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Research Article

Research on the Regional Cooperation of Technological Innovation in Food Industry Cluster

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Abstract: This study analyzes the technological innovation in food industry cluster cooperation and the non-cooperative game phenomenon between two regions and uses the tools of dynamic differential equations to ensure the realization of time consistency. This study solves the problem of optimal strategies of inter-regional cooperation by differential equations, achieves a reasonable distribution of income under the respective optimal trajectory and explains the cooperation between regional innovation in food industry cluster of food industry cluster from a new perspective, which is an effective way to promote inter-regional cooperation according to the required layout and style.

Keywords: Cooperative technology innovation, differential equations, food industry cluster

INTRODUCTION

Technical cooperation and innovation in food industry cluster is most collaborative R&D, Cooperative Research. Its essence is based on the division of a series of innovative activity. There is a certain stage actors involved in other innovation in food industry clusters in the innovation in food industry cluster process, which can be considered a co-innovation in food industry cluster.

The current problems are: First, alone innovation in food industry cluster and co-innovation in food industry cluster study did not produce contact with the path to create a theory of innovation in food industry cluster and there is no answer how to unlock alone innovation in food industry cluster and co-innovation in food industry cluster path dependence. Second, there are no comparative studies about independent innovation in food industry cluster and co-innovation in food industry cluster. Because of differences arising between the two different development trajectories in the path creation process, it is difficult to make decisions for different environmental changes.

MATERIALS AND METHODS

Currently scholars study the feasibility of cooperation and innovation in food industry cluster focusing primarily on industrial organization theory. Among them, (Kamien, 1989) found that most innovation in food industry cluster spillover models overflowing more than one key level will increase significantly relative gains of cooperative innovation in food industry cluster; (Katsoulacos, 1994) considered that when the spillover is out of reluctance of business, the participation and cooperation of innovation in food industry cluster companies can get access to outside expertise by facilitating knowledge transfer within the enterprise through sharing information. Irwin and Klenow (1996) also confirmed by empirical research that the members of the American semiconductor manufacturing technology strategic alliance can make profits under the circumstances of reducing R&D investment after the introduction of cooperative technology innovation in food industry cluster. The more similar the technologies of cooperative enterprises are, the less likely to have cooperative innovation in food industry clusters they are: Quite the reverse in non-related fields. Currently there is much literature of research on inner-regional innovation in food industry cluster of food industry cluster, mainly involving partners, ways of cooperation (relationship types), cooperative tendencies, cooperative performance and so on. In addition, scholars also discussed a number of other issues of innovation in food industry cluster cooperation in the study, such as Edquist *et al*. (2002) who studied the number of participants in innovation in food industry cluster cooperation, time of cooperation, the number of formal contracts and informal contracts, contents prescribed in the formal contracts, forms of knowledge transfer between partners, source of cooperation projects fund, patent cooperation. However, there is still not so much literature of research on inter-regional cooperative technology innovation in

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food industry cluster (d'Aspremont *et al*., 1981; Petrosyan and Yeung, 2007).

Theory analysis: On the base of theoretical derivation for dynamic stochastic cooperative game, the profit due to the alliance of two participants is that as follows:

$$E_{t_0}\left\{\int_{t_0}^{T}\sum_{j=1}^{2} g^j\left[s,x(s),u_1(s),u_2(s)\right]\exp\left[-\int_{t_0}^{s} r(y)dy\right]ds+\exp\left[-\int_{t_0}^{T} r(y)dy\right]\sum_{j=1}^{2} q^j(x(T))\right\}$$

To $i\in[1,2]$, there was $g^i(\cdot)\geq 0, q^i(\cdot)\geq 0$, which is subject to stochastic differential dynamic system:

$$dx(s)=f[s,x(s),u_1(s),u_2(s)]ds\ ,\ x(t_0)=x_0$$

Among them, $[t_0,T]$ is the duration of the game; $x(s)\in X$ is the status when the region is "s". $u_i(s)$ stands for the control variable of the participant "*i*" (it is called a strategy in static game). The participant "*i*" would obtain the terminal payment $q^i(x(T))$. $g^i[s,x(s),u_1(s)u_2(s)]$ is the instant payment (or reward) of the participant "*i*". Given a discount rate $r(s)$ changed by time, for $s\in[t_0,T]$, the profit on "t" after the point of time "t_0" would be taken according to the discount factor $\exp\left[-\int_{t_0}^{t} r(y)dy\right]$.

