Editorial

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Game and Evolutionary Game Theory

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INTRODUCTION

GAME theory is an important method to study the reality, and is a theoretical method that integrates ecological, psychological, social and economic dimensions. It can be imagined for the development of research society. It is different from traditional game theory. It does not require participants to be completely rational, nor does it require full information, because it is very difficult for participants to be completely rational and fully informed in real life. Therefore, evolutionary game theory has become an important analytical tool, and has continuously developed into an important field of economics. [1] This paper analyzes the current research situation of evolutionary game theory.

In recent years, more and more scholars have begun to pay attention to the research of evolutionary game theory, and applied evolutionary game theory to explore many problems in the field of economics. However, there are still many problems in domestic research results, mainly reflected in the following: The first point is that the characteristics and basic concepts of evolutionary game theory are not clear enough [4]. The evolutionary game is not an evolutionary view and the game's ideas are simply added; the second point [5] is that using evolutionary game theory to explain certain problems seems to be "reluctantly attached", and people feel that it is simply applying evolutionary game theory or not understanding the theoretical framework of evolutionary game theory; The third point is that only some very simple evolutionary game models can be used, and the research is not deep enough. In fact, at least part of the second and third questions [6] are caused by the first question. Therefore, it is necessary to define the specific characteristics and basic concepts of evolutionary game theory.

According to whether participants can form a binding agreement for collective action, the game can be divided into cooperative games and non-cooperative games [7,8]. Game experts such as Nash have studied more non-cooperative games. Cooperative game refers to the participants negotiating agreements or forming alliances with other participants from their own interests, and the results are beneficial to the alliance parties; Non-cooperative game refers to the agreement that participants cannot reach a binding decision when they choose their actions. The economic activity of people's division of labor and exchange is a cooperative game, and the prisoner's dilemma is a non-cooperative game.

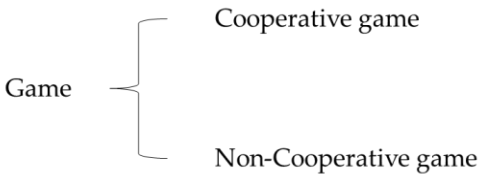

Figure 1. Classification of game by whether participants.

Prisoner's Dilemma [2]: Two thieves, A and B, were jointly committed but privately occupied by the police. The police placed the two in separate rooms for interrogation. For each suspect, the police gave a policy: If a suspect confessed the crime and handed over the stolen goods, the evidence was conclusive. They were all found guilty. If one of the criminal suspect makes a confession, the both of them will be sentenced to 8 years in prison; If one of the criminal suspect denies it but the other one confesses it, then the criminal who denies it will be sentenced to 10 years due to crime of obstructing official duties and stealing but the criminal who confesses it will be released. If one of the criminal suspect does not confess but the other denies it, then the criminal who denies it will be sentenced to 10 years due to crime of

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obstructing official duties and stealing but the criminal who confesses it will be released. If both of them deny it, the police can't convict the two people for stealing because of insufficient evidence, but they can be sentenced to jail for 1 year on charges of private residence.

Two prisoners are separated into individual rooms and cannot communicate with each other. The normal game is shown in Table 1.

TABLE 1
CANONICAL PD PAYOFF MATRIX

B \ A	Cooperates	Defects
Cooperates	(-1，-1)	(0，-10)
Defects	(0，-10)	(-8，-8)

It is not difficult to find that "confession" is the dominant strategy of any criminal suspect, and the fact (cooperates, cooperates) is called Nash equilibrium.

The structure of the traditional Prisoner's Dilemma can be generalized from its original prisoner setting. Supposed that the two players are represented by the mark, A and B, and that each player chooses to either "Cooperate" or "Defect".

If both players cooperate, they both receive the reward R for cooperating. If both players defect, they both receive the punishment payoff P. If B defects while A cooperates, then B receives the temptation payoff T, while A receives the "sucker's" payoff, S. Similarly, if B cooperates while A defects, then B receives the sucker's payoff S, while A receives the temptation payoff T.

