ISSN : 0974 - 7435 Volume 10 Issue 8

2014

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(8), 2014 [2349-2355]

The income distribution mechanism of cooperation leaguers in the contractual knowledge alliance

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ABSTRACT

Contractual Knowledge Alliance is a network organization contracting as the link, sharing knowledge resources, promoting the knowledge flow and innovation, through stock rights or contracts with other institutions formed network organization of complementary advantages and sharing risk. Organizational limited rationality, opportunism and uncertainty in the external environment lead to instability in the alliance itself. Designing effective income distribution mechanism is conducive to enhancing the stability of the alliance. Clear the four principles on income distribution of Contractual Knowledge Alliance, according to the size of contribution value, the size of risk taking, the principle of utility maximization and the principle of systems comprehensive optimization. We analyzed based on the size distribution of income, according to the contribution value, according to the size of the risk compensation, according to the distribution of utility maximization principle of three kinds of income distribution mathematical model. To systematically and comprehensively reflect the differences in the income distribution of the above three principles in various situations, using improved optimization group center-of-gravity model and introducing the importance coefficient, the paper illustrates the application of group center-of-gravity model in the income distribution of cooperation Leaguers in the Contractual Knowledge Alliance through specific examples.

KEYWORDS

Contractual knowledge alliance; Cooperation leaguers; Income distribution.

INTRODUCTION

The 21st century is the era of knowledge economy, if organizations want to occupy the advantageous position in the intense market competition, we must quickly improve learning innovation ability of the whole organization, and the learning innovation ability cannot leave the organization communication, sharing and transfer knowledge. The effectiveness of this process is largely depended on the interests of the members between the internal and external partners. This process contributes to the formation of Contractual knowledge alliance. Knowledge alliance refers to the enterprises and research institutions to share knowledge resources, promoting the knowledge flow and innovation, and through stock rights or contracts with other institutions formed network organization of complementary advantages and sharing risk[1]. In terms of knowledge innovation and knowledge sharing, knowledge alliance has advantage sharing, flexible, cost economics and high efficiency, and thus become an important institutional choice of organizational members to improve the competitiveness. However, the knowledge alliance exists in cooperation risk and unstable situation because of the effect of various factors. A lot of practice investigation and study found that the proportion of the alliance instability or collapse as high as 70%[2,3]. So, the research of knowledge alliance stability has become an important problem in the current academic circles. Some scholars focus on the influence factors of alliance instability, with the transaction cost theory, game theory, resource dependence and social dilemma theory. In the application of game theory in the study, most of them consider the establishment of the alliance as a process of repeated game, and the alliance members in repeating the game will have the cooperation intention. Long term alliance contract can produce effect of cooperation, while short term alliance contract will have a competition effect, leading to the opportunistic behavior and the instability of alliance[4]. Based on the above analysis, the author thinks that using the contract theory to analyze the problems of the stability of knowledge alliance, seizing the key points of the compact knowledge alliance income distribution, to solve the above problems should be able to draw useful conclusions.

INCOME DISTRIBUTIONS SHOULD FOLLOW THE BASIC PRINCIPLES IN THE KNOWLEDGE ALLIANCE

When determining the income distribution scheme, Knowledge Alliance followed the basic principles are as follows:

1. The principle of income distribution based on the size of contribution value. Assume that the resources E_i (mainly for human resources) invested by leaguer i is greater than the resources E_j invested by leaguer j ,then the income b_i of leaguer i should be greater than the income b_j of leaguer j , namely, If $E_i > E_j$, then $b_i > b_j$ [5].

2. The principle based on the size of the risk to compensate. Risks involved are the risk of both system and non-system in the process of cooperation of knowledge alliance. Due to extensiveness of effect of many factors, systemic risks show that overall income of knowledge alliance is decreased. The paper assumes that this risk loss borne average by the Leaguers, not be considered. Risks referred by this paper focuses on consideration of non-systematic risk.

Assume that the risk F_i borne by leaguer i is greater than the risk F_j borne by leaguer j , then the income of leaguer i should be greater than the income of leaguer j , namely: if $F_i > F_j$, then $b_i > b_j$.

3. The principle of distribution based on utility maximization. Let knowledge alliance has n cooperative leaguers, whose income distribution vector respectively is:

$V_1 = (b_{11}, b_{12}, \cdots, b_{1n})$, $V_2 = (b_{21}, b_{22}, \cdots, b_{2n})$.

The utility function of the cooperation leaguer i is $U_i(b_i)$, to that

$Z_1 = \prod_{i=1}^{n} U_i(b_{1i})$, $Z_2 = \prod_{i=1}^{n} U_i(b_{2i})$.

If $Z_1 > Z_2$, the income distribution scheme $V_1 > V_2$ [6].

4. The principle of systems comprehensive optimization. This principle is a combination of the above three principles. Distribution scheme of income obtained by knowledge workers relying on knowledge should be in accordance with the principles of scientific and reasonable, which fully reflects the intellectual investment invested by their respective and the risk they respective borne among members of Knowledge Alliance, and make the members of knowledge alliance their own the product of utility maximization, guarantee the internal stability of cooperation of the entire knowledge alliance contract.

