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Abstract: Based on the sharing mode of supply chain resources in the environment of cloud service, this research constructed the evolutionary game model of supply chain resource-sharing to reveal the behaviors between two types of enterprise, the equilibrium in model and local stability are analyzed under the state of uniform mixed and non-uniform mixed populations. By using the method of system dynamics, the evolutionary game model is built, and a contrastive analysis of evolutionary results affected by diverse parametric variations is performed. The results of the research shows that the evolutionary trends of the game are significantly influenced by the initial sharing proportion in enterprise group, the cost and benefit of upgrading equipment, and the risk of technological loss. To facilitate the information interaction and resource sharing between enterprises, continuous improvement needed to be done in line with the above aspects.

Keywords: cloud platform, sharing of supply chain resource, evolutionary game, system dynamics model

1. INTRODUCTION

Nowadays, the development of information technology has transformed the competition between enterprises into the competition of global supply chain[1], and the overall competitiveness of the supply chain can be achieved through the coordinated development between the members. One of the conditions for synergetic development lies in the circulation and sharing of resources. At the same time, with the advancement of information technologies such as Internet of Things and cloud computing, the cloud service platform makes the seamless connection of information and resources among supply chain enterprises accessible[2]. All of this can build a virtual enterprise alliance, and jointly improve product quality and enhance the overall competitiveness of the supply chain. However, the information among members of the supply chain is not open and opaque, besides, the conditions that companies capitalize on supply chain member’s core competencies and protect their own knowledge and technology are widespread, which leads to the low willingness of sharing the supply chain resources, so it is hard to form an effective community of supply chains. Therefore, it is of theoretical and practical significance to study how to maximize the benefits of supply chain members under the premise of ensuring the overall interests of supply chain cooperative organizations.

2. LITURATURE REVIEW

Up to now, the research on supply chain resource sharing mainly includes the following two aspects. First, the impact of resource sharing on the performance of supply chain operations, the representative paper are, Frank Chen[3](2000) explored the degree of variation of the variance var(q^k) of orders placed in the kth stage of the supply chain relative to the variance of market demand var(D) under the pattern of demand determination and uncertainty, indicating that resource sharing can significantly increase the performance of supply chain operations. However, most of the literatures focuses on the distribution of benefits between resource sharing

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parties, Fu Heng[4](2018) argues that wholesale price of the manufacturer and retailer's pricing strategy are the main factors that determine the distribution of benefits between the supply chain, they constructed a single manufacturer-retailer supply chain system to discuss the each pricing strategy for manufacturer and retailer to find out the best distribution point of interest under the uncertainty market demand, and verify the existence of utility equilibrium in the optimal decision. Based on the retailer's risk appetite, Wang Cong and Yang Deli[5](2017) studied the conditions that tradition retailer sharing demand information with manufacturers, and discussed the impact of information resource sharing on their business decisions and profits of both retailers and manufacturers. And numerical simulations showed that resource sharing can maximize the benefits of both parties only when the demand is uncertain. Lu Jizhou, Feng Gengzhong[6](2017) Aiming at the problem of bullwhip effect in the supply chain inventory, they established a cooperative game model covering the individual utility function and the overall collaborative optimization of the supplier and the retailer, and transforms the equilibrium of the resource allocation in the game community into the optimal decision balance, to ensure that the sharing of resources can maximize the interests of both parties.

However, most of the existing literature focuses on the decision of resource sharing through the distribution of benefits. But there is a lack of discussion on the factors that limit the resource sharing between supply chains, and the influence of different situations on the final decision behavior is also lack of argument. In addition, the resource sharing among supply chain is a dynamic process, the dynamic changes of sharing factors will ultimately affects the choice of a balanced strategy for both supply chains. Therefore, this study adopts the evolutionary game method to analyze the evolution trend of the dynamic cooperation process of resource sharing among supply chain members in the cloud service environment, and measure the impact of various factors on the equilibrium strategy in different situations by using system dynamic simulation model.