In the study, we suppose that $u(s)_i$ was the investment in the region "*i*" for regional technology progress and R&D in the point of time "*S*"; $mu_i(s)$ was the cost for R&D; $x_i(s)$ was the level of technology process of the region "*i*" in the point of time "*S*". $e^k(x(T))^{1/2}$ was the innovation in food industry cluster benefit in the terminal region "T" and e^k was a constant. Considering the impact of government policies, we suppose that "*a*" was the government preferential tax rate and "*b*" was the value of each point under the government financial subsidies allocation, which met uniform distribution during $[t_0,t]$. The discount factor was $e^{(-r(t_0\to t))}$ and its rate "r" was fixed. We assume that the objective function is strictly concave function of control variables, which meant there were positive correlation among the instant payment, terminal payment and state variables. When x_i become bigger, $g^i\left[s,x(s),u_1(s),u_2(s)\right]$ and $q^i(x(T))$ would be bigger either, which was in line with the actual relation between R&D investment and innovation in food industry cluster benefit.

The process of innovation in food industry cluster analysis:
Non-cooperative innovation in food industry cluster Analysis: Object:

$$V=\int_{t_0}^{T}[(1-a)(e^p x_i(s)^{0.5}-mu_i(s)+b)]e^{(-r(t_0\to s))}ds+e^k(x_i(T))^{0.5}e^{(-r(t_0\to T))}$$

Dynamic system:

$$\dot{x}_i(s)=e^{\partial}u_i(s)^{1-\theta}x_i(s)^{\theta}$$

In the study, we suppose that $e^{\partial}=\delta e^p$ Bellman equation (optimal strategy):

$$\begin{cases}-V_t^{(t_0)i}(t,x_i)=\max\limits_{u_i}\left\{(1-a)(e^p x_i^{0.5}-mu_i+b)e^{(-r(t-t_0))}+V_{x_i}^{(t_0)i}(t,x_i)e^{\partial}u_i^{1-\theta}x_i^{\theta}\right\}\\ V^{(t_0)i}(T,x_i)=e^{(-r(T-t_0))}e^k x_i^{0.5}(T)\end{cases}$$

To solve the equation of optimal strategy of area i :

$$\psi_i^*(t,x_i)=\left\{\frac{e^{\partial}}{4m(1-a)}\left[e^k-\frac{1-a}{r}e^p\right]e^{r(t-T)}+\frac{1-a}{r}e^p\right\}^2$$

The value function of area *i*:

$$V^{(t_0)i}(t,x_i)=\left[A_i^{\{i\}}(t)x_i^{0.5}-B_i^{\{i\}}(t)\right]e^{-r(t-t_0)}$$

The optimal state trajectory:

$$x_i^*(t)=\frac{e^{\partial}}{4}\left\{\frac{e^{\partial}}{4m(1-a)r}\left(e^k-\frac{1-a}{r}e^p\right)e^{r(t-T)}+\frac{1-a}{r}e^p t\right\}+x_i^0-\frac{e^{2\partial}}{16m(1-a)r}\left(e^k-\frac{1-a}{r}e^p\right)e^{-rT}$$

Cooperative innovation in food industry cluster analysis: The mutual influence of region and regional technical level is inversely proportional to the distance, the farther the distance cost more. d'Aspremont *et al*. (1981), have done such a hypothesis and we suppose that: $n=\frac{e^q}{h}$ was effect of distance factor, h was the distance between two areas, e^q was the constant.