THE INCOME DISTRIBUTION MODEL OF LEAGUERS OF KNOWLEDGE ALLIANCE

Income distribution based on the principle of the resulting distributed by the size of contribution value

Income of knowledge assigned to cooperation leaguer i should be proportional to the intellectual resources invested, let the total income of the Knowledge Alliance is B, there are:

$$\frac{\mathbf{b_1}}{\mathbf{K_1}} = \frac{\mathbf{b_2}}{\mathbf{K_2}} = \cdots = \frac{\mathbf{b_n}}{\mathbf{K_n}} \quad \textbf{(1)}$$

By type (1), have:

$$\mathbf{b_i} = \frac{\mathbf{K_i}}{\sum_{j=1}^{n} \mathbf{K_j}} \quad \textbf{(2)}$$

Income distribution based on the principle of the resulting compensated by the size of the risk taking

(1) The principles of risk identified. The risk of this paper is the accident that all Leaguers of knowledge Alliance are not expected to occur and result in the termination of cooperation. In order to facilitate analysis, this paper assumes that risk R is a function of the probability p of risk events and the loss c caused by risk events[7], namely:

$$\mathbf{R = F(p, c) = pc} \quad \textbf{(3)}$$

Assume that partners use all their knowledge resources invested to bear the loss caused by risk events occurred at most, and introduce the risk loss rate λ, so $c = \lambda K$, by type (3) we can derive:

$$\mathbf{R = p\lambda K} \quad \textbf{(4)}$$

Let $\delta = p\lambda$, by type (4) we can derive:

$$\mathbf{R = \delta K} \quad \textbf{(5)}$$

δ is a parameter that is associated with risk loss rate and the probability of risk events occur, the determination of its value can be obtained through the analysis of the historical data, the general value ranges between 0.1 ~ 0.8.

(2) The determination of income distribution scheme of cooperative Leaguers. The income assigned to cooperative leaguer i is proportional to the risk he (she) bears, we have:

$$\frac{\mathbf{b_1}}{\mathbf{R_1}} = \frac{\mathbf{b_2}}{\mathbf{R_2}} = \cdots = \frac{\mathbf{b_n}}{\mathbf{R_n}} \quad \textbf{(6)}$$

By equation (5) and (6) we can obtain:

$$\mathbf{b_i} = \frac{\delta_i \mathbf{K_i}}{\sum_{j=1}^{n} \delta_j \mathbf{K_j}} \quad \textbf{(7)}$$

The principle of income distribution based on maximize the utility value

(1) The construction of utility function. The paper builds a risk-preferred utility function. We assume that the marginal utility of income distribution amount and the income distribution amount is linearly correlated, and when b_i is small, Δb_i has a large effect on $U(b_i)$. There are:

$$\frac{\mathbf{dU(b)}}{\mathbf{db}} = \alpha \mathbf{b} \quad \textbf{(8)}$$

In the formula (8) α is a parameter, and the solution is:

$$\mathbf{U(b)} = \frac{\mathbf{1}}{\mathbf{2}} \alpha \mathbf{b}^2 + \beta \quad \textbf{(9)}$$

In the formula (9), β is a parameter. we can obtain the allocated quota is b_m by standard test questions when leaguers of the Contractual Knowledge Alliance get income, the utility value is 1, namely $U(b_m) = 1$;When the gain allocated quota is 0,the utility value is 0, namely $U(0) = 0$; therefore, we can obtain:

$$\alpha = \frac{2}{b_m^2}, \beta = 0 \quad \textbf{(10)}$$

By type (9) with type (10), we have:

$$U(b) = \frac{b^2}{b_m^2} \quad \textbf{(11)}$$

(2)The determination of income distribution scheme of cooperation leaguers. According to establish cooperative member utility maximization principle, income distribution, and the benefits distribution solutions to the mathematical model of optimal solution:

$$\left.\begin{aligned} &\max Z = \prod_{i=1}^{n} U_i(b_i), \\ &s.t. \sum_{i=1}^{n} b_i = B, 0 \le b_i \le B \end{aligned}\right\} \quad \textbf{(12)}$$

The above mathematical model can use dynamic programming algorithm.

Income distribution based on the principle of systems comprehensive optimization.

In order to comprehensively reflect the different roles of above three principles in the income distribution of cooperation leaguers. Using improved and optimized group center-of-gravity model algorithm to determine the optimal income distribution scheme. Idea is as follows: Using optimized group center-of-gravity model algorithm, introducing an importance coefficient ω_h, and there $\sum_{h=1}^{3} \omega_h = 1$, using AHP to determine ω_h. The optimized group center-of-gravity model is:

$$\left.\begin{aligned} &\min S = \omega_1 \sum_{i=1}^{n} (b_i^{'} - b_{1i})^2 + \omega_2 \sum_{i}^{n} (b_i^{'} - b_{2i})^2 + \omega_3 \sum_{i}^{n} (b_i^{'} - b_{3i})^2, \\ &s.t. \sum_{i=1}^{n} b_i^{'} = B, 0 \le b_i^{'} \le B. \end{aligned}\right\} \quad (13)$$

