Choice of the Models for the Co-operative Innovation of Industries, Universities and Research Institutes by Game Analysis

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Abstract

This paper builds game model to analyze selection issues of IUR co-operation model through Nash bargaining theory. The result shows that, the stronger innovative capability, more economic benefits expected, less technical content of scientific research, companies more inclined to choose a higher degree of close model; otherwise, companies tend to choose more closely integrated degree lower mode.

Keywords: IUR Co-operation, Model, Game

Since the co-operation between the industries, universities and research institutes becomes more and more important, the co-operation shows diversified forms, and many modes occupied in practice. Different modes of cooperation have different characteristics, cope and selection basis, therefore, the study of best mode for the better performance is required.

1. Basic Cooperation Model

1.1 Transfer technology

The model of technology transfer is the economic legal behavior of the parties to transfer of the right to the use of patented technology, technical secrets, licensing, etc. the most common situation is the research institutes and universities are transfers, while the enterprises are transferees.(Wang wenyan, Sun Fuquan etc,2008).

1.2 Joint development (commissioned Development)

joint development model refers to the enterprise put labor and capital, and the company gives technical cooperation requests according to the production and market needs, or by the parties bring the technologies to production, all parties participation to total or a section of the development process. This model is a concurrent development, with market driven and technology driven.

1.3 Joins forces to the entity

the model of building a entity is the enterprises, universities, research institutions build a new consortium to share resources(including information, finance and technology, etc) and personnel, it has a resource allocation optimization, and to benefit from the consortium. Enterprises choose to build consortium with universities and research institutions based two reasons. On the one hand, the new consortium realized the internalization of technology transactions, reducing transaction costs; other hand, the joint between the different units, thereby increasing the formation process of the transaction costs.

These three models have different levels of integration, and the levels of them become more and more strengthen. (Xin aifang. 2008)

2. Game Model

2.1 Basic assumptions

(1) Suppose the game players are A-enterprises and B-university or research institutions (without considering the

universities and research institutions into the game). B has a strong R & D capability, But do not have the capacity to commercialize R & D results, so if B and A don't choose to cooperate, then its expected return is 0. A has stronger commercialization capacity of R & D, but its R & D ability is less than B.

(2) Suppose R & D costs is C1, C1 reflected R & D achievements of Technical content, the higher-tech R & D results, the higher cost of C1; after the success of phase, A puts development into production, and C2 are production costs.

(3) Suppose the probability of success can be showed as the Pi, of Which P1, P2, P3, respectively show the separate R & D success Probability of A, the probability of successful R & D of B, the Probability of success of cooperative R & D of A and B, they were Indirectly react the innovation capability of A,B, and new Organization. Under the assumption (1), 1> P3> P2> P1> 0. If the R & D fails, the gain is 0.

(4) R & D and successful commercialization of R & D success is expected to create revenue of V.

(5) Select the transfer mode, the transfer price is P.

(6) Select the cooperative development mode, A certain percentage of R & D costs, the percentage coefficient is x.

(7) Select the build entity models, the costs of increased formation of Entities set up is I, the costs reduced of transaction is I1.

(8) A and B sides have the symmetric information, and the process of cooperation without moral hazard problem.

Through the basic assumptions of the Cooperative process, cooperative game tree can be drawn from companies A and University B (seen in Figure 1).

2.2 Model Solution.

it is seen that, A and B need consultation around the transfer price P, the ratio of profits and corporate R & D expenses, it is a bargaining process, the paper uses Nash bargaining solution problems.

