

Research on the Operational Mechanism of University-enterprise Cooperation from the Perspective of Game Theory

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Abstract. University-enterprise cooperation is the important way to cultivate applied talents for colleges and promote technology innovation for enterprises. Currently more and more universities and enterprises participate in the cooperation activities. However, there exists the low embedding degree, weak resource dependencies and distribution of benefits conflicts in the practical. Based on game theory, the earnings of different cooperative behavior are analyzed in the article. The purpose of this paper is to construct the effective mechanism of university-enterprise cooperation.

Keywords: University-enterprise cooperation; Operational mechanism; Game theory; Pareto optimality.

1. Introduction

The Outline of National Medium and Long-term Education Reform and Development Plan (2010-2020) published in 2010 requires that vocational education should take employment as guidance and implement the personnel training mode of university-industry cooperation. The outline also insists that higher education strengthens the practice teaching and constructs new mechanism of joint training talents. In April 2015, vice minister of MOE, Lu Xin, defined the transformation direction of the local undergraduate universities, which is to strengthen practice teaching. Soon after, ministry of finance published a document which says that colleges and universities should transform the idea of running school and try to strengthen students' hands-on ability and creative ability. Against this background, it has been become an inevitable trend to strengthen cooperation between schools and enterprises.

University-enterprise cooperation is a kind of new school-running pattern that is conducive to resource sharing, complementary advantages, as well as mutual benefit and reciprocity. However, because of diverse interest demands, cooperative performance is not as ideal as expected. Furthermore, there exists low dependence and coupling degree in the process of cooperation. As a result, the stability and sustainability of cooperation is worrying. Through investigation, some scholars find that the failure rate of university-enterprise cooperation is more than 50%. Based on this, this paper adopts game model to explore root of the troubles and analysis the pathway to achieve win-win. At the same time, the benefit distribution plan promoting long-term cooperation would be put forward.

2. Game model of university-enterprise cooperation

During the long-term cooperation, universities and companies are as rational economic man. That is to say, they are in the pursuit of their economic benefit maximization. Since the nature of their cooperation is trading, interest acquisition is the focus of both. When they cooperate, both are in the game and pursue maximum interests according to the information they have mastered.

Under the condition of asymmetric information, the colleges and universities, as rational economic man, decide whether to continue to cooperate with the other on income gained. Game theory says that cooperation or not can be chosen by both when making decisions. Cooperation is to be deeply involved in university-enterprise cooperation process and actively provide service support for each other, while noncooperation is to passively participate, don't provide support or don't work hard for

each other. In the game, if colleges and companies take different behavior, the both would get various income. Benefit matrix of different strategic behavior is shown in table 1.

Table 1 Benefit matrix of universities and enterprises

University Enterprise	Cooperation	Noncooperation
Cooperation	$Re_1+re-Ce,$ $Ru_1+ru-Cu$	Re_2-Ce, Ru_2
Noncooperation	Re_3, Ru_3-Cu	Re_4, Ru_4

In table 1, “R” is for normal cooperation profit; “r” is for extra income gained from successful collaboration; “C” is cooperation cost; “i”=1,2,3,4, standing for different strategy combinations; e=enterprise ,u=university;

3. The analysis of game model

In the game of universities and enterprises, this article makes an assumption: when the same behavior occurs, the benefits and costs are same, whether actors are university or business. That is to say, $Re_1= Ru_1, Re_4= Ru_4, Re_2= Ru_3, Ru_2= Re_3$. Therefore, table 1 can be turned into table 2. This hypothesis is not entirely consistent with the reality, but it doesn't affect the results discussed in this paper. If they form an long-term cooperation relationship during cooperation, both will benefit. So $R1 > R4$ is right.

Table 2 Simplified benefit matrix of universities and enterprises

University Enterprise	Cooperation	Noncooperation
Cooperation	R_1, R_1	R_2, R_3
Noncooperation	R_3, R_2	R_4, R_4

In game of education and industry, both are striving to maximize their own interests. They also convince that they have chosen the best strategy relative to each other's behavior. That is, they think that R_i is not likely to increase when the other doesn't change behavior. Once these strategies are taken, the interest structure of the policy combinations are reached. Based on variety of R_i , benefits are as follows:

If $R_1 > R_3$ and $R_2 > R_4$, enterprises as the rational economic man, would choose cooperation to get the maximum profit, regardless of universities choosing to cooperate or not. Colleges also choose cooperation, whether companies choose cooperation or not. So, (cooperation, cooperation) is the Nash equilibrium in this state. In this context, universities and businesses eliminate the cooperation cost. Then they both take cooperative behavior to obtain greater benefits. Based on game theory, this is the best interest combination for both to conduct a long-term cooperation relationship. In this case, partners both gain the maximum individual interests and collective benefit. Pareto optimality is achieved. In other words, only in this state, a long-term partnership can be maintained and win-win comes true.

