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Professional talent competition of similar colleges from game theory perspectives

Huirong Xing

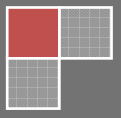
Shandong University of Finance and Economics, Jinan, 250014, (CHINA)

ABSTRACT

With the development and scientific progress of the society, today the competition of comprehensive national strength is increasingly competitive and reflected in innovation capability of technology. In this case, major universities increase professional strength and competitiveness, forming a "game" relations. The term originally refers to the chess game, poker and other games of athletics. In game theory, the game refers to the conflict as well as cooperation between rational people or groups. Early the "game theory" was more used to explain some economic phenomena. With the knowledge heterogeneity, strategic interactivity among individuals, traditional resources, technology, information and other constraints of various organizations are no longer limited by knowledge and time. In such a scenario, the university is the main place to train professionals and a part for cognitive coordination. In this study, " Game Theory " is as an entry point and the model of it characterizes the competion status of similar professionals in our universities. It also analyzes the strategic interaction from the same subjects of different universities in the transition process of shared resources. Ultimately based on the "Game Theory", learning behavior and policy advice are proposed and more inspiration and advice are given.

KEYWORDS

Game theory; University management; Economics of education; Guidence policy.



INTRODUCTION

"Game theory", based on abstract reasoning, combining mathematical theory and logic, analyzes conflict and cooperation phenomenon of actors. The word in the Chinese means a chess game, with participants making corresponding countermeasures, response and guessing according to the opponent's movements. At this stage, practicality and methodology of " Game Theory " has been extended from the field of economics to other social sciences, and is recognized and become a useful method for other disciplines in the theoretical analysis.

OVERVIEW OF THE DEVELOPMENT OF GAME THEORY

Basic developing content of " game theory "

"The Game"originally referred to the chess game, meaning make corresponding countermeasures and response according to the opponent's movements and intentions in a chess game. "Game Theory" was built in the early 18^{th} century, and developed in 20^{th} century. Based on the source, "Game Theory" is derived from overall planning of mathematics, using mathematical methods to analyze possible results of the interaction of actors in the game. In 1994 John Newman and Morgenstern coauthored "Theory of Games and Economic Behavior", in which they discussed how to use mathematical methods to make the optimized victory strategy of competitors in a conflict. "The Game" is a better solution to handle conflict and crisis[1]. In short, " Game Theory" is a rational decision-making behavior and analyzes benefit maximization and loss minimization principle of participants in the game situations. The "Theory of Games and Economic Behavior" make "game theory" lay the foundation for the development of it. In 1950s Nash extends "game theory" to military and international relations tactics inquiry. In 1960s, "Game Theory" matures gadually. Incomplete information theory and equilibrium selection theory make the "game theory"more extensive[2]. Based on this, the "game theory" has become a complete and systematic theory, which is no longer limited to the analysis of the economic field, but from the basic concept of the theory of deduction to a complete system with rich content. In application, there are also furthur study on the political and economic models. Non-cooperative game theory, equilibrium game theory and incomplete information theory accordingly makes the " game theory " widely used in economics, political science, sociology, social psychology, international relations, organizational behavior, business administration, and research in the field of biological sciences, forming a full range of disciplines architecture.

Basic model of " game theory "

The Enrichment and Development of "Game Theory" is not only reflected in its widely use of various fields, but also in a variety of game models created by researchers. In the game model, based on a comprehensive pay, it is divided into zero-sum game and non-zero -sum game; according to the cooperation of participants, the game can be divided into cooperative game and non-cooperative games[3]. At this stage, " game theory " refers to a non-cooperative game. Non-cooperative game is divided into static games of complete information, dynamic games of complete information, static game of incomplete information, dynamic game of incomplete information. The equilibrium concept of static games of complete information is Nash equilibrium. It points out the game participants are expected to achieve their maximum benefit value, on which basis the other participants in the game follow the same rules. Supposing there are N participants in the game, its strategy formula is expressed as:

$$G = (S1,\ldots\ldots Sn;\ U1\ldots\ldots Un) \quad \textbf{(1)}$$

The strategy conbination is $S^* = (S1^*,\ldots\ldots,Si^*\ldots\ldots,Sn^*)$. This is a Nash equilibrium.