3. THE FRAMEWORK OF EVOLUTIONARY GAME MODEL

3.1 Problem description

Enterprises can access various resources that are lacked in the enterprise through the resource sharing platform, but they needed to pay a certain access costs, and bear the risk of the leakage of core technologies, but they may also obtain excess returns. This research draw lessons from the game method that Qi Ershi used to analysis the resource sharing between manufacturers, we assumes that the main body of sharing supply chain resources are two types of "group" enterprises, one type of enterprises mainly share hard manufacturing resources(denoted as enterprises group A), and the other type is based on sharing soft service resources(recorded as enterprises group B). The strategies among both of them are S{shared, not shared}, and both sides of the game are "bounded rationally". The evolutionary game model is constructed by the strategies and benefits of both sides to study the evolution of the result of both parties under the condition of homogeneous and heterogeneous mixed groups.

3.2 Model assumption

(1) If both group A and group B does not share enterprise’s resources, both parties produce and operate independently, the income earned by group A is P_a and that of group B is P_b.

(2) If group A share enterprise resources while group B do not, group A needed to invest a lot of fixed costs to purchase or upgrade existing material-sensing devices, denoted as C_a. At this point, although there is no platform for the cooperation information between supply chain enterprises, but the production and information level of group A has been improved, the proceeds will also change accordingly, here the degree of enterprise informatization is R_a, from the extra income brought by the improvement of information technology was

recorded as I_a, while that of the group B was still P_b.

(3) If group B share enterprise resources while group A do not, group B are mainly rely on back-end productive service businesses in the supply chain and have a higher level of informationization, so the cost of investment in upgrading devices of group B is less than group A, marked as C_b. However, group B have to bear the risk of the leakage of core technologies. Therefore, the loss risk factor for group B is recorded as R_b, and the losses due to technological loss is recorded as L_b. The income of group A is still P_a.

(4) If both group A and B share enterprise resources, group A not only update their own devices, but also obtained support from the advanced production technology and other resources, the degree of enterprise informatization is increased to $R^s{}_a$. On the other hand, through mutual complementation of sharing resources between both parties, the efficiency of product production is increased, the production cost is reduced, and the market competitiveness of products is enhanced. Both types of enterprises have obtained excess returns, namely $P^s{}_a$ and $P^s{}_b$. At the same time, group B and A signed a collaborative manufacturing contract to reduce the risk of technology loss, the loss of risk in this case is denoted $R^s{}_b$.

(5) χ is the proportion of individuals who choose to share enterprise resources in group A. $1-\chi$ is the proportion of individuals who choose not in the group A; y is the proportion of individuals choosing to share the enterprise resources in group B, and $1-y$ is the proportion of individuals who choose not.

3.3 Solve the model

3.3.1 Homogeneous mixed evolution game model

In a standard homogeneous mixed replication dynamic system, the population size is assumed to be infinite and the probability of contact between population individuals is the same[7]. According to the hypothesis of the above several variables, we can get the game payment matrix shown in Table 1.

Table 1. Evolutionary game payment matrix of supply chain enterprises.

			Group B	
			Share	Not share
		Proportion	y	$1-y$
Group A	Share	χ	$P^s{}_a-C_a+R^s{}_aI_a$, $P^s{}_b-C_b-R^s{}_bL_b$	$P_a-C_a+R_aI_a$, P_b
	Not share	$1-\chi$	P_a, $P_b-C_b-R_bL_b$	P_a, P_b

Among them, $P^s{}_a>P_a$, $P^s{}_b>P_b$, $R^s{}_a>R_a$, $R^s{}_b<R_b$.