Formula (13): $b_i^{'}$ indicates that cooperation leaguer i had been allocated quota in the optimal distribution scheme; b_{ij} indicates that cooperation leaguer j had been allocated quota in the kind of i income distribution scheme. Therefore, solving $b_i^{'}$ is transformed into solving the equation $\partial S / \partial b_i^{'} = 0$, the solution of this equation can be obtained:

$$b_i^{'} = \omega_1 b_{1i} + \omega_2 b_{2i} + \omega_3 b_{3i} \quad (14)$$

THE ANALYSIS OF AN EXAMPLE IN THE CONTRACTUAL KNOWLEDGE ALLIANCE

Suppose that a Contractual Knowledge Alliance is made up of three cooperation leaguers, knowledge resources invested by leaguer 1 equivalent to equivalent currency (calculated by the opportunity cost of the knowledge workers working the same term) 500,000 RMB, knowledge resources invested by leaguer 2 equivalent to equivalent currency 400,000 RMB, knowledge resources invested by leaguer 3 equivalent to equivalent currency 350,000 RMB, the expected total income of the knowledge alliance is 2,500,000 RMB.

1. Income contribution based on the principle that the resulting value is assigned according to the size of contribution value. According to equation (2), we can obtain:

$$b_1 = 1000000\text{RMB},\ b_2 = 800000\text{RMB},\ b_3 = 700000\text{RMB} \quad (15)$$

2. Income distribution based on the principle that the resulting value is compensated according to the size of risk taking. By referring to the historical data of previous collaboration to determine δ of three cooperation leaguers, the value respectively is 0.6, 0.4 and 0.3; according to Equation (7) to obtain:

$$b_1 = 1325000\text{RMB},\ b_2 = 71000\text{RMB},\ b_3 = 465000\text{RMB} \quad (16)$$

3. Income distribution based on the principle of utility maximization. Using standard test method to ask the three cooperation leaguers, we obtain, b_m respectively is 1,250,000 RMB; 1,000,000 RMB; 900,000 RMB. According to formula (11), we can obtain utility functions $U_i(b_i)$ of three cooperation leaguers, as follows:

$$U_1(b_1)=\frac{1}{125^2}b_1^2, U_2(b_2)=\frac{1}{100^2}b_2^2, U_3(b_3)=\frac{1}{90^2}b_3^2 \quad (17)$$

According to the formula (12) and (17) to establish a mathematical model, we can obtain:

$$\left.\begin{array}{l}\max Z=\frac{b_1^2}{125^2}\times\frac{b_2^2}{100^2}\times\frac{b_3^2}{90^2},\\ b_1+b_2+b_3=250,\\ 0\le b_i\le 250, i=1,2,3.\end{array}\right\} \quad (18)$$

Using dynamic programming method for solving the equation (18) can obtain:

$$b_1=\frac{250}{3}\times 10000RMB,\ b_2=\frac{250}{3}\times 10000RMB,\ b_3=\frac{250}{3}\times 10000RMB \quad (19)$$

INCOME DISTRIBUTION BASED ON THE PRINCIPLE OF SYSTEMS COMPREHENSIVE OPTIMIZATION

The determination of the important coefficient ω_h. Assume the relative importance of principles as 1, 3,5,7,9 Compared principles i with principle j, they are equally important, more important, important, very important, extremely important. According to the size of the contribution value, the size of risk taking, utility value maximum, and such three principles are pair wise compared to obtain the judgment matrix:

$$X=\begin{bmatrix}1 & 7 & 5\\ \frac{1}{7} & 1 & \frac{1}{5}\\ \frac{1}{5} & 5 & 1\end{bmatrix} \quad (20)$$

Normalized processing according to the column of matrix X, the available:

$$Y=\begin{bmatrix}0.746 & 0.538 & 0.808\\ 0.105 & 0.076 & 0.031\\ 0.149 & 0.386 & 0.162\end{bmatrix} \quad (21)$$

Normalized processing according to the sum of row, it is concluded that the importance coefficient of each principle is as follows:

$$\omega=\begin{bmatrix}0.697\\ 0.071\\ 0.232\end{bmatrix} \quad (22)$$

The determination of the optimal income distribution scheme obtains the optimal solution for income distribution according to formula (14), (15), (16), (19) and (22) to:

$$b_1'=1740000RMB,\ b_2'=180000RMB,\ b_3'=580000RMB \quad (23)$$

CONCLUSIONS

Income distribution is a relatively complex issue in the Contractual Knowledge Alliance. For cooperation leaguer particularity of knowledge production, the author of this paper puts forward four principles of income distribution, and correspondingly designs four kinds of income distribution schemes. Among them, the fourth scheme is the former three integrated and optimized. It is worth mentioning that determine the importance coefficient of income distribution in the fourth scheme which has a significant effect on income distribution. This coefficient should be determined according to the actual situation in the process of knowledge production in the Contractual Knowledge Alliance. To guarantee strong scientific and rationality of income distribution scheme and achieve the stability of the Contractual Knowledge Alliance, the paper borrows a relatively simple and intuitive analytic hierarchy process (AHP) to make it.

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