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Abstract
This note examines how the second chance, when provided to a disadvantaged player, can resolve the prisoner's dilemma.

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Highlights:

- A second chance given to a disadvantaged player resolves the prisoner's dilemma.
- Two effects of the second chance: making a cooperative action safer; making a non-cooperative action less attractive.

1. Introduction

The prisoner's dilemma game has been extended in various ways to resolve the dilemma. Infinite repetition of the game combined with the trigger strategy (folk theorem), incomplete information (Kreps *et al.*, 1982), and taking fairness into account (Rabin, 1993) are included in these extensions. This note presents another approach, possibly the simplest: giving a second chance to a disadvantaged player. Kalai (1981) provides a preplay negotiation procedure, which resolves the dilemma in a one-shot game. The current paper shows that Kalai's procedure can be substituted with the goal-directed behavior of the "investigator" in our example.

2. The prisoner's dilemma game with the second chance

Let us assume the payoff matrix given in Table 1. The story behind it is as usual: the police investigate two suspects under arrest. The suspects committed a crime together, but the available evidence is sufficient only for minor convictions. The estimated penalties are 5 years in jail if both suspects confess, 2 years in jail if both refuse to confess, and 1 year for one suspect and 10 years for the other, if the former confesses while the latter refuses.

Table 1

		Suspect B	
		Refuse	Confess
Suspect A	Refuse	-2, -2	-10, -1
	Confess	-1, -10	-5, -5

2.1. An extensive form representation

Figure 1 shows an extensive form representation of the above matrix. The subgame perfect equilibrium of this game is characterized by confessions from both suspects (Confess, Confess) and Pareto inefficient outcomes (-5, -5).

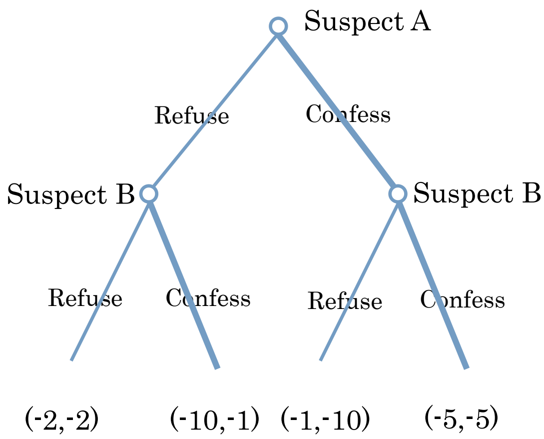

Figure 1

Now, suppose that the investigator in charge is well known to be a perfectionist, who stubbornly seