revenue function w (s), a collaborative knowledge accumulation level $s^*(\theta)$ and a posteriori probability $\mu(s)$, make:

(P_1) Given w (s), s^* maximization $u_\theta(w(s), s)$;

(P_2) w (s^*) = $\mu(s^*)s^*$ +2(1- $\mu(s^*)$) s^*;

(B) $\mu(s)$ is consistent with Bayes' rule.

Among them, the condition(P_1) is "self selection constraint",(P_2) is the "participation constraint", and (B) is Bayesian conditions.

Therefore, in equilibrium, the administrative subject with the same ability will choose the same collaborative knowledge accumulation level. In separation equilibrium cases, the different ability administrative subject will choose different collaborative knowledge accumulation level. In particular, the administrative subject whose ability for θ=1 will select $s^*(1) = s_1$, and the administrative subject whose ability for θ=2 will select $s^*(2) = s_2$, and $s_1 \neq s_2$. That the administrative subject whose collaboration knowledge accumulation level is s_1 will be the low ability and the acquired cooperation revenue is $w(s_1) = s_1$; the administrative subject whose collaboration knowledge accumulation level is s_2 is the high ability, and the acquired cooperation revenue is $w(s_2) = ks_2$.

In the confusion equilibrium cases, the other administrative subject in the region could not according to the coordination knowledge accumulation level to judge the level of administrative subject ability; therefore, we just anticipated that each of the administrative subjects can get the same cooperation profit $w(s^*) = s_1$. And the administrative subject whose collaborative knowledge accumulation level as s_2 is high ability and the acquired cooperation revenue is $w(s^*) = 0.5s^* + 0.5ks^* = 0.5(1 + k)s^*$.

In separation and balance situation, low ability administrative subject willing to choose s=s_1, w=s_1, however, the ability administrative subject willing to choose s=s_2 , w=s_2.In figure 3, coarse line represents the cooperative income curve of the administrative subject w (s), A and C are two equilibrium, in which, A is the optimum point of the low ability administrative subject and C is the optimum point of the high ability administrative subject. Obviously, in separation and balance state, low ability administrative subject has no enthusiasm to choose C, and the high capacity administrative subject also does not have the enthusiasm to choose A.

In the confusion equilibrium cases, confuse equilibrium means all types of administrative subject choose the same collaborative knowledge accumulation level, and get the same cooperation revenue. In figure 4, given a equilibrium point$\{s^*, w^*\}$, as long as satisfy the condition that $w^* = 0.5(1 + k)s^*$, and for any $s \neq s^*$, U $(w^*, s^*) \geq$ U $(w(s), s)$, all is confusion equilibrium. In the confusion equilibrium, if the administrative subject wants higher cooperation benefits, they are tempted to constantly improve their collaborative knowledge accumulation level.
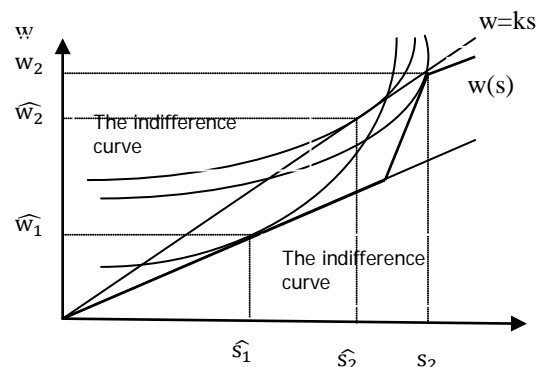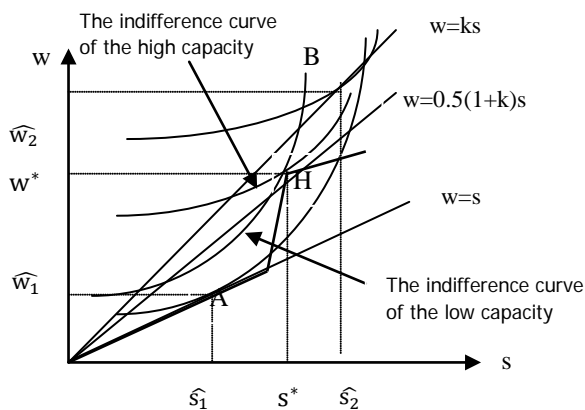
Figure 3.Separation equilibrium state