When A chooses cooperation model of technology transfer, the Nash bargaining solution needs meet:

$$\max_P (P_2V - C_2 - P - P_1V + C_2 + C_1)(P - 0) \tag{1}$$

Solves the first derivative in the P-style of the equation (formula 1):

$$P = \frac{P_2 - P_1}{2}V + \frac{C_1}{2} \tag{2}$$

When a selectes technical innovation through Cooperative development mode, the Nash bargaining solution meets:

$$\max_m (mP_3V - C_2 - xC_1 - P_1V + C_2 + C_1)[(1-m)P_3V - (1-x)C_1] \tag{3}$$

Solves the first derivative in the P-style of the equation (formula 3):

$$m = \frac{(P_3 + P_1)V - 2(1-x)C_1}{2P_3V} \tag{4}$$

Therefore, the payment vector of A and B at various strategic combinations can be expressed as:

(Technology transfer, cooperation): $(\frac{P_2 + P_1}{2}V - \frac{C_1}{2} - C_2, \frac{P_2 - P_1}{2}V + \frac{C_1}{2})$

(Technology transfer, un-cooperation): $(P_1V - C_2 - C_1, 0)$

(Joint development, cooperation): $(\frac{P_3 + P_1}{2}V - C_1 - C_2, \frac{P_3 - P_1}{2}V)$

(Joint development, un-cooperation): ($P_1V- C_2- C_1,0$)

In summary, it can be seen, as 1> P3> P2> P1> 0, no matter b choose which type of cooperation, its expected return is greater than 0, therefore, B's dominant strategy is to agree to cooperate with A. otherwise, A's dominant strategy depends on both the size of the inequality and variables C1, P1, P2, P3, and V (Wang Liping, Ma Qingxi, 2009).

2.3 The impact of various factors on Choice

(1) The ability of innovation. the effect of Technological innovation through Cooperative is 1 +1> 2, Therefore, while other variables remain the same circumstances, innovation ability is stronger,

$$\frac{P_3 + P_1}{2}V - C_1 - C_2 > \frac{P_2 + P_1}{2}V - \frac{C_1}{2} - C_2 \text{ more likely, A is likely to choose a development model.}$$

(2) The technical content of scientific research. Based on the basic assumptions of the game model, the technical content of scientific research reflected into the R & D costs, in the case of the other variables constant, the greater the cost, $\dfrac{P_2 + P_1}{2}V - \dfrac{C_1}{2} - C_2 > \dfrac{P_3 + P_1}{2}V - C_1 - C_2$ the greater the likelihood. That is, the higher concentration of scientific research of technology, A is more likely to select the technology transfer cooperation.

(3) Expected economic benefits. Based on the game's basic assumptions, P3> P2> P1, so $\dfrac{P_3 + P_1}{2}$ > $\dfrac{P_2 + P_1}{2}$, in the case of other variables constant, we can see that the economic benefits expected greater V,

$$\frac{P_3 + P_1}{2}V - C_1 - C_2 > \frac{P_2 + P_1}{2}V - \frac{C_1}{2} - C_2 \text{ more likely, A more may choose to co-development model.}$$

3. Cooperation Mode Analysis

Through the preceding analysis, we can draw the following conclusions:

When Cooperation meets the following conditions, enterprises tend to choose universities or research institutes with co-development, or even choose to build an entity with access to technology through Cooperative (Wang Xueyuan, Wang Hongqi etc, 2005).

(1) Large-scale enterprises, a more complete R & D institutions and a number of R & D researches, having some R & D capabilities, and don't have large difference between academic and research side. Such enterprises can afford high costs through Cooperative, to ensure the smooth progress of cooperation.

(2) The technical content of scientific and technological achievements through Cooperative development and input costs are not high, in this case, enterprises to participate in part of the development process is profitable. While, when technical and R & D is immature, but having great marketing prospects, despite through Cooperative R & D in the way that enterprises have to bear the risk of failure of technology development, but once developed, companies will get huge profit margins, therefore, Enterprises tend to choose the close combination.

Select this Cooperative Mode can not only successfully obtain the necessary technical achievements, and more importantly, enterprises can accumulate some experience at the same time, improve their research institutions and enhance their R & D capability. When subject to the following conditions, companies tend to choose the way of technology transfer or commissioned research from the academic and research side to obtain the required technology.