If $R_1 < R_3$ and $R_2 < R_4$, they both would choose uncooperative to get the largest earnings, no matter what strategy the other has chosen. In this state, (non-cooperation, non-cooperation) becomes the Nash equilibrium and partners sink into the "prisoner's dilemma". At the moment, they are both clear that their choices are not the best, but they have to betray each other in order not to make their minimum interests in the case of asymmetric information. It is with regret that both get the smallest gain. But if they are willing to understand each other and increase the sense of trust, the "prisoner's dilemma" is out.

If $R_1 < R_3$ and $R_2 > R_4$, when companies choose to cooperate, universities would choose non-cooperation to obtain greater benefits. But if companies choose to non-cooperate, universities

choose cooperation to gain R_2 rather than choose non-cooperation to get R_4 . As rational economic man, companies would also take the same activities as with universities when the other adopt those practice. So the Nash equilibriums are (cooperation, non-cooperation), (non-cooperation, collaboration) under this scenario, in which the both don't mutually support each other instead of choosing departure. This is the lower efficiency of cooperation. The reason it happens is that there is a high cost of cooperation. When one choose to work together, the other select uncooperative to get more revenue. These game behaviors are not conducive to building a long-term partnership. After some time, the two sides will fall into the "prisoner's dilemma", and then lift the partnership.

If $R_1 > R_3$ and $R_2 < R_4$, When companies choose the cooperative strategy, universities get more benefit from choosing cooperation. If companies choose uncooperative strategy, the universities take uncooperative behavior to pursue maximize benefits. Similarly, when universities adapt cooperation or noncooperation, companies would take cooperative behavior and cooperative behavior respectively. That is to say, there are two Nash equilibrium in this situation. They are (cooperation, cooperation), and (non-cooperation, non-cooperation). (cooperation, cooperation) is the perfect strategy pattern that is the first choose for rational partners. However, in the beginning of the cooperation, they are likely to take uncooperative behavior in order not to reduce their own interests due to lack of trust. Thus, the long-term and effective cooperation mechanism would be challenged.

4. Suggestions to build a long-term cooperation mechanism

Though the analysis of R_i , the paper put forward the following suggestions concerned with the long-term and stable cooperation relationship between universities and enterprises.

The government provides economic incentives and social propaganda for cooperative institutions. The game analysis above shows that pareto optimality can be achieved, only if $R_1 > R_3$ and $R_2 > R_4$. The earning is the driving force of long-term cooperation between schools and enterprises. Thus, the long-term cooperative mechanism could be built only when the maximize interests come true. So the government had better use his mandate to implement some preferential policies which will maximize community resources, such as economic incentives, financial subsidies, tax breaks and so on. In addition, the government can also praise units who have better cooperation performance to encourage more organizations to participate in cooperation. The enthusiasm and initiative of cooperation may be improved by guidance and encouragement of government. It is good for building long-term, stable and effective school-enterprise mechanism. If so, the win-win situation for socio-economy and educational innovation would be achieved.

Improve supervision and restraint mechanisms of cooperation. In the game, there is the phenomenon that one tries to betray each other for the sake of its own income. As a result, such a situation is that everyone's interests are reduced. Of course, this caused the waste of resources. Actually once being partnership, cooperation is not only providing support or assistance to the other, but also responsible for obligations and responsibilities. They need work hard for the project or technology together. In the case of incomplete information, appropriate regulatory and restraint mechanism established can reduce moral hazard and acts of mutual betrayal. In addition, the Chinese government may follow the example of Germany or other countries to set up specially an institution to supervise cooperation organizations. If systems and regulations on university-enterprise cooperation are published, it would strengthen bilateral contractual relationship and regulate cooperative behavior .

Establish information sharing platform. Because of asymmetric information, participators can't know each other's strategic behavior clearly. They rebel against each other and fail in "cooperation paradox" finally. This plight may be solved by establishing an information sharing platform that can make information transparent and reduce decision puzzle caused by information asymmetry. By sharing information, the partners can know more about each other and the cost looking for new partners would be smaller. Besides, technical difficulties could be discussed on the platform. Overall, information sharing platform allows universities and companies access to getting efficiently

information as possible at the lowest cost possible. Maybe it is the best way to reduce the risk of adverse selection and achieve pareto optimal.

Improve competitiveness and trust. Resources and benefits provided for each other are the key factors deciding whether to cooperate. In reality, they must enhance their strength to make others convinced that cooperation with it could get scarce resources. In addition, in the process of cooperation, both determine the authenticity of the other only by searching for information rather than observing partners clearly. Therefore, enhancing trust helps to build and maintain a long-term partnership. So if universities and companies want to obtain the maximum benefit, enhancing the strength and trust is critical.

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