If the S^* is settled, and the other game participants choose $S-I^* = (S1^*\ldots\ldots,Si-1^*,\ Si+1^*\ldots\ldots,\ Sn^*)$, the most optimazed strategy of the Nth participant is $U_i(S_i^*, S_i^*) \geq U_i(S_i, S-i)$, $V_{si} \in S_i$.

Equilibrium concept of dynamic games of complete information is Subgame Perfect Nash Equilibrium, which removes incredible threat strategy of Nash equilibrium. Every game between microcosmic bodies is a sub-gam, which is a Nash equilibrium of the original one and also that of the sub-gam. The Game between microcosmic bodies is as follows:"

TABLE 1 : Game between microcosmic bodies in sub-games

		A	
		Innovation	**Not innovation**
B	Innovation	$(a-c)/2, (a-c)/2$	$a-c, 0$
	Not innovation	$0, a-c$	0,0

According to Figure 1, a is the benefit with only one micro innovation body. C is the cost of micro innovation body. So if there is only one innovation body, it is bound to get the full benefits of innovation to bring (a-c). When there is another innovation body at the same time, the innovation profit will be halved (a-c) 2.

In addition, the equilibrium concept of dynamic games of incomplete information is the Bayesian Nash equilibrium. With incomplete information, the situation of all players are improved, and with transforming, everyone has the right to improve actively, and ultimately achieve the Nash equilibrium[4]. The dynamic games of incomplete information refines Bayesian Nash equilibrium, combining the disadvantages of Nash Equilibrium and Bayesian equilibrium. It gives game players and other players the opportunity to observe and amend others. The core of it is "Faith " in a game.

GAME THEORY AND COMPETITION OF SIMILAR PROFESSIONAL TALENTS IN COLLEGES AND UNIVERSITIES

Competition for talent is a product of the strength competition in the new century

A series of initiatives show the colleges and universities must take the initiative to meet the needs of economic and social development. " China's central decision on education reform " says:" Education must serve the socialist construction and the socialist construction must rely on education."[5]. In this case, the university management is continuously optimized. Universities use innovative educational ideas and market needs to train talents. It is the requirements for universities from commodity economy and also a way to make itself function.

Description of competition of universities professionals from the same subjects

The core of modern teaching development is improving the quality of labor, and promoting the development of productivity of higher education. Therefore, personnel training is an important measure of university competition. Personnel training must be nurtured from a macro point of view, which are the talents, talent level and quality of talent. It means "Modern talent", namely "seeking change, focusing on knowledge, self-confidence, openness"[8]. It is "KAO" compound talents combining knowledge, ability and quality of [6].

Recently, the number of comprehensive universities are increasing. The reforming concept focuses on broadening the students' aspect of knowledge, enhancing innovation ability, and improve the overall quality of students in order to provide creative, live, physically sound social talents[7].

In this situation, the knowledge and the ability has become the most important strategic resource. Demands of a new era promote this particular organization knowledge innovation and the benefit distribution. This game relationship is reflected in similar professional. The more powerful universities have more obvious advantages on professionals. The other participants are the subordinate organizations. To achieve mutual winning, you must set the game relationship between innovation cooperation.

For example, one of its strongest professional of Peking University is mathematics. In this case, other participants are subordinate organizations. At the request of innovative partnerships, the investment is shared by Peking University and other colleges and universities. In this case, the participation rate of Peking University and other subordinate colleges and universities is t and 1-t, $0 \le t \le 1$.

The innovation performance P is knowledge stock, affected by a. The function relationship is $y(a) = \beta - \alpha - \gamma + \varepsilon$, where P and A is a positive associated.

β is the grown result of a. γ is the elastic universities investments, which can measure the growth of y when a changes; ε represents changes in the environment, which should be assumed that the expected value is 0, so that the expected performance of y (a) is

$$\hat{Y}(a) = \beta - a^{-\gamma} \quad \textbf{(2)}$$

Thus, knowledge innovation performance of the universities can be converted to the interests of the organization. If the marginal revenue yL of Peking University and the marginal revenue yεof other subordinate colleges are constants. The organization gain π of universities equals to the revenue minusing cost. The expected return of Peking University $\hat{Y}L$, expected return of subordinate colleges $\hat{Y}F$, the overall expected return of Peking University and its subordinate colleges $\hat{Y}$ are as follows:

$$\hat{Y}L = yl(\beta - \alpha - \gamma) - at \quad \textbf{(3)}$$

$$\hat{Y}F = yF(\beta - \alpha - \gamma) - a(1-t) \quad \textbf{(4)}$$

$$\hat{Y} = \hat{Y}L + \hat{Y}F = (yl + yF)(\beta - \alpha - \gamma) - a \quad \textbf{(5)}$$