Object:

$$V=\int_{t_0}^{T}\sum_{i=1}^{2}a(e^{p_i}x^{0.5}-\frac{1}{2}c_i u_i+b_i)e^{(r(t-t_0))}ds+\sum_{i=1}^{2}e^{k_i}(x(T))^{0.5}e^{(-r(t-t_0))}$$

Dynamic system:

$$\dot{x}_i(s)=e^{\partial}u_i(s)^{0.5}x_i(s)^{0.5}+n_i^{(j,i)}(x_j x_i)^{0.5}$$

To solve the equation:

$$V_t^{(t_0)\{1,2\}}(t,x_1,x_2)=\left[A_1^{\{i\}}(t)x_1^{0.5}+A_2^{\{i\}}(t)x_2^{0.5}+B^{\{1,2\}}(t)\right]e^{-r(t-t_0)}$$

This place:

$$\begin{cases}\dot{A}_i^{\{1,2\}}(t)=rA_i^{\{1,2\}}(t)-\dfrac{n_i^{\{j,i\}}}{2}A_j^{\{1,2\}}(t)-(1-a)e^p\\ \dot{B}^{\{1,2\}}(t)=rB^{\{1,2\}}(t)-(1-a)b+\dfrac{e^{2\partial}}{16m_i(1-a)}\left[A_i^{\{1,2\}}(t)\right]^2\\ A_i^{\{1,2\}}(T)=e^{k_i},B^{\{1,2\}}(T)=0\end{cases}$$

By the same token:

$$\begin{cases}A_1^{\{1,2\}}(t)=\dfrac{1}{2}\left[\dfrac{2(1-a)e^p}{r-\frac{n_1}{2}}+\left(e^{k_1}+e^{k_2}-\dfrac{2(1-a)e^p}{r-\frac{n_1}{2}}\right)e^{(r-\frac{n_1}{2})(t-T)}+(e^{k_1}-e^{k_2})e^{(r+\frac{n_1}{2})(t-T)}\right]\\ A_2^{\{1,2\}}(t)=\dfrac{1}{2}\left[\dfrac{2(1-a)e^p}{r-\frac{n_1}{2}}+\left(e^{k_1}+e^{k_2}-\dfrac{2(1-a)e^p}{r-\frac{n_1}{2}}\right)e^{(r-\frac{n_1}{2})(t-T)}-(e^{k_1}-e^{k_2})e^{(r+\frac{n_1}{2})(t-T)}\right]\\ B_1^{\{1,2\}}(t)=\left\{\begin{aligned}&\frac{(1-a)b}{r}+\frac{e^{2\partial}}{64m_1(1-a)}\left[\begin{aligned}&-\frac{4(1-a)^2e^{2p}}{r(r-\frac{n_1}{2})^2}+\left(e^{k_1}+e^{k_2}-\frac{2(1-a)e^p}{r-\frac{n_1}{2}}\right)^2\frac{1}{r-n_1}e^{(2r-n_1)(t-T)}\\&+(e^{k_1}-e^{k_2})^2\frac{1}{r+n_1}e^{(2r+n_1)(t+T)}\end{aligned}\right.\\&-\frac{4(1-a)e^p}{r-\frac{n_1}{2}}\left(e^{k_1}+e^{k_2}-\frac{2(1-a)e^p}{r-\frac{n_1}{2}}\right)\frac{2}{n_1}e^{(r-\frac{n_1}{2})(t-T)}+\frac{4(1-a)e^p}{r-\frac{n_1}{2}}(e^{k_1}-e^{k_2})\frac{2}{n_1}e^{(r+\frac{n_1}{2})(t-T)}\\&\left.+2\left(e^{k_1}+e^{k_2}-\frac{2(1-a)e^p}{r-\frac{n_1}{2}}\right)(e^{k_1}-e^{k_2})\frac{e^{2r(t-T)}}{r}\right]\end{aligned}\right\}+M\end{cases}$$