The income of group A choose and choose not to share the enterprise resources respectively are:

$$I^s{}_a=y(P^s{}_a-C_a+R^s{}_aI_a)+(1-y)(P_a-C_a+R_aI_a) \quad (1)$$

$$I^n{}_a=yP_a+(1-y)P_a \quad (2)$$

Therefore, the average income of group A is:

$$I_a=\chi I^s{}_a+(1-\chi) I^n{}_a \quad (3)$$

By the same token, the income of group B choose to share and not share are respectively as follows:

$$I^s{}_b=\chi(P^s{}_b-C_b-R^s{}_bL_b)+(1-\chi)(P_b-C_b-R_bL_b \quad (4)$$

$$I^n{}_b=\chi P_b+(1-\chi)P_b \quad (5)$$

Therefore, the average income of group B is:

$$I_b= y I^s{}_b+(1-y) I^n{}_b \quad (6)$$

According to Malthusian dynamic equation[8], the strategy adjustment process can be simulated by replicating dynamic mechanism. So the replication dynamic equation of group A and B are:

$$F(\chi)= \chi(I^s{}_a-I_a)=\chi(1-\chi)(I^s{}_a-I^n{}_a)=\chi(1-\chi)[y(P^s{}_a-C_a+R^s{}_aI_a)+(1-y)(P_a-C_a+R_aI_a)-P_a] \quad (7)$$

$$F(y)=y(I^s{}_b-I_b)=y(1-y)(I^s{}_b-I^n{}_b)= y(1-y)[\chi(P^s{}_b-C_b-R^s{}_bL_b)+(1-\chi)(P_b-C_b-R_bL_b)-P_b] \quad (8)$$

Copying the dynamic steady state means that the proportion of game parties adopting both strategies remains constant. So when F(x)=0 and F(y)=0, we can get the five equilibrium points of the evolutionary game process, respectively are, O（0,0），A（0,1），B（1,0），C（1,1），D（χ_D，y_D）, among them, $X_D=\frac{c_b+R_bL_b}{P^s{}_b-P_b+(R_b-R^s{}_b)L_b}$, $y_D=\frac{C_a-R_aI_a}{P^s{}_a-P_a+(R^s{}_a-R_a)I_a}$. And when χ=0，χ=1 or $y=\frac{C_a-R_aI_a}{P^s{}_a-P_a+(R^s{}_a-R_a)I_a}$, the probability of choosing a "share" strategy for group A is stable, while y=0，y=1 or $\chi=\frac{c_b+R_bL_b}{P^s{}_b-P_b+(R_b-R^s{}_b)L_b}$, the probability of choosing a "share" strategy for group B is stable. Thus, the stability of evolutionary game equilibrium can be obtained by Friedman's Jacobian matrix stability decision method[9]. Deriving F (χ) and F (y) from partial derivatives of χ and y respectively, we get the Jacobian matrix of the system as follows:

J=

$$\begin{bmatrix} (1-2\chi)[y(P^s{}_a-C_a+R^s{}_aI_a)+(1-y)(P_a-C_a+R_aI_a)-P_a] & \chi(1-\chi)\left[(P^s{}_a-C_a+R^s{}_aI_a)-(P_a-C_a+R_aI_a)\right] \\ y(1-y)[(P^s{}_b-C_b-R^s{}_bL_b)-(P_b-C_b+R_bL_b)] & (1-2y)[\chi(P^s{}_b-C_b-R^s{}_bL_b)+(1-\chi)(P_b-C_b+R_bL_b)-P_{b]} \end{bmatrix}$$

consequently, we can get the stability analysis of five equilibrium points on the basis of the Jacobi ratio of the matrix stability analysis showed in Table 2. Because χ and y represent the probability of a strategy for both sides of the game to choose, so $0\le\chi\le1$, $0\le y\le1$, then the constraints conditions are available: $C_b+R_bL_b\ge0$, $P^s{}_b-P_b+(R_b-R^s{}_b)L_b\ge0$, $C_a-R_aL_a\ge0$, $P^s{}_a-P_a+(R^s{}_a-R_a)L_a\ge0$.

Table2. Balance point and local stability.