It can be seen when the commodity economy matching higher education, the higher cost of education is not held by the weak market. On the contrary, to have asolute advantage of professionals in the field of occupation, we must precede knowledge innovation and cooperation, increase the cost of investment in order to be consistent with the core organization and obtain relative benefits[8]. For example, if two universities have the same output of professional talent, but because of different schools, learning background, it means they are different in abilities, qualities and knowledge of architecture. This leads to a strong alternative of professional personnel among colleges and universities. According to the market demand of a variety of different stages, talent capacity of university 1 and 2 are Y1 and Y2. Their respective demands functions are:

$$P_1 = P_1(Y_1, Y_2) = a_1 - b_1 Y_1 - d_1 Y_2 \quad \textbf{(6)}$$

$$P_2 = P_2(Y_1, Y_2) = a_2 - b_2 Y_2 - d_2 Y_1 \quad \textbf{(7)}$$

The profit functions of two universities are:

$$U_1 = U_1(Y_1, Y_2) = (P_1 - C_1) = (P_1 - C_1)(a_1 - b_1 P_1 + d_1 + P_2) \quad \textbf{(8)}$$

$$U_1 = U_1(Y_1, Y_2) = (P_1 - C_1) = (P_1 - C_1)(a_1 - b_1 P_1 + d_1 + P_2) \quad \textbf{(9)}$$

In this game, using the above inverse functions we can find the benefits and strategies of two universities.

Professional competitive strategy of the same professionals in uneversiies

Collaboration between universities

There is game exsting in the talent competition of the same professionals in colleges and uneversiies. In the competition universities need cooperation in knowledge innovation, so that it can generate marginal revenue core of universities and subordinate colleges. Suppose the marginal benefit of core universities is YL, elasticity of development capital investment is γ, maximum value of knowledge innovation performance theoretically is β, the main game model between universities from the analysis are as follows:

TABLE 2 : Analysis results of university game model

Serial number	ρ	α	t_1	t_F	π_L	π_F	π
1	0.8						
2	0.7						
3	0.6	0.1896	0.1176	0.8824	0.4621	0.1960	0.6581
4	0.5	0.1943	0.2857	0.7143	0.4343	0.1673	0.6016
5	0.4	0.1989	0.4444	0.5556	0.4066	0.1370	0.5436
6	0.3	0.2035	0.5946	0.4054	0.3790	0.1050	0.4841
7	0.2	0.2081	0.7368	0.2632	0.3516	0.0715	0.4231

According to the game relationship between the core universities and subobordinate colleges, the synergic relationship among colleges and universities is:

TABLE 3 : Analysis list of cooperative game between universities

Serial number	ρ_r	α	t_1	t_F	π_L	π_F	π
1	0.8	0.3869	0.0425	0.9575	0.5932	0.2852	0.8784
2	0.7	0.3667	0.1518	0.8482	0.5482	0.2519	0.8000
3	0.6	0.3462	0.2642	0.7358	0.5053	0.2176	0.7229
4	0.5	0.3667	0.4619	0.5381	0.5665	0.2335	0.8000
5	0.4	0.3044	0.4988	0.5012	0.4264	0.1469	0.5733
6	0.3	0.2832	0.6212	0.3788	0.3904	0.1107	0.5011
7	0.2	0.2615	0.7464	0.2536	0.3568	0.0741	0.4308

If the core universities and subordinate colleges reach an agreement in cooperating, the more the core universities participate, the higher the cost of knowledge innovation will become. And the subordinate colleges are more willing to cooperate. As a result, the profit maximization can be reached between the universities.

In addition, the core universities and subordinate colleges cooperate to make the magnitude of collaboration greater and have no constraints of the marginal revenue, which means it is more adapted to the knowledge innovation cooperation among several universities. Finally, the university can not develop independently. To gain benefits of all sides, it is necessary to encourage investment, in order to optimize profits between the universities of similar professionals.

Allocation of costs among universities

In the game relations among universities, the reason why universities establish generally similar professional is the same. In the game relations major colleges and universities follow the same rules of the game, which means it is a relationship of cooperation. It determines the cooperative game between the universities can constitute a relatively stable knowledge chain.