Figure 4.Confusion equilibrium state

4. China's Yangtze River Delta area of public management multi-agent based signaling game model collaborative analysis.

In the regional integration process, information of the administrative body collaboration is asymmetry. One administrative body knows their collaboration, but he does not t know other administrative body. Some people spread collaboration information of accumulation of knowledge to other administrative body collaboration administrative body, so the size of the administrative body collaboration revenue depends primarily on the amount of the pros and cons of their collaboration and knowledge accumulation levels.

Cooperation between the administrative bodies in the Yangtze River Delta regional mainly expands the areas of cooperation, cooperation in the establishment of institutions, the institutionalization of cooperative behavior, emphasis on cooperation and dispute resolution. Yangtze River Delta regional integration improves the level of knowledge accumulation in the cooperative game process of the administrative body continuously process. In 1992, joint conference system was upgraded to the Yangtze River Delta Economic Coordination. In such a regional cooperation organization, collaboration level of knowledge accumulation continuously is improved, the degree of integration of the Yangtze River Delta region is also continued to increase.

Collaborative gaming process of the regional integration in the Yangtze River Delta is also the process that collaboration is continuously improved. Administrative body collaboration improves performance in the following aspects. First, the number of the Yangtze River Delta Economic Coordination Committee Member increases. In 1992, there are only 14 member cities of the Economic coordination; in 2003 it expands to 16 cities. Second, the Yangtze River Delta regional integration space boundary extension. This collaboration game mode has affected the administrative body of the area outside of the Yangtze River Delta region; they also strive to improve the level of collaboration and actively participate

in regional cooperation in the Yangtze River Delta region, so the space actually is not limited to the existing boundary16 cities. Third, the subject of collaboration game is no longer confined to government. Accompanied by the strengthening of collaborative game signaling effect, the collaborative game body apart from the Government, but also it includes academic elite. The collaborative game content develops from a simple exchange of experience to the strategic discussions. The signaling game model applied to the study of the integration process of the Yangtze River Delta region, we can infer that administrative body strengthen coordination rely on accumulation of knowledge and collaboration capabilities because of asymmetric information. So we are able to further accelerate the process of regional integration in the Yangtze River Delta.

5. Revelation

The process of coordination between the various administrative bodies is actually the signal passing game process of a mutual influence, mutual exchanges and mutual promotion. In the case of separating equilibrium, type and performance status of the administrative body is very clear, the level of collaborative knowledge accumulated clearly reflects the merits of the administrative body performance. While in the case of pooling equilibrium, administrative body to obtain the expected collaboration revenue will have to be more motivated to improve collaboration knowledge and put it into specific coordinated action.

Cooperation and coordination between the administrative bodies of the Yangtze River Delta region are still many problems. First, regional coordination regulations are not sound. The second is the lack of effective supervision and incentive mechanism. Third is deep-rooted in the Yangtze River Delta cooperation mechanism has not yet been formed. At present, the cooperation between the Yangtze River Delta region places more focus on common interests, but common regional governance and the system of cooperation involves little.

How to achieve synergy between the public management of the Yangtze River Delta region and shared interests? First of all, we should build regional benefit-sharing mechanisms that based on the main interest in the region to give full consideration to the interests of various stakeholders' demands. Standardize the behavior of the distribution of interests of stakeholders in order to achieve the purpose of preventing the uneven distribution of benefits. From the aspect of organizational form, we should change the bureaucracy into formal organizations and businesses, residents, non-profit organization interconnected network structure; From the aspect of morphology of the system, we should improve the formal system and informal system, in particular, and pay attention to mutual trust, mutual benefit, mutual aid, interactive informal system; From the aspect of governance structure, we should provide an open, transparent, convenient channels for participation for stakeholders; From the aspect of the governance approaches, we should change the form of bureaucracy

into consultation for the market ,administrative, legal, and third-party participation in many ways; From the aspect of content, we should improve multi-agent negotiation mechanism.

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