E C O N O M I C S   B U L L E T I N

On cheap talk in games

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Abstract

It has been proved in many studies that cheap talk has great influence on the players' choices of strategies in games. But the effect of cheap talk has still not been properly evaluated in game theory. Based on a novel game model with parameters denoting how one player cares for the other's payoff, we can take the relations between players into account in games and extend the use of games theory. In this study the effect of cheap talk was analyzed by using the new game model.

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1. INTRODUCTION

Many truths have shown that costless and non-binding pre-play communication (cheap talk) has great influence on the players' strategies in games. But the effect of cheap talk has still not been properly estimated in game theory.

Crawford and Sobel (1982) examined the implications of cheap talk in a game in which one player send information to another player who has to choose an action. Effect of cheap talk was denoted by cheap talk extension -set of outcomes- that can be implemented in equilibrium. Aumann and Hart (1996) use the notion of a bi-martingale to characterize the set of equilibrium payoffs in a cheap talk extension of a two-player game in which only one player has private information. Farrell and Rabin (1996) and Blume (1998) characterize conditions under which cheap talk might be useful. Ben-Porath (2003) studies conditions of Bayesian Nash equilibrium in games, which are extended by adding pre-play communication.

In fact, it is the relations between players that determine whether a game is cooperative or non-cooperative. If we assume the relations between players are either cooperative or non-cooperative and don't take account of the variety of the relations in the process of games, the function of cheap talk can't be estimated properly.

By using numerical values denoting how one player care for another's payoff, a new game model taking relations between players into account was developed, which would extend the use of game theory to more general cases. Cooperative and non-cooperative games are both special cases in the frame of new game model. More complicated games such as combined games are possible to be analyzed with the new model. Then the effect of cheap talk on the players' choices of strategies was investigated.

2. A NEW MODEL FOR GAMES

Definition 1: For players ***i*** and ***j*** in a game, ***relation*** R_{ij} is a numerical value denotes how player ***i*** care for player ***j***'s payoff. Specially, there is $R_{ii} = 1$.

For example, $R_{ij} = 0$ means player ***i*** don't care for ***j***'s payoff at all, and ***i***'s attitude toward ***j*** is non-cooperative. $R_{ij} = 1$ means player ***i*** cares for ***j***'s income equal as that of his own. $0 < R_{ij} < 1$ indicates in what degree player ***i*** cares for ***j***'s income, and ***i***'s attitude toward ***j*** is cooperative. If $R_{ij} < 0$ player ***i*** would rather to have ***j*** suffered loss, this means ***i***'s attitude toward ***j*** is hostile.

Definition 2: For players ***i***, ***j*** and ***k*** in a game, ***inferred relation*** $\overline{{}_iR_{jk}}$ is a numerical value denotes player ***i*** thinks how player ***j*** cares for player ***k***'s payoff. Specially, There is $\overline{{}_iR_{jj}} = 1$.

Similarly, $\overline{{}_iR_{jk}} = 0$ means player ***i*** thinks player ***j*** don't care for ***k***'s payoff at all. $\overline{{}_iR_{jk}} > 0$ means player ***i*** thinks player ***j***'s attitude toward ***k*** is cooperative. And $\overline{{}_iR_{jk}} < 0$ means player ***i*** thinks player ***j*** 's attitude toward ***k*** is hostile.

R_{ij} and $\overline{{}_iR_{ji}}$ character the relations between player ***i*** and ***j*** from the viewpoint of player ***i***, and the numerical values of them are determined by foregone games.

We call payoffs set $U=(u_1,\cdots,u_n)$ objective payoffs because it is the viewpoint of a third party and it has no relation to the players' subjective thought. As opposed to objective payoffs, subjective payoffs of a player are his subjective consideration of objective payoffs.

Definition 3: For a game $G=\{S_1,\cdots,S_n;u_1,\cdots,u_n\}$, R_{ij} denotes how player ***i*** cares for player ***j***'s payoff, $\overline{{}_iR_{jk}}$ denotes player ***i*** thinks how player ***j*** cares for player ***k***'s payoff, we call $(u_1,\cdots,u_n)$ ***objective payoffs*** and define $({}_iu_1,\cdots,{}_iu_n)$ ***subjective payoffs*** of player ***i***, where

$$
{}_iu_j(s_1,s_2,\cdots,s_n)=\begin{cases}\sum_{k=1}^{n}R_{ik}u_k(s_1,s_2,\cdots,s_n), & \text{if } i=j\\ \sum_{k=1}^{n}\overline{{}_iR_{jk}}u_k(s_1,s_2,\cdots,s_n), & \text{if } i\neq j\end{cases} \tag{1}
$$

For example, if objective payoffs are (u_1,u_2) for two players when they have chose strategies (s_1,s_2) in a two players' game, subjective payoffs of player ***1*** are $(u_1+R_{12}u_2,\ u_2+\overline{{}_1R_{21}}u_1)$. Similarly, subjective payoffs of player ***2*** are $(u_1+\overline{{}_2R_{12}}u_2,\ u_2+R_{21}u_1)$.

New Game Model: $G=\{S;U;R;\overline{R}\}$ is a n-player game, where $S=(S_1,\cdots,S_n)$ are strategies of players, $U=\{u_1,\cdots,u_n\}$ are objective payoffs, $R=\{R_1,\cdots,R_n\}$ are relations between players, $\overline{R}=\{{}_1R,\cdots,{}_nR\}$ are inferred relations between players. Each player will choose strategy based on his subjective payoffs.