(1) when Company's R & D capability is weak, and academic and research side of the greater potential difference, rely on external forces to gain the necessary skills, not only avoid the weakness of their own lack of research and development capabilities, and can also reduce the risks of research, which will help enterprises to rely on external forces to complete their development projects, products, meet changes timely in market demand, also play an important role for Enterprises to seize the opportunities.

(2) The application of technology is narrowed and the market is small, and without high complexity. The technology is mature technology, if companies take a huge cost to acquire this type of technology that is obviously not economical.

Whether selected the mode of entity depends on transaction costs of setting up the early entity enterprise can save transaction costs. If entity has a lower total cost of the entity, A and B will build a entity as cooperation choice. The transaction costs of building, including costs of collection of information (the cost of A searching for suitable partners), opportunity costs and other costs; the cost savings of operational phase including communication costs, negotiation costs, compliance costs. Generally it is suitable for larger corporate groups and universities and research institutions.

References

Wang, Liping & M,a Qingxi. (2009). The selection of Enterprises and universities (research institutions) cooperative game mode. *Daqing: Daqing Petroleum Institute,* Vol. 1, 93-96.

Wang, wenyan & Sun Fuquan et al. (2008). Classification, characteristics and choice of Cooperative Mode. *Beijing: China Science and Technology Forum*, Vol. 5, 37-40.

Wang, Xueyuan & Wang Hongqi et al. (2005). The study of Academy Union model and selection strategy. *Beijing: China University of Technology Transfer*, Vol. 11, 64-67.

Xin, Aifang. (2008). Analysis of Cooperation Choice of Research Cooperation model. *Nanchang: Enterprise economy*, Vol. 9, 62-63.
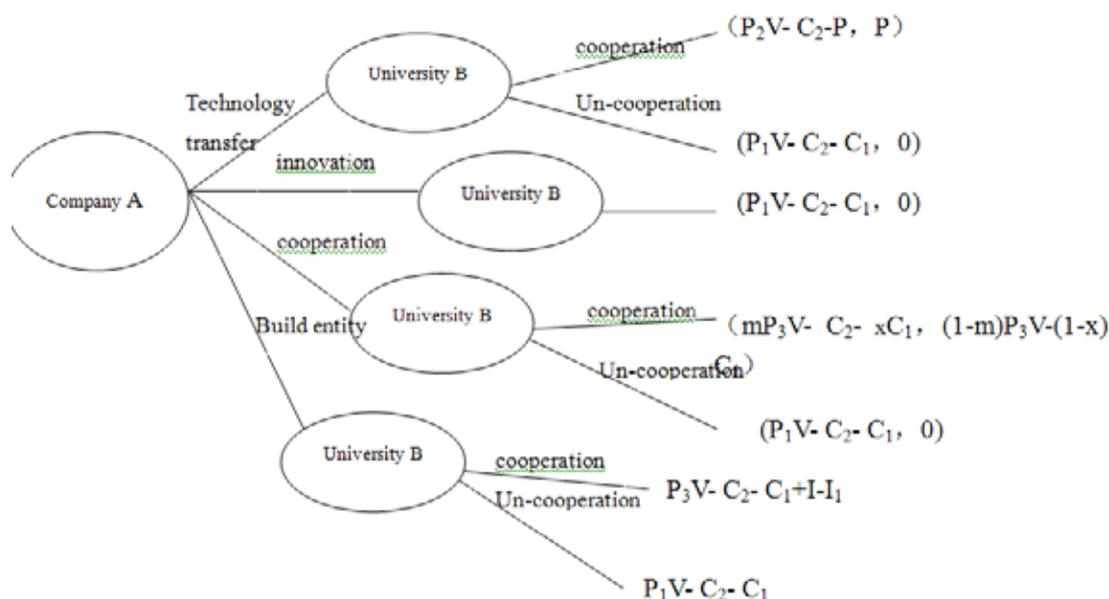
Figure 1. Mode game tree of Technological innovation through Cooperation