Motive Mechanism of Industry-University-Research Cooperation and Its Countermeasures to Conflict from Profits Allocation

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Abstract: IUR cooperation is the cooperation of different profit subjects. Much IUR cooperation is not successful, although it can bring about excess earnings and has endured tremendous development. The crux conflict lies in the unreasonable profits allocation way. Fair and reasonable profits allocation playing the important role of motive mechanism which facilitates cooperation of partners. This essay adopts a method that combines qualitative and quantitative research and discusses the motive mechanism of IUR cooperation. Furthermore, empirical analysis of cooperation profits allocation methods are carried out with the application of Shapley value.

Keywords: Industry-University-Research (IUR) cooperation, motive mechanism, profits allocation conflict and countermeasures, Shapley value

1. Introduction

As the age of knowledge economy comes, Industry-University-Research (IUR) cooperation has become the successful experience and trend of combining science, technology and education in many countries, and it is the optimum way that transforms scientific and technological achievement into productive forces. Along with the development of our economy, the intensification of institutional reform and the enhancement of technologies of enterprises, IUR cooperation has endured tremendous development. Nevertheless, researches show that much IUR cooperation is not successful. Such as Betz, E (1996) study suggests that, both of the quantity, relationship and the outputs of new technology are far below the level of IUR cooperation actually can achieve. There are many reasons for the unsuccessful, the empirical research from Lv Hai-ping and GONG Jian-li (2004) shows that more than 50% failure of cooperation derive from unreasonable profits allocation way.

IUR cooperation is the cooperation of different profit subjects. Each subject focuses on ascertaining the proportion of interest distributed. In the process of IUR cooperation in various countries, allocation of economical profits serves as the principal driving leverage and favorable relationships among subjects secure the development of IUR cooperation.

There have been many researches about IUR cooperation profits allocation. American scholars N.X.Jia and R.Yokoyama (2003), Voropai Nikolai (2006), put forward the application of cooperative game theory to solve power enterprise profits allocation. Chinese scholar LUO Li, LU Ruo-yu(2000) established the game model of the IUR cooperation, and discussed the profits allocation on the base of game theory. In terms of the characteristics of IUR cooperation, DONG Biao and WANG Yu-dong (2006) analyzed the factors that influence interests-allocation of the cooperation. Based on that, they designed the method on profits allocation of the cooperation and made positive analysis according to the satisfaction degree of cooperating partners by using asymmetric Nash negotiating model. YANG De-qian(2007) established an evolutionary game model of IUR cooperation basing on evolutionary game theory, and analyzed the spontaneous evolutionary process of IUR cooperation. The result shows system's evolutionary direction presents the characteristics of path dependence and it is affected by cooperative profits the partners can acquire from IUR cooperation and the equitable degree of profits allocation.

The researches of foreign scholars of IUR cooperation profits allocation have comprehensive and thorough, and most Chinese scholars' researches are still remain at the technical level, although some
new theoretical tools have been carried out. We adopt a method that combines qualitative and quantitative research in this paper. On the basis of the research achievements of scholars at home and abroad, we discuss the motive mechanism of IUR cooperation, and carry out the empirical analysis of cooperation profits allocation with the application of Shapley value from the perspective of knowledge supply chain, trying to find out the crux of the profits allocation conflicts and more reasonable solution.

2. Motive Mechanism of IUR Cooperation

2.1 Motive factors
Good motive mechanism is a fundamental condition to produce optimal function for IUR cooperation. The motive of cooperation comes from market demand, market competition, incentive policies and technological developments, etc, and these dynamic factors may vary according to the different subjects, different industry and different ways of cooperation. Industries, university and scientific research institutes have their respective economic interests and social benefit in the process of the integration of production, teaching and research. These different interests have constituted the driving force for IUR cooperation.

2.2 Factor of profits allocation
Taking advantage of knowledge support system is essential in establishing a favorable knowledge supply chain interaction hierarchy. Generally speaking, two parts are contained in such support system. One is university, the other is institutes. Universities and institutes’ superiority of being bases for knowledge innovation is determined by their advantages in discipline, talents, information and academic atmosphere. Harnessing these advantages can contribute to improving industries’ equipments, innovating technology, meliorating operations and developing new products. In addition, technology innovation ability and market competitiveness can be enhanced and new growth areas can be fostered. In practices of IUR cooperation, not only universities and institutes take their advantages, but also industries make their voice heard through their preponderance in enterprise economic management, marketing management and expansion, information about supply and demand and fund raising. Cooperation with industries helps boost commercial application and industrialization of scientific and technological achievements. What’s more, industries can be attracted to invest into universities and institutes, thus ameliorating conditions of universities and institutes’ running. Unique resources and advantages of each side can be effectively associated through favorable cooperation. Resources sharing and complementation of each other’s advantages creates new comprehensive advantages which are unprecedented, making the whole profit surpass the total profits added up by profits made by each member running alone. Meanwhile, with regard to each member, they can acquire more profits after their participation in such cooperation relationship. Profits allocation is the crux issue of IUR cooperation, which has a direct impact on the chronicity and stability of cooperation. However, profits allocation tends to restrain and hinder the promotion of IUR cooperation due to factors like the diversity of cooperation patterns, complexity of innovation and variation of supply and demand in market. Therefore, each side should make clear definition in advance towards profits allocation in the preliminary phase of cooperation. Distributable profits of IUR cooperation contains intangible assets like patent, trademark, copyright and reputation generated in cooperation process besides margins and other cooperation products. And scientific assessment on these intangible assets proves to be major constituent part of distributable profits of IUR cooperation. Profits allocation mechanism of IUR cooperation combined with technological innovation refers to institutional arrangement that allocates tangible and intangible profits generated in the process of cooperation and innovation.
2.3 Method of profits allocation

Method selection for profits allocation should be prudent. Existing methods are listed as follows: technology development and transfer expenses paid in a lump sum (that is aggregate payment); successive commissions paid in proportion to output, sales or margins (that is commission payment); drawing extra dividends in proportion to capital stocks of each side owned by investing into technologies and funds. For the time being, the prevailing method is commission paid in proportion to sales. Each side aims at creating and providing ultimate products and services by taking advantage of their technologies. Industries pay to institutes in accordance with market value achieved in certain limits and periods. Such method corresponds with principles of profits allocation. Specific standards guarantee profits of each side and market competitiveness is indicated by sales. Profits are related with risks involved closely with standards of technology innovation and reliability. So it keeps to laws of market economy and is scientific. Meanwhile, it’s relatively easy to check sales, which reflect enterprise performance directly and strengthen the confidence of each side. In the following part, we adopt Shapley value method to conduct positive analysis towards profits allocation of IUR cooperation.

3. Shapley Value Model

Shapley value method was a method of mathematics proposed by Shapley L.S. in 1953 used for settling Cooperative-person game issues. Shapley value method bases upon allocating total profits on the ground of marginal contribution of each side made to the alliance, which ensure the fairness of allocation. Shapley value method better embodies contribution of each side made to the alliance than any other general means, thus being more reasonable and scientific. When $n$ individuals are engaged in economic activities, every combination of certain number of persons will bring about some benefits. When profit-making activities of each side are not antagonist, the increase of individuals won’t cut down profits. So the cooperation of entire $n$ individuals will generate maximum profits. And Shapley value method is just one way of allocating maximum profits. It’s defined as follows:

There’s a assumed set $I=\{1,2,...,n\}$ meaning a combination of $n$ individuals. If any subset $s$ of $I$ corresponds to a real-valued function and the meet following two conditions:

$$v(\Phi) = 0$$

$$v(s_1 \cup s_2) \geq v(s_1) + v(s_2), s_1 \cap s_2 = \Phi, \ s_1 \subseteq I, s_2 \subseteq I$$

then $v(s)$ can be called the characteristic function defined in $I$ and $v(s)$ indicates the profits of $s$.

Expression (1) and expression (2) expound system thinking that entirety is greater than accumulated parts. Put in another word, it means each member makes more profits when they cooperate with cooperation not damnifying individual profits. What’s more, maximum profits are achieved when all members collaborate together. Maximum cooperation profits can be written as $v(I)$.

On the basis of cooperation $I$, the due profits obtained by member $i$ comes at $\phi_i(v)$ with maximum cooperation profits being $v(I)$. Then allocation of cooperation issues can be depicted as $\Phi(V) = \{\phi_1(v), \phi_2(v), \cdots, \phi_n(v)\}$. Obviously, following conditions should be met if it comes to the coming through of cooperation.

$$\sum_{i=1}^{n} \phi_i(v) = v(I), \phi_i(v) \geq v(i), \ i = 1, 2, \cdots, n$$

Based upon cooperation $I$, profits of each cooperative partner can be determined by means of Shapley value method:

$$\phi_i(v) = \sum_{s \in S(i)} w(|s|)[v(s)-v(s \setminus i)], \ i = 1, 2, \cdots, n$$
\[ w(\{s\}) = \frac{(n-|s|)!(|s|-1)!}{n!} \]  

In expression (4) and expression (5), \( s(i) \) indicates all subsets of set \( I \) which contain cooperative partner \( i \). \(|s|\) indicate quantity of elements in subsets. \( n \) indicates quantity of elements in set \( I \). \( w(\{s\}) \) acts as weighted factor. \( v(s) \) indicates profits of subset \( S \). \( v(s \setminus i) \) is the attainable profits when member \( i \) is excluded. Shapley value method to some extent suggests the fairness and rationality of profits allocation for it allocates profits in light of contribution made by each cooperative partner.