This knowledge chain determines the partnerships from competition of similar professional talents in colleges and universities. They play their strengths and form the cooperation relationship. In this process, the nucleolus solution will be used, which requires cooperation among at least 3 universities to reach the results of cost allocation. Figure 1 shows the distribution of cost.

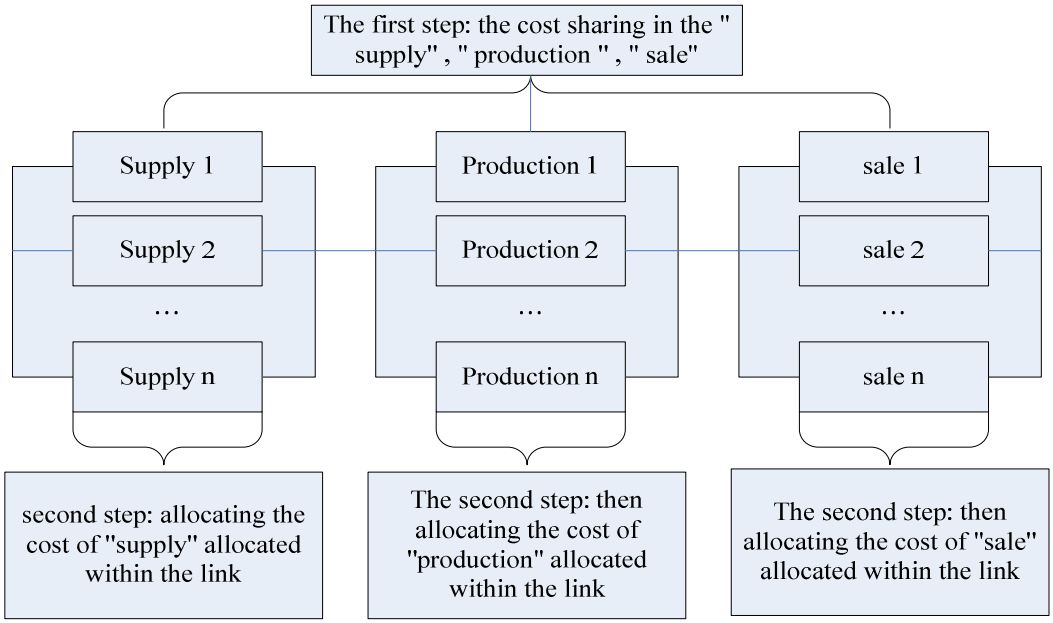


Figure 1 : Schematic diagram of a cost allocation of college knowledge innovation cooperation

First, in the knowledge chain the colleges and universities, as a part of it, can have multi-directional cooperation with others. It forms the sophisticated " knowledge Nest" shown as Figure 2:

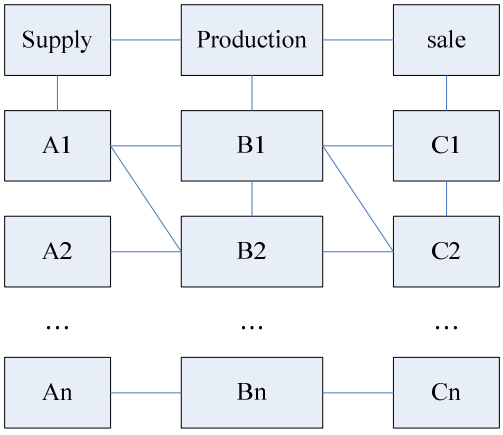


Figure 2 : knowledge nest

As shown in Figure 2, the "knowledge Nest" determines all universities, in order to accomplish a specific goal, participate in the game, which forms a complex but cooperate relationship. Thus the colleges and universities form a cooperation partnerships in series and in parallel.

CONCLUSION

Colleges and universities are the special groups in the social structure. It is both external carrier of knowledge, but also the internal mechanism of the development of cultural knowledge. The society is inseparable from the output of colleges and universities. But along with the transformation and blind expansion of universities and colleges, many universities offer a variety of specialized majors in the development process. But because they do not match the investment and earnings, it results in a waste of talents. The "Game Theory" is conducive for universities to establish cooperative relationships with others and their own development, so that in the process of competition colleges and universities can also inspire others to invest. As a result, all will achieve a win-win situation.

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