$$B_2^{\{1,2\}}(t)=\left\{\begin{array}{l}\dfrac{(1-a)b}{r}+\dfrac{e^{2\partial}}{64m_1(1-a)}\left[-\dfrac{4(1-a)^2e^{2p}}{r(r-\frac{n_1}{2})^2}+\left(e^{k_1}+e^{k_2}-\dfrac{2(1-a)e^p}{r-\frac{n_1}{2}}\right)^2\dfrac{1}{r-n_1}e^{(2r-n_1)(t-T)}\right.\\ \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad+(e^{k_1}-e^{k_2})^2\dfrac{1}{r+n_1}e^{(2r+n_1)(t+T)}\\ -\dfrac{4(1-a)e^p}{r-\frac{n_1}{2}}\left(e^{k_1}+e^{k_2}-\dfrac{2(1-a)e^p}{r-\frac{n_1}{2}}\right)\dfrac{2}{n_1}e^{(r-\frac{n_1}{2})(t-T)}-\dfrac{4(1-a)e^p}{r-\frac{n_1}{2}}(e^{k_1}-e^{k_2})\dfrac{2}{n_1}e^{(r+\frac{n_1}{2})(t-T)}\\ \left.-2\left(e^{k_1}+e^{k_2}-\dfrac{2(1-a)e^p}{r-\frac{n_1}{2}}\right)(e^{k_1}-e^{k_2})\dfrac{e^{2r(t-T)}}{r}\right]\end{array}\right\}+M$$

Among them:

$$M=-\frac{(1-a)b}{r}-\frac{e^{2\partial}}{64m_1(1-a)}\left[-\frac{4(1-a)^2e^{2p}}{r(r-\frac{n_1}{2})^2}+\left(e^{k_1}+e^{k_2}-\frac{2(1-a)e^p}{r-\frac{n_1}{2}}\right)^2\frac{1}{r-n_1}+(e^{k_1}-e^{k_2})^2\frac{1}{r+n_1}e^{(2r+n_1)2T}\right.$$
$$\left.-\frac{4(1-a)e^p}{r-\frac{n_1}{2}}\left(e^{k_1}+e^{k_2}-\frac{2(1-a)e^p}{r-\frac{n_1}{2}}\right)\frac{2}{n_1}+\frac{4(1-a)e^p}{r-\frac{n_1}{2}}(e^{k_1}-e^{k_2})\frac{2}{n_1}+2\left(e^{k_1}+e^{k_2}-\frac{2(1-a)e^p}{r-\frac{n_1}{2}}\right)(e^{k_1}-e^{k_2})\frac{1}{r}\right]$$

In two areas of Technology Alliance, The optimal strategy of area i:

$$\psi_i^{*\{1,2\}}(t,x_i)=\frac{e^{2\partial}}{16m_i^2(1-a)^2}\left[A_i^{\{1,2\}}(t)\right]^2$$

The optimal state trajectory:

$$x_1^*(t)=\left(\frac{\dfrac{-e^{2\partial+p}}{4m\left(r-\frac{n_1}{2}\right)}}{n_1}+\frac{\dfrac{e^{2\partial}}{8m(1-a)}\left(e^{k_1}+e^{k_2}-\dfrac{2(1-a)e^p}{\left(r-\frac{n_1}{2}\right)}\right)e^{-\left(r-\frac{n_1}{2}\right)T}}{2e^{\left(r-\frac{n_1}{2}\right)t}-n_1}e^{te^{\left(r-\frac{n_1}{2}\right)t}}+\frac{\dfrac{e^{2\partial}}{8m(1-a)}\left(e^{k_1}-e^{k_2}\right)e^{-\left(r+\frac{n_1}{2}\right)T}}{2e^{\left(r+\frac{n_1}{2}\right)t}+n_1}e^{te^{\left(r+\frac{n_1}{2}\right)t}}+\frac{c_0e^{\frac{n_1}{2}t}}{2}+\frac{c_1e^{\frac{-n_1}{2}t}}{2}\right)^2$$