Balance point	DetJ	Symbol	TrJ	Symbol	Result
0(0,0)	$(C_a-R_aI_a)(C_b+R_bI_b)$	+	$-C_a+R_aI_a-C_b-R_bI_b$	–	ESS
A(0,1)	$-(P^s{}_a-P_a-C_a+R^s{}_aI_a)(P^s{}_b-P_b-C_b+R^s{}_bI_b)$	—	$P^s{}_a-P_a-C_a+R^s{}_aI_a$	+	Not stable
B(1,0)	$-(C_a-R_aI_a)(C_b+R_bI_b)$	—	$P^s{}_b-P_b-C_b+R^s{}_bI_b$	+	Not stable
C(1,1)	$(P^s{}_a-P_a-C_a+R^s{}_aI_a)(P^s{}_b-P_b-C_b+R^s{}_bI_b)$	+	$-P^s{}_b+P_b+C_b+R^s{}_bI_b$	—	ESS
D($\frac{C_b+R_bL_b}{P^s{}_b-P_b+(R_b-R^s{}_b)L_b}$, $\frac{C_a-R_aI_a}{P^s{}_a-P_a+(R^s{}_a-R_a)I_a}$)	$\frac{(C_a-R_aL_a)P^s{}_a-P_a-C_a+R^s{}_aI_a}{P^s{}_a-P_a+(R^s{}_a-R_a)I_a}$3 $\frac{(C_b+R_bL_b)P^s{}_b-P_b-C_b-R^s{}_bI_b}{P^s{}_b-P_b+(R^s{}_b-R_b)I_b}$	+	0	/	Saddle point

Through the stability analysis we can see that there are 2 out of 5 equilibrium points are evolutionary stability strategy (ESS), respectively, they are O (0,0) point and the C (1,1) point which meet the conditions DetJ>0 and TrJ<0. So the corresponding strategy is {share, share} and {not share, not share}. A (0,1) and B (1,0) are unbalanced point, D ($\frac{c_b+R_bL_b}{P^s{}_b-P_b+(R_b-R^s{}_b)L_b}$, $\frac{C_a-R_aI_a}{P^s{}_a-P_a+(R^s{}_a-R_a)I_a}$) are Saddle point. Analysis shows that the dynamics game eventually converges to individuals in both types of group select share enterprise resources O (0,0) or choose not to share enterprise resources C (1,1) those two equilibrium points, and which direction does saddle point move is decided by the system initial state, the income that companies share enterprise resources, the investment costs access to cloud service platform, the improvement of information technology and technology losses and other factors that affect the common role. Two groups of enterprises can adjust and control their own implementation of enterprise resource sharing costs, information gains number, the risk of technological loss coefficient and other parameters to make the dynamic game process moves towards the ideal equilibrium point, promoting enterprise to share resources under cloud service environment.

3.3.2 Heterogeneous mixed evolution game model

In the actual situation, the number of a population is limited, and the rate of contact between individuals are different[10]. So according to Taylor[11](2006), QuanJi[12](2013) research on non-uniform contact rate, our study record the contact rate of group A and B choose shared strategy between individuals as R_{11}, the contact rate between individuals who choose shared strategy in group A and choose not share in group B is R_{12}, the contact rate between individuals who choose shared strategy in group B and who do not in group A recorded as R_{21}, the contact rate between individuals who choose not share in both group A and B recorded as R_{22}.

For the convenience of the model, set $\chi_a=P^s_a-C_a+R^s_aI_a$, $y_a=P_a-C_a+R_aI_a$, $W_a=Z_a=P_a$, $\chi_b=P^s_b-C_b-R^s_bL_b$, $y_b=Z_b=P_b$, $W_b= P_b-C_b-R_bL_b$.