Subjective payoffs of player ***i*** will be equal to the objective payoffs when there is $R_{ij}=\overline{{}_iR_{jk}}=0\ \ (i\neq j,\ j\neq k)$, and it becomes a non-cooperative game when there is $R_{ji}=\overline{{}_jR_{ik}}=0\ \ (i\neq j,\ i\neq k)$ at the same time. This shows that non-cooperative games are just special cases of the new game model.

Obviously, cooperative games and non-cooperative games are all included in the new model. For a game with complete information there should be $\overline{{}_iR_{jk}}=R_{jk}$ for any $i,j,k\ \ (i\neq j,\ j\neq k)$ before the game, which means that the relations between any two players is common knowledge. For a game with perfect information there should be $\overline{{}_iR_{jk}}=R_{jk}$ after the game.

Most of real-life games are games with imperfect and incomplete information because of the nature of R_{ij} and $\overline{{}_iR_{jk}}$. R_{ij} only can be known by player ***i*** exactly and other players have to estimate it. Even if player ***i*** declares its real value, other players have to judge whether it is credible. $\overline{{}_iR_{jk}}$ can be verified by the results of games and information exchange, but player ***i*** can't make sure $\overline{{}_iR_{jk}}$ always equal to R_{jk}.

3. CHEAP TALK IN GAMES

It has been proved by many truths that cheap talk has great influence on players' choice of strategies. How can cheap talk influence the results of games will be analyzed based on the new game model.

Since it is according to subjective payoffs for a player in games to choose his strategies, relations between players have influence on every player's decision-making as well as objective payoffs. For instance, the strategies of player ***i*** in a two-person game are determined by strategy set U and relations R_{ij} and $\overline{{}_iR_{ji}}$.

When there is $R_{ij} = \overline{{}_iR_{ji}} > 0$, player ***i*** wants to cooperate with player ***j*** and knows that player ***j*** wants to cooperate with player ***i***. Then a promise of cooperation proposed by player ***j*** is credible for player ***i*** here. When there is $R_{ij} = \overline{{}_iR_{ji}} < 0$, player ***i*** expects player ***j*** to suffer loss in the game and knows that player ***j*** expects player ***i*** to suffer loss in the game. Then a threat of defection proposed by player ***j*** is credible for player ***i*** in this instance.

When there is $R_{ij} = 0$ and $\overline{{}_iR_{ji}} = 0$, neither of promises of cooperation and threats of defection is credible for player ***i*** . If there is $R_{ji} = 0$ and $\overline{{}_jR_{ij}} = 0$ at the same time the game is non-cooperative, and cheap talk has little effect on it.

When there is $R_{ij} \neq \overline{{}_iR_{ji}}$, the relations between players will be complicated and there will be deceiving, commiserating or dedicating behavior in the game. This type of problems will be studied in future research.

In conclusion, cheap talk of cooperation is credible in cooperative games, and cheap talk of threat is credible in hostile games.

One player ***i*** with higher R_{ji} will receive higher long-term payoffs in repeated games. This is the motivity for player ***i*** to keep R_{ji} higher (positive at least). Hence, $\overline{{}_iR_{ji}}$ can also denote the degree of credit on how player ***i*** trust in player ***j***. The larger $\overline{{}_iR_{ji}}$ is the higher degree player ***i*** trust in player ***j***. Suppose that two players promise to each other that they will choose strategy S^*, the possibility of coming forth of S^* is mainly determined by $\overline{{}_iR_{ji}}$ and $\overline{{}_jR_{ij}}$.

In the event S^* doesn't come true, there must be at least one player whose payoff does not accord with his anticipated value after the game. Assume that there is difference value Δu_i between player ***i***'s intending payoff and his real one and ***i*** attribute Δu_{ij} to player ***j***'s not abidance of promise, there will be $\Delta\overline{{}_iR_{ji}} = f(\Delta u_{ij})$, where $\Delta\overline{{}_iR_{ji}}$ is the change of $\overline{{}_iR_{ji}}$. In general R_{ij} is in accordance with $\overline{{}_iR_{ji}}$, hence not coming forth of S^* will change at least one player's credit ($\overline{{}_iR_{ji}}$) and attitude (R_{ij}) to others.

In the event of one player j departures from his promised strategy S^*, it usually causes other players' payoffs decreased and consequently causes $\overline{{}_iR_{ji}}$ and R_{ij} decreased, so each player has positivity to keep his promise in general cases.

For example, a conceited man j in a bar claimed that if anyone wins him in hand wrestling he would pay for everyone's beverage, but he lost the game as a result. Of course the man is unwilling to pay, but that action will cause his credit ($\overline{{}_iR_{ji}}$, $\overline{{}_kR_{jk}}$ $\cdots$) declined. If he cares for his credit more than that money, he would choose *Pay.* This example indicates that the change of $\overline{{}_iR_{ji}}$ can be looked as a kind of payoff for player j. On condition that a player's credit lowers, his long-term payoffs will decrease and the possibility of successful cheap talk will also decrease. Sometimes cheap talk is not cheap.

4. CONCLUSION

Cheap talk has an influence on relations between players and consequently changes the results of games. On condition that relations between players were neglected the function of cheap talk should not be estimated properly. Based on a new game model with parameters denoting how one player care for other's payoff, we could take the relations between players into account in games and extended the use of games theory to more general cases. Then the importance of cheap talk can be explained with the new game model. I believe that more and more economic and social phenomenon will be properly analyzed by using the new game model.

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