$$x_2^*(t)=\left(\frac{\dfrac{-e^{2\partial+p}}{4m\left(r-\frac{n_1}{2}\right)}}{n_1}+\frac{\dfrac{e^{2\partial}}{8m(1-a)}\left(e^{k_1}+e^{k_2}-\dfrac{2(1-a)e^p}{\left(r-\frac{n_1}{2}\right)}\right)e^{-\left(r-\frac{n_1}{2}\right)T}}{2e^{\left(r-\frac{n_1}{2}\right)t}-n_1}e^{te^{\left(r-\frac{n_1}{2}\right)t}}-\frac{\dfrac{e^{2\partial}}{8m(1-a)}\left(e^{k_1}-e^{k_2}\right)e^{-\left(r+\frac{n_1}{2}\right)T}}{2e^{\left(r+\frac{n_1}{2}\right)t}+n_1}e^{te^{\left(r+\frac{n_1}{2}\right)t}}+\frac{c_0e^{\frac{n_1}{2}t}}{2}+\frac{-c_1e^{\frac{-n_1}{2}t}}{2}\right)^2$$

Among them:

$$c_0=\left(x_1^0\right)^{0.5}+\left(x_2^0\right)^{0.5}+\frac{\dfrac{e^{2\partial+p}}{4m\left(r-\frac{n_1}{2}\right)}}{n}-\frac{\dfrac{e^{2\partial}}{4m(1-a)}\left(e^{k_1}+e^{k_2}-\dfrac{2(1-a)e^p}{\left(r-\frac{n_1}{2}\right)}\right)e^{-\left(r-\frac{n_1}{2}\right)T}}{2e^{\left(r-\frac{n_1}{2}\right)t}-n_1}$$

$$c_1 = \left(x_1^0\right)^{0.5} - \left(x_2^0\right)^{0.5} - \frac{\frac{e^{2\partial}}{4m(1-a)}\left(e^{k_1} - e^{k_2}\right)e^{-\left(r+\frac{n_1}{2}\right)T}}{2e^{\left(r+\frac{n_1}{2}\right)t} + n_1}$$

In the guarantee under the premise of time consistency, the distribution mechanism in accordance with:

$$\mu^{(t_0)i} = V^{(t_0)i}(t_0, x_0) + \frac{1}{2}\left[V_t^{(t_0)\{1,2\}}(t_0, x_0) - \sum_{j=1}^{2} V^{(t_0)j}(t_0, x_0)\right]$$

In the subgame $\Gamma(x_\tau^*, T-\tau)$, area $i \in \{1, 2\}$ was satisfied:

$$\mu^{(\tau)i} = V^{(\tau)i}(\tau, x_\tau^*) + \frac{1}{2}\left[V_t^{(\tau)\{1,2\}}(\tau, x_\tau^*) - \sum_{j=1}^{2} V^{(\tau)j}(\tau, x_\tau^*)\right]$$

At the time $\tau \in [t_0, T]$, the moment balance compensation was:

$$\begin{aligned} C_i(\tau) = &-\frac{1}{2}\left\{\left[\left(\dot{A}_1^{\{1\}}x_1^{\tau*} + \dot{B}(\tau)\right) - r\left(A_1^{\{1\}}x_1^{\tau*} + B(\tau)\right)\right] + \frac{1}{2}A_1^{\{1\}}(x_1^{\tau*})^{-0.5}\left[\frac{e^{2\partial}}{4m_i(1-a)}A_1^{\{1,2\}}(x_1^{\tau*})^{0.5}\right]\right\} \\ &+\frac{1}{2}\left\{\begin{aligned}&\left[\left(\dot{A}_1^{\{1,2\}}(x_1^{\tau*})^{0.5} + \dot{A}_2^{\{1,2\}}(x_2^{\tau*})^{0.5} + \dot{B}^{\{1,2\}}(\tau)\right) - r\left(A_1^{\{1,2\}}(x_1^{\tau*})^{0.5} + A_2^{\{1,2\}}(x_2^{\tau*})^{0.5} + B^{\{1,2\}}(\tau)\right)\right] \\ &+\frac{1}{2}A_1^{\{1,2\}}(\tau)(x_1^{\tau*})^{-0.5}\left[\frac{e^{2\partial}}{4m_i(1-a)}A_1^{\{1,2\}}(x_1^{\tau*})^{0.5} + n_2^{(2,1)}\left(x_2^{\tau*}, x_1^{\tau*}\right)^{0.5}\right]\end{aligned}\right\} \\ &+\frac{1}{2}\left\{\left[\left(\dot{A}_2^{\{2\}}x_2^{\tau*} + \dot{B}(\tau)\right) - r\left(A_2^{\{2\}}x_2^{\tau*} + B(\tau)\right)\right] + \frac{1}{2}A_2^{\{2\}}(x_2^{\tau*})^{-0.5}\left[\frac{e^{2\partial}}{4m_i(1-a)}A_2^{\{1,2\}}(x_2^{\tau*})^{0.5}\right]\right\} \end{aligned}$$

In the Regional Alliance, the end payment was:

$$V_t^{(t_0)\{1,2\}}(T, x_1, x_2) = e^{-r(T-t_0)}e^{k_i}\left[x_i(T)\right]^{0.5}$$

RESULTS AND DISCUSSION

Arrange a simulation experiment to further analyze the difference between non-cooperative innovation in food industry cluster and cooperative innovation in food industry cluster. Under common condition, assume that there exist two areas (Area 1 and 2):

$m = 1$, $p = 1$, $\partial = 2$, $k_1 = 1$, $k_2 = 2$, $a = 0.2$, $b = 5$, $r = 0.02$, $t \in [0, 5]$, $u_1^0 = 1$, $u_2^0 = 2$, $n_1 = n_2 = n = 0.01$

Base on this, by using MATLAB program, optimal strategy, optimal trajectory and cost function are described respectively under the conditions of non-cooperative innovation in food industry cluster and cooperative cooperation.

Non-cooperative innovation in food industry cluster: The two areas show the innovation in food industry cluster under non-cooperative cooperation. The R&D investment at the starting point of Area 1 is $u^0{}_1$ and the same for Area 2 is $u^0{}_2$ and the final revenues of the two areas at the ending point T are different. When all the other parameters stay the same, difference in k_1 and k_2 leads to the difference of $e^k(x(T))^{1/2}$. The condition of signing cooperation agreement determines k_1 and k_2 and generally speaking, abundant areas gain more from the agreement, so k becomes higher.

Firstly, while analyzing optimal strategy, Fig. 1 shows that in the game of non-cooperative innovation in food industry cluster, the innovation in food industry cluster costs of the two areas are gradually increasing.

Secondly, we check the locus of technical progress after the optimal strategy being settled, the curves of the two different areas in Fig. 2 show that no matter what original conditions are, technical progresses are stable after R&D investment.