In this way, the game revenue matrix for supply chain resource sharing of two groups of enterprises in the cloud service environment can be expressed as follows:

$$\begin{bmatrix} (\chi_a,\chi_b) & (y_a,y_b) \\ (W_a,W_b) & (Z_a,Z_b) \end{bmatrix}$$

From the perspective of group A, in the condition of non-uniform contact rate, the income of group A choose to share and not share the enterprise resources are:

$$I^s_a=\frac{x_aR_{11}x+y_aR_{12}(1-x)}{R_{11}x+R_{12}(1-x)},\ I^n_a=\frac{W_aR_{21}x+Z_aR_{22}(1-x)}{R_{21}x+R_{22}(1-x)} \quad (10)$$

So according to the copying equation $F(x)=\chi(I^s_a-I_a)=\chi(1-\chi)(I^s_a-I^n_a)$, we can conclude that:

$$I^s_a-I^n_a=\frac{(\varphi+\eta-\delta)\chi^2+(\delta-2\eta)\chi+\eta}{[R_{11}\chi+R_{12}(1-\chi)][R_{21}\chi+R_{22}(1-\chi)]} \quad (11)$$

Among them,, $\delta=(x_a-Z_a)R_{11}R_{12}+R_{12}R_{21}(y_a-W_a)$, $\varphi=(x_a-W_a)R_{11}R_{21}$, $\eta=(y_a-Z_a)R_{12}R_{22}$. Set as $h(\chi)=(\varphi+\eta-\delta)\chi^2+(\delta-2\eta)\chi+\eta$, $T(\chi)= \chi(1-\chi)(I^s_a-I^n_a)$.

And then let $h(x)=0$, when$\delta^2\geq4\varphi\eta$, we can conclude that:

$$X_1=\frac{2\eta-\delta+\sqrt{\delta^2-4\varphi\eta}}{2(\varphi+\eta-\delta)},\qquad X_2=\frac{2\eta-\delta-\sqrt{\delta^2-4\varphi\eta}}{2(\varphi+\eta-\delta)} \quad (12)$$

Divided into three cases, we discussed the evolutionary stability on the value of the proceeds of group A:

(1) When $(\chi_a-y_a)(W_a-Z_a)$ and $(\chi_a-W_a)(y_a-Z_a)$ are both positive number,

$$\frac{R_{11}R_{12}}{R_{21}R_{22}}\geq\left(\frac{\sqrt{(\chi_a-\gamma_a)(W_a-Z_a)}+\sqrt{(\chi_a-W_a)(\gamma_a-Z_a)}}{\chi_a-Z_a}\right)^2 \text{ or } \frac{R_{11}R_{22}}{R_{12}R_{21}}\leq\left(\frac{\sqrt{(\chi_a-\gamma_a)(W_a-Z_a)}+\sqrt{(\chi_a-W_a)(\gamma_a-Z_a)}}{\chi_a-Z_a}\right)^2,\ \delta^2\geq4\varphi\eta.$$

In this situation, if $\chi_a∃W_a$, $y_a∃Z_a$, the $\chi=0$ is unstable while $\chi=1$ is stable, at this time, φ, $\eta∃0$. But if φ and $\eta∃\frac{\delta}{2}$, so $\chi_1′\chi_2$, at this point, χ_1 is the stable balanced point while χ_2 is the unstable point. In other word, it means when $\chi_a-W_a= P^s_a-C_a+R^s_aI_a-P_a∃0$, $y_a-Z_a=R_aI_a-C_a∃0$, and φ , $\eta∃\frac{\delta}{2}$, $0\rightarrow\chi_1\leftarrow\chi_2\rightarrow1$. On the other hand, if $\chi_a′W_a$, $y_a′Z_a$, $\chi=0$ is stable while $\chi=1$ is unstable, at this time, φ, $\eta′0$. But if φ and $\eta′\frac{\delta}{2}$, so $\chi_1∃\chi_2$, at this point, χ_1 is the stable balanced point while χ_2 is the unstable point. In other word, it means when $\chi_a-W_a= P^s_a-C_a+R^s_aI_a-P_a′0$, $y_a-Z_a=R_aI_a-C_a′0$, and φ , $\eta′\frac{\delta}{2}$, $0\leftarrow\chi_2\rightarrow\chi_1\leftarrow1$.