4. Application of Model

Assume that there’s a combination of university A, institute B and enterprise C, which can be described as \( I=\{1, 2, 3\} \). University A and institute B act as the suppliers of scientific technologies to enterprise C, and the latter promotes technologies into productivity so that profits of the cooperation can be made. In this cooperation alliance, original mutual independent institutions optimize and integrate their own core competencies in order to pursue maximum profits.

Assume that university A, institute B and enterprise C run each own business independently, then each reaps profits of \( v(1)=v(2)=v(3)=100 \) million Yuan.

Assume that university A and enterprise C establish cooperative partner relationship then their total profits arrives at \( v(1, 3)=250 \) million Yuan.

Assume that institute B and enterprise C establish cooperative partner relationship then their total profits arrives at \( v(2, 3)=300 \) million Yuan.

Assume that university A, institute B and enterprise C make up cooperative partner alliance, then their overall profits come at \( v(1, 2, 3)=500 \) million Yuan.

Owing to university A and institute B both being institutions that supply scientific technologies, it’s improper to absorb the two a profit-making cooperation alliance, that is to say \( v(1, 2) \) is nonexistent.

After that, we can establish models to allocate profits through Shapley value method used in Cooperative-person game.

As mentioned, \( \Phi(V) = \{\phi_1(v), \phi_2(v), \phi_3(v)\} \) indicates profits allocation after partner relationship of university A, institute B and enterprise C is established. In this expression, \( \phi_i(v) \) refers to profits allocated to partner v. In terms of fixed I, \( S_i \) is taken as a set which contains subsets of \( I \).

Combined with expression (4) and expression (5), we can figure out \( \phi_1(v)=125 \) million Yuan. That is to say, university A reaps profits of 125 million Yuan in cooperation alliance. Likewise, institute B can make profits of 150 million Yuan, and enterprise C share the maximum 225 million, which corresponds to its status in cooperation alliance. It is thus clear that profits allocation of IUR cooperation takes significance level of each side into consideration. Consequently, drawbacks of equal allocation can be avoided.

Profits of each side vary due to before and after the application of Shapley value method for profits allocation (showed as table1).

<table>
<thead>
<tr>
<th>Table 1 Comparison of profits of each side before and after application of Shapley value method (Unit: million Yuan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before application</td>
</tr>
<tr>
<td>( v(1)=100 )</td>
</tr>
<tr>
<td>( v(2)=100 )</td>
</tr>
<tr>
<td>( v(3)=100 )</td>
</tr>
<tr>
<td>( v(1)+v(3)=250 )</td>
</tr>
</tbody>
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\[
\begin{array}{|c|c|}
\hline
v(2) + v(3) = 300 & \phi_2(v) + \phi_3(v) = 375 \\
\hline
v(1) + v(2) + v(3) = 500 & \phi_1(v) + \phi_2(v) + \phi_3(v) = 500 \\
\hline
\end{array}
\]

IUR cooperation brings about profits of 500 million Yuan, which generates more profits than any other forms of combination according to table 1. Therefore, each side will perform more positively in fabricating cooperation alliance by virtue of the necessity of cooperation.

5. Conclusion

This paper presents Shapley value profits allocation method in IUR cooperation, which can overcome the defects of equalitarianism in allocation and arouse enthusiasm of each side effectively. It is practicable not only in theories but in enlightening practice. However, as fundamental criteria for profits allocation, the results of Shapley value method are just expected values, this can not invariably reflect practical significance of each side.

So, various principles and methods for allocation are to be considered according to specific circumstances. And design of profits allocation system should pay more attention to first line personnel and cut down intermediate mediums, avoiding profits preserved in different levels. Each side of cooperation should clarity specifications on responsibilities, authorities and benefits and ensure benefit sharing and joint adventure. Governments and other external forces can provide supervision and security for cooperation. In order to build up a healthy profits allocation system to ensure that the cooperation can run healthily and orderly, effective value evaluation system of the scientific and technological achievements should to be established, recognition of the importance of establishing and perfecting IUR cooperation should also to be deeply implemented.

References