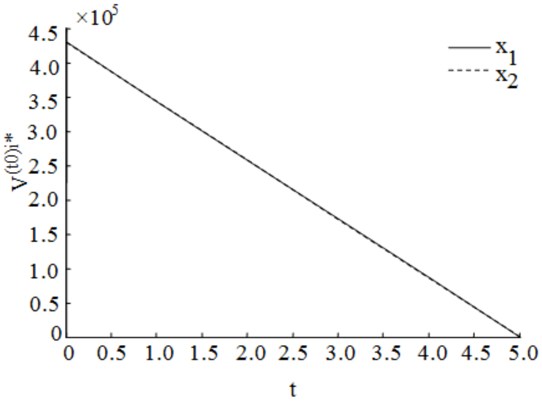

Fig. 1: Optimal strategy

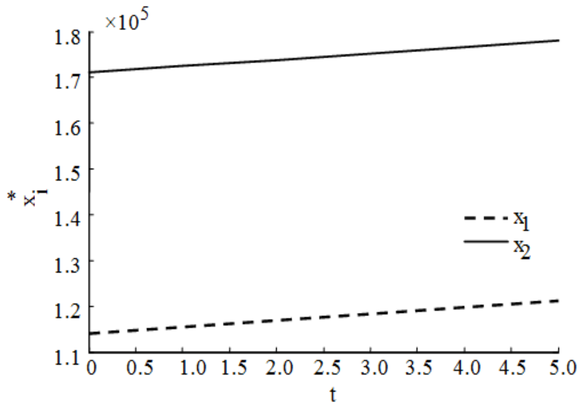

Fig. 2: Optimal trajectory

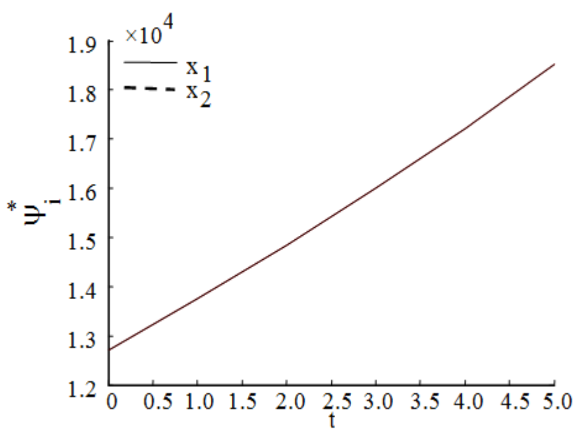

Fig. 3: Value function

Thirdly, when analyzing the value functions of both areas, along with technical innovation in food industry cluster, Fig. 3 shows a slow reduction in the innovation in food industry cluster income of non-cooperative innovation in food industry cluster and finally approaches 0.

Cooperative innovation in food industry cluster: The two areas show the innovation in food industry cluster