(2) When $(\chi_a-y_a)(W_a-Z_a)$ and $(\chi_a-W_a)(y_a-Z_a)$ are both positive number,

$$\left(\frac{\sqrt{(\chi_q-\gamma_a)(W_a-Z_a)}-\sqrt{(\chi_a-W_a)(\gamma_a-Z_a)}}{\chi_a-Z_a}\right)^2<\frac{R_{11}R_{22}}{R_{12}R_{21}}<\left(\frac{\sqrt{(\chi_q-\gamma_a)(W_a-Z_a)}+\sqrt{(\chi_a-W_a)(\gamma_a-Z_a)}}{\chi_a-Z_a}\right)^2,\ \delta^2<4\varphi\eta.$$

Under this circumstance, there are only two balanced point in evolutionary game system, respectively are: $\chi=0$ and $\chi=1$.

So if $\chi_a∃W_a$, $y_a∃Z_a$. the $\chi=0$ is unstable while $\chi=1$ is stable. In other word, it means when $P^s_a-C_a+R^s_aI_a-P_a∃0$ and $R_aI_a-C_a∃0$, $0\rightarrow1$.But if $\chi_a′W_a$, $y_a′Z_a$, the $\chi=0$ is stable while $\chi=1$ is unstable. In other word, it means when $P^s_a-C_a+R^s_aI_a-P_a′0$ and $R_aI_a-C_a′0$, $0\leftarrow1$.

(3) When $(\chi_a-y_a)(W_a-Z_a)$ and $(\chi_a-W_a)(y_a-Z_a)$ are negative number, or $(\chi_a-y_a)(W_a-Z_a)$ is positive number, $(\chi_a-W_a)(y_a-Z_a)$ is negative number, $\delta^2\geq4\varphi\eta$ is permanently established under this circumstance.

So if $\chi_a∃W_a$, $y_a′Z_a$, the $\chi=0$ and $\chi=1$ both are stable. At this point, $\varphi∃0$ and $\eta′0$, χ_2 is the stable balanced point. it means when $P^s_a-C_a+R^s_aI_a-P_a∃0$ and $R_aI_a-C_a′0$, $0\leftarrow\chi_2\rightarrow1$. But if $\chi_a′W_a$, $y_a∃Z_a$, the $\chi=0$ and $\chi=1$ both are stable. At this point, $\varphi′0$ and $\eta∃0$, χ_1 is the stable balanced point, it means when $P^s_a-C_a+R^s_aI_a-P_a′0$ and

$R_aI_a – C_a \exists 0$, $0 \rightarrow \chi_1 \leftarrow 1$.

Here, since the group B only differ in their strategic returns from the group A, so they will not be discussed again. In the case, for non-uniform contact rate, the evolutionary result is related to the contact rate only when $(\chi_a–y_a)(W_a–Z_a)$ and $(\chi_a–W_a)(y_a–Z_a)$ are both positive. In other cases, the contact rate only change the position of χ_1 or χ_2. Because in the income matrix, $W_a=Z_a=P_a$, so $(\chi_a–y_a)(W_a–Z_a) = 0$, indicating that the contact rate in the system only changes the position of the saddle point without changing the direction of the evolutionary result. This also means that when group A chooses the strategy of not share the resources, increasing or decreasing the contact rate between group A and B only affect the process of evolution but won't affect the evolutionary result.

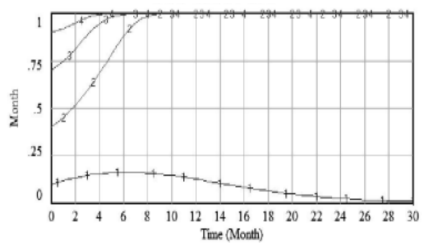
4. SD MODEL OF THE EVOLUTIONARY GAME THEORY AND ITS SIMULATION ANALYSIS

4.1 Simulation analysis of the SD model

Use Vensim PLE 6.3 to establish the evolutionary game model of sharing enterprise resource under cloud service environment. According to the above analysis, the simulation process in this paper fixed most of the initial value under the premise, from the initial sharing probability, upgrading equipment costs and profit, and technology loss risk factor those three aspects, and with the adjustment of the parameter size, observe the impact of its changes on the evolutionary results.

