Study on the Game Relationship between Teachers and Students

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Abstract

This paper describes the game relationship model between teachers and students through mathematical functions, and uses the relevant theoretical knowledge of game theory to solve and analyze the model. The results show that there is a unique game equilibrium solution between teachers and students, and the income of teachers (students) is positively correlated with their own effort efficiency, students (teachers) effort efficiency, students (teachers) effort influence coefficient. But negatively correlated with their own effort cost coefficient, students (teachers) effort cost coefficient.

Keywords

College teachers, College students, Game relationship, Effort input.

1. Introduction

In October 2018, the Ministry of Education of China issued "opinions on speeding up the construction of high-level undergraduate education to comprehensively improve the ability of talent training ", and will comprehensively improve the ability of talent training as the core, with the goal of speeding up the formation of a high-level talent training system and training socialist builders and successors with all-round development of morality, intelligence, physical education, beauty and labor. It can be seen that China attaches great importance to the cultivation of college students. And teachers as the direct cultivation of students, it is necessary to understand the game relationship between teachers and students, which also provides a realistic basis for the study of this paper.

On the research of teacher-student relationship, XIAO[1] constructs a new model of teacher-student cooperative game based on game theory, and analyzes the teaching and learning model between teachers and students. TANG and YIN[2] used the evolutionary game method to explore the game relationship between tutors and graduate students, constructed the game model between tutors and graduate students, and put forward corresponding management strategies for the results of game analysis. ZHANG and BAI[3] constructed a dynamic game model of incomplete information to classify and compare the game of mutual evaluation between typical students and teachers. Besides, there are also scholars from the perspective of students to carry out research, such as JIAO and other application SPSS analysis, the investigation and research on the relationship between learning input and learning performance of logistics major graduate students[4], and the investigation and research on the relationship between learning input, self-efficacy and learning performance of logistics major graduate students[5].

On the basis of the above literature, this paper considers the situation that the income of teachers and students is affected by efforts, and constructs the income function model of both. Then, the dynamic game equilibrium solution is solved by reverse induction. Finally, the paper analyzes the effect of effort efficiency, effort cost coefficient and effort influence coefficient on the income of teachers and students.

2. Model Assumptions

Hypothesis 1: the teaching income of college teachers is positively related to their hard work, and the hard work of students will also have a positive impact on the income of teachers. The teaching benefits of teachers (Teachers, subscript T) are represented by π_T:

$$\pi_T = k_S e_S (a_T + b_T e_T - c_T e_T^2) \tag{1}$$

In the above formula , e_T is the teacher's effort input level , a_T is the teaching gains that teachers get when they don't work hard, b_T is the teacher's effort efficiency coefficient , c_T is the teacher's effort cost coefficient , k_S is the student's effort influence coefficient on the teacher's income (abbreviated as the effort influence coefficient), e_S is the student's effort input level , $c_T e_T^2$ is the teacher's effort cost.

Hypothesis 2: the student's income is positively related to his effort input, and the teacher's effort will also have a positive impact on the student's income. Use π_S to represent the student's (Students, subscript S) earnings:

$$\pi_S = k_T e_T (a_S + b_S e_S - c_S e_S^2) \tag{2}$$

In the above formula , e_S is the input level of students' efforts , a_S is the income obtained when students do not work hard , b_S is the efficiency coefficient of students' efforts , c_S is the cost coefficient of students' efforts , k_T is the influence coefficient of teachers' efforts on students' income, and $c_S e_S^2$ is the cost of students' efforts.

Hypothesis 3: throughout the game, the teacher is the dominant.

3. Model Solving and Analysis

3.1 Model Solving

In the teacher-led game model, teachers first determine their level of effort input, and then students decide their effort input according to the teacher's decision. Next, the inverse induction method in game theory is used to solve the problem.

The first and second order partial derivatives of π_S pair e_S are:

$$\frac{\partial \pi_S}{\partial e_S} = k_T e_T (b_S - 2c_S e_S) ,$$

$$\frac{\partial^2 \pi_S}{\partial e_S^2} = -2c_S k_T e_T$$

Since $\partial^2 \pi_S / \partial e_S^2 < 0$, the existence of the only optimal e_S^* results in maximum student gain, making $\partial \pi_S / \partial e_S = 0$ available:

$$e_S^* = \frac{b_S}{2c_S} \tag{3}$$

By substituting (3) with (1), then the teacher's decision-making problem is:

$$\max_{e_T} \pi_T = \frac{k_S b_S (a_T + b_T e_T - c_T e_T^2)}{2c_S}$$

The first and second order partial derivatives of π_T pair e_T are:

$$\frac{\partial \pi_T}{\partial e_T} = \frac{k_S b_S (b_T - 2c_T e_T)}{2c_S}$$

$$\frac{\partial^2 \pi_T}{\partial e_T^2} = \frac{-2c_T k_S b_S}{2c_S}$$

Since $\partial^2 \pi_T / \partial e_T^2 < 0$, the existence of the only optimal e_T^* results in maximum student gain, making $\partial \pi_T / \partial e_T = 0$ available:

$$e_T^* = \frac{b_T}{2c_T} \tag{4}$$

By substituting formulas (3) and (4) into formulas (1) and (2) respectively, we can obtain:

$$\pi_T^* = \frac{b_S k_S (b_T^2 + 4a_T c_T)}{8c_S c_T}$$

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3.2 Model Analysis

In this paper, we find out the equilibrium solution of the game between teachers and students, and then analyze the sensitivity of the core coefficient.

The first and second order partial derivatives of π_T^* pair b_T, b_S, c_S, c_T, k_S are:

$$\frac{\partial \pi_T^*}{\partial b_T} = \frac{b_S k_S b_T}{4c_S c_T}$$

$$\frac{\partial \pi_T^*}{\partial b_S} = \frac{k_S (b_T^2 + 4a_T c_T)}{8c_S c_T}$$

$$\frac{\partial \pi_T^*}{\partial c_S} = -\frac{k_S b_S (b_T^2 + 4a_T c_T)}{8c_S^2 c_T}$$

$$\frac{\partial \pi_T^*}{\partial c_T} = -\frac{k_S b_S b_T^2}{8c_T^2 c_S}$$

$$\frac{\partial \pi_T^*}{\partial k_S} = \frac{b_S (b_T^2 + 4a_T c_T)}{8c_S c_T}$$

Through the above analysis, the following proposition can be obtained.

Proposition 1: ① $\frac{\partial \pi_T^*}{\partial b_T} > 0$; ② $\frac{\partial \pi_T^*}{\partial b_S} > 0$; ③ $\frac{\partial \pi_T^*}{\partial c_S} < 0$; ④ $\frac{\partial \pi_T^*}{\partial c_T} < 0$; ⑤ $\frac{\partial \pi_T^*}{\partial k_S} > 0$.

Proposition 1 shows that the income of teachers is positively correlated with their own effort efficiency, students' effort efficiency, students' effort influence coefficient, but negatively correlated with their own effort cost coefficient and students' effort cost coefficient.

The first and second order partial derivatives of π_S^* pair b_T, b_S, c_S, c_T, k_S are:

$$\frac{\partial \pi_S^*}{\partial b_T} = \frac{k_T (b_S^2 + 4a_S c_S)}{8c_S c_T}$$

$$\frac{\partial \pi_S^*}{\partial b_S} = \frac{k_T b_S b_T}{4c_S c_T}$$

$$\frac{\partial \pi_S^*}{\partial c_S} = -\frac{k_T b_S^2 b_T}{8c_S^2 c_T}$$

$$\frac{\partial \pi_S^*}{\partial c_T} = -\frac{k_T b_T (b_S^2 + 4a_S c_S)}{8c_S c_T^2}$$

$$\frac{\partial \pi_S^*}{\partial k_T} = \frac{b_T (b_S^2 + 4a_S c_S)}{8c_S c_T}$$

Thus, proposition 2 can be obtained.

Proposition 2: ① $\dfrac{\partial \pi_S^*}{\partial b_T} > 0$; ② $\dfrac{\partial \pi_S^*}{\partial b_S} > 0$; ③ $\dfrac{\partial \pi_S^*}{\partial c_S} < 0$; ④ $\dfrac{\partial \pi_S^*}{\partial c_T} < 0$; ⑤ $\dfrac{\partial \pi_S^*}{\partial k_T} > 0$.

Proposition 2 shows that students' income is positively correlated with their own effort efficiency, teachers' effort efficiency, teachers' effort influence coefficient, but negatively correlated with their own effort cost coefficient and teachers' effort cost coefficient.

4. Conclusion

This paper discusses the game relationship between university teachers and students, and studies their efforts to invest in decision-making. Finally, the sensitivity of correlation coefficient is analyzed. Through full-text analysis, the following conclusions can be drawn:

① The income of teachers and students increases with the increase of the efficiency of their own efforts or game objects.

② The income of teachers and students increases with the increase of the influence coefficient of the game object.

③ The income of teachers and students decreases with the increase of cost coefficient of effort of their own or game object.

Acknowledgements

References

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