TABLE 2
CANONICAL PD PAYOFF MATRIX

B \ A	Cooperate	Defect
Cooperate	(R,R)	(S,T)
Defect	(T,S)	(P,P)

The following condition must hold for the payoffs:

$$T>R>P>S$$

Stag Hunt Model [3]: One day two hunters, A and B, surrounded a stag each of which was stuck in one of the two intersections where the stag might escape. As long as they work together, the stage will become their prey, but it is impossible to hunt down the stage by the strength of one person. If there is a group of hares running around at this time, any one of the two hunters will succeed if they go to catch the hare. He will catch 4 hares. From the point of view of being able to fill the stomach, 4 hares can be eaten by one person for 4 days. If one stage is caught, it will be divided equally between the two hunters for 10 days per person.

TABLE 3
THE PAYOFF MATRIX

B \ A	stag	Hare
Stage	(10,10)	(0,4)
Hare	(4,0)	(4,4)

In this matrix diagram, each grid represents the result of a game. Specifically, the grid in the bottom right corner indicates that both Hunter A and B catch the hare, and the result is that both Hunter A and B can eat for 4 days; in the upper right corner, the Hunter A catches the hare and the hunter B hits the stag. It is Hunter A who can eat for 4 days, B has nothing to gain; in the upper left corner, Hunter A hits the stag, Hunter B catches the hare, the result is that Hunter A has nothing to gain, Hunter B can eat hare for 4 days; in the upper left corner, Hunter A and B are cooperate, the arrest of the stag results in two people sharing the stag and eating for 10 days. Obviously, the benefits of two people working together to hunt stag are much greater than the benefits of their own hares, but the two hunters are required to have equal contributions. If a hunter has a strong ability and a large contribution, he will ask for a larger one, which may make another hunter feel that the interests are damaged and unwilling to cooperate.

TABLE 4
GENERIC SYMMETRIC STAG HUNT

B \ A	stag	Hare
Stag	(a,a)	(c,b)
Hare	(b,c)	(d,d)

Formally, a stag hunting is a game with two pure strategy Nash equilibria — one is risk-dominant and is payoff dominant. The payoff matrix in Table 4 illustrates a generic stag hunting, where $a>b\geq d>c$. Often, games with a similar structure but without a risk dominant Nash equilibrium are called assurance game. For instance, if a=2, b=1, c=0, and d=1. While (Hare, Hare) remains a Nash equilibrium, it is no longer risk dominant. Nonetheless many would call this game a stag hunt.

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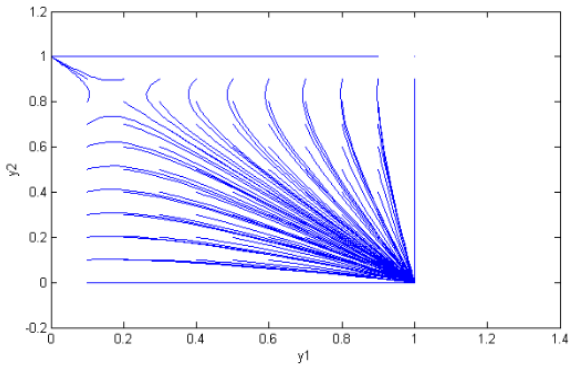

Figure 2. The figure is a schematic diagram of the results of cooperation of a game model under different initial conditions, where the x-axis represents the participant y2 and the y-axis represents the participant y1.

CONCLUSIONS

Although the research on evolutionary game theory has achieved some results. However, most of the domestic evolutionary game theory researches only concentrate on the application of evolutionary game theory to solve a certain kind of problems, but have not given satisfactory answers to the current research. The following aspects are worthy of further study: the first aspect should further improve the theoretical system of evolutionary game theory and explore the necessary and sufficient conditions for the existence of evolutionary equilibrium; the second aspect is to combine the theory of evolutionary game theory with the study of dynamic systems to find The relationship between general dynamic system and evolutionary equilibrium[9]; the third aspect should further expand the application scope of evolutionary game theory in management, and apply existing theoretical results to enterprise operation management, supply chain organization and management. Research on the operation management and industrial structure of the supply chain [10]. The study of the evolution law of industrial structure is a very meaningful direction; the fourth aspect is to learn from foreign research ideas and further strengthen the theoretical exploration of evolutionary game theory, not just in applied research.

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