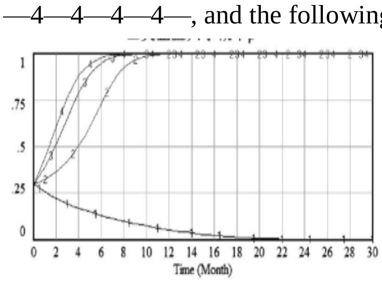
(1) The influence of the change of initial sharing probability on evolutionary results

Assuming that the INITIAL TIME=0, FINAL TIME=30, TIME STEP=0.5, P_{as}=2.2, P_a=1.2, C_a=0.4, I_a=0.6, r_{as}=0.8, r_a=0.4, P_{bs}=2, P_b=1, C_b=0.2, L_b=0.6, r_{bs}=0.1, r_b=0.2. With the given initial probability β=0.3 of choosing the shared strategy in group B, we divided the initial probability of choosing the shared strategy in group A into 0.1, 0.4, 0.7 and 0.9, and then observe the changes in the probability of choosing shared strategies between the two types of enterprises. The results can be seen in Fig.1 that when the initial probability of group B is fixed, the trend of evolution of the probability choosing the shared strategy of group A is more significantly affected by their initial probabilities. When the initial sharing probability α is higher, the evolution rate of the probability value converging to 1 is also relatively fast. And also when the initial sharing probability α of group A is higher, the sharing probability of group B will converges to 1; on the contrary, the sharing probability of group B converges to 0, Shown in Fig.2.(among them, α=10% represent —1—1—1—1—; α=40% represent —2—2—2—2—; α=70% is —3—3—3—3—; α=90% is —4—4—4—4—, and the following is equivalent)



The sharing probability α of group A

Fig. 1 The influence of the changes of the initial value α on the sharing probability of group A.

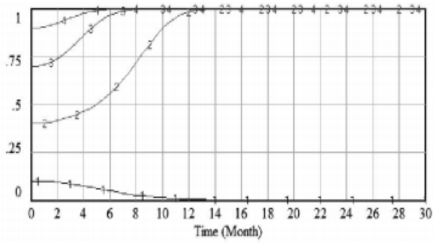


The sharing probability α of group B:

Fig. 2 The influence of the changes of the initial value α on the sharing probability of group B.

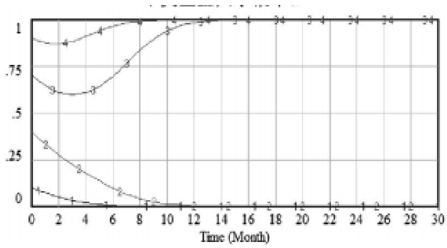
(2) The impact of the cost and profit of changing the equipment on the evolutionary result

In the other parameters remains the same conditions, we adjust the upgrade equipment cost C_a from the initial 0. 4 to 0. 6 and 0. 9, then get the evolution result shown in Figure3,4. Compared with the Figure 1, when the cost of upgrading equipment in group A gradually increases, the probability of choosing the sharing strategy converge to 1 decreases. In particular, when C_a = 0.9, group A with the initial probability 0.4 will eventually converge to 0, which means that group A will choose to abandon the strategy of sharing enterprise resources on the premise of higher equipment cost. Besides, because the profits is mainly brought by the information improvement factor, so we set improvement factor of information sharing r_{as} of group A rise from the initial 0. 8 to 0.9, and the information improvement coefficient r_a rise from the initial 0.4 to 0.6, as shown in Figure 5,6. At this point, the rate of shared probability in group A convergence to 1 is accelerated compared with that of Figure 4, the more prominent change is that the initial shared probability α=0.1 converges to 1 in Fig.6. From this we can see that enterprises promote information construction will not only enhance the efficiency of business operation, but also serve as an important guarantee for the cooperation among supply chains.



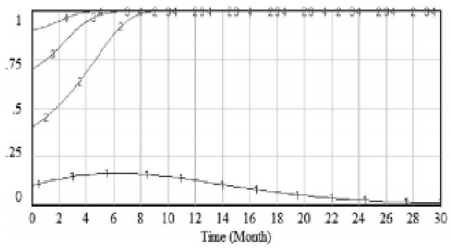
The sharing probability α of group A

Fig.3 The evolution results of the sharing probability in group A when C_a=0.6.



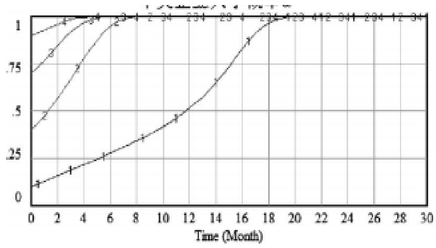
The sharing probability α of group A

Fig.4 The evolution results of the sharing probability in group A when C_a=0.9.



The sharing probability α of group A

Fig.5 The evolution results of the shared probability in group A when r_{as}=0.8, r_a=0.4.

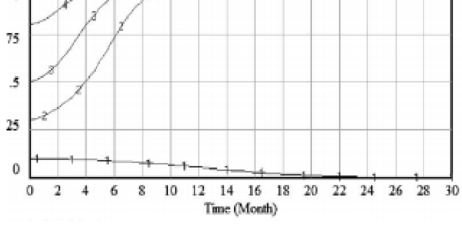


The sharing probability α of group A

Fig.6 The evolution results of the shared probability in group A when r_{as}=0.9, r_a=0.6.

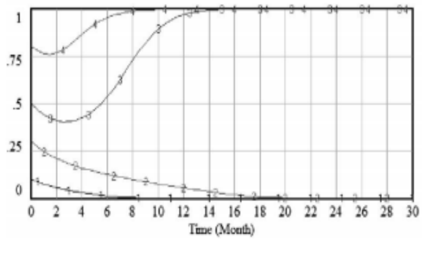
(3) Effect of risk factors of technological loss on evolutionary results

we adjust the technology loss risk factor from r_{bs}=0.1 to r_{bs}=0.4, then observe the evolutionary result of the shared probability in group B. Comparing Figure 7 with Figure 8, it is not difficult to find that the increase of technology loss risk greatly reduces the rate of initial value β=0. 5 and β=0. 8 converges to 1, and initial value β=0. 3 finally converges to zero. This shows that the probability of choosing a sharing strategy for group B will decrease as the risk of technology loss increases. When the coefficient increases to a certain extent, the enterprise will undoubtedly choose a strategy of not sharing enterprise resources.(β=0.1 is —1—1—1—, β=0.3 is —2—2—2—, β=0.5 is —3—3—3—, β=0.8 is —4—4—4—)



The sharing probability β of group B

Fig.7 The evolution results of the shared probability in group B when r_{bs}=0.1.



The sharing probability β of group B

Fig.8 The evolution results of the shared probability in group B when r_{bs}=0.4.

5. CONCLUSION

From the perspective of evolutionary game, this study constructed a strategy selection model of sharing enterprise resources, and uses the method of system dynamics to simulate the model dynamically. The impact of different factors on the evolutionary results is compared and analyzed. Through the discussion, supply chain members can adjust the contact rate between enterprises to make the evolutionary results more favored. Besides, the guiding effect brought by the construction of resource sharing platform and business alliances will make other businesses produce follow-up behavior, which help form the industry rules. And the ration between cost and benefit access to cloud platform is the main factor that enterprise consider when sharing resources, the technology loss risk factor also takes a part. But our research also has some disadvantages, as a resource sharing third-party intermediary, the model in our research didn’t include the factors involving cloud service platform provider, besides, the coordinated development of multi-cooperation is also widespread and it makes the evolutionary game model more complex. All of this are the directions of our next research.

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