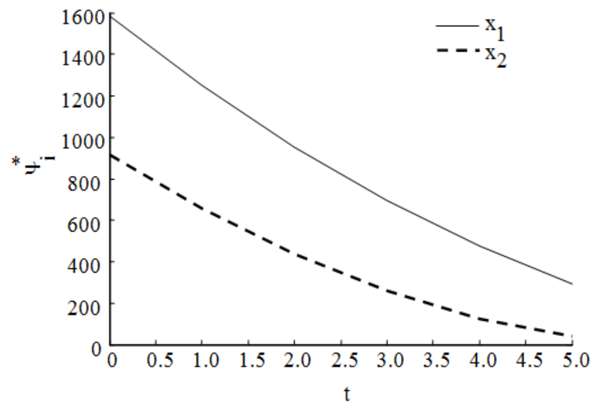

Fig. 4: Optimal strategy

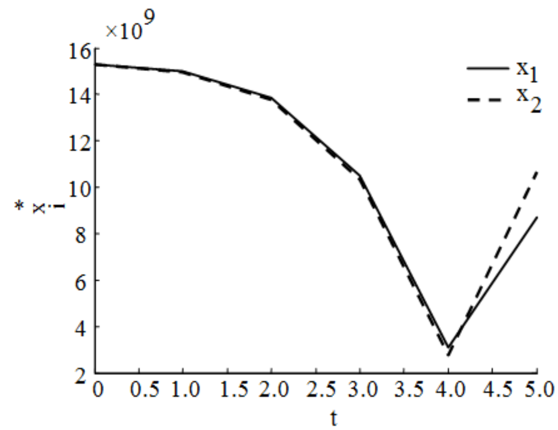

Fig. 5: Optimal trajectory

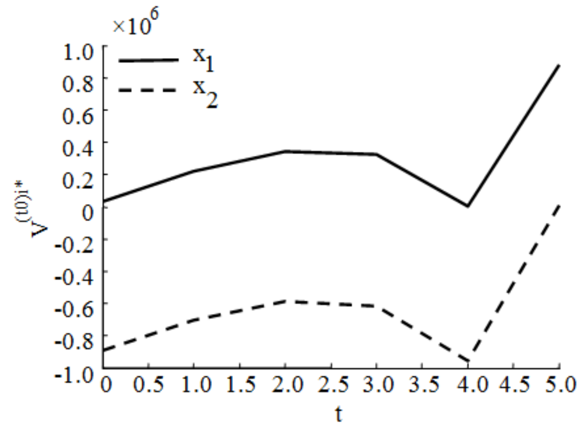

Fig. 6: Value function

under cooperative cooperation. Just like non-cooperative innovation in food industry cluster, the R&D investment at the starting point of Area 1 is $u^0{}_1$ and the same for Area 2 is $u^0{}_2$ and the final revenues of the two areas at the ending point T are different. When all the other parameters stay the same, difference in k_1 and k_2 leads to the difference of $e^k\,(x\,(T))^{1/2}$.

Firstly, when analyzing the optimal strategy, Fig. 4 shows that in the game of cooperative innovation in food industry cluster, the innovation in food industry cluster costs of the two areas are gradually reducing.

Secondly, we check the locus of technical progress after the optimal strategy being settled. The curves in Fig. 5 show that the regional technical progress first reduce and then increase after cooperatively innovates among regions.

Thirdly, we analyze the value functions of the both areas. Figure 6 shows that the cooperative innovation in food industry cluster among regions first increases then falls, but it rapidly increases in a certain time.

According to the theory, technical innovation in food industry cluster path shows that technical innovation in food industry cluster keeps increasing rapidly at the beginning, then slows down and finally subsides, which is called Technology Lock-in. Path creation begins through the "unlock" process and new rapid growth of technical progress begins. The author deals with non-cooperative innovation in food industry cluster and cooperative innovation in food industry cluster in this text to prove that both innovation in food industry clusters make different contributions to technical progress in different period of times. It shows an obvious advantage of non-cooperative innovation in food industry cluster at the beginning, so when selecting path, investment should be more on non-cooperative innovation in food industry cluster. Soon after, rapid growth in technical innovation in food industry cluster diverts advantage to cooperative innovation in food industry cluster, so more investments should be put into cooperative innovation in food industry cluster when selecting path. In the third period, optimal strategy of cooperative innovation in food industry cluster keeps reducing and technical progress subsides after reached a previous peak, then advantage returns to non-cooperative innovation in food industry cluster in the path selecting process and thus a new technical progress begins.

CONCLUSION

This study found that the instant income and compensation is associated with both earnings of the non-cooperation and cooperation. As already expressed, income of non-cooperative innovation in food industry cluster is associated with investment strategies of innovation in food industry cluster subjects, tax preference and other factors. when the earnings of non-cooperative innovation in food industry cluster is large, inputs and outputs of the regional innovation in food industry cluster of food industry cluster subject increase, the regional innovation in food industry cluster of food industry cluster subject have stronger Bargaining power in co-innovation in food industry cluster, obtain more cooperative distributive profit. When the non-cooperation income of cooperation is high, their profit of cooperation is also high. Thus, the income of each main innovation in food industry cluster cooperation is higher. At any time, in accordance with transferable payment got distribution program, procedures are in accordance with the optimal allocation of both the principle of consensus earnings initially locked and achieve win-win Pareto optimal situation. Of course, our study can still be extended to multi-player cooperation, but the process is quite complicated and this study will not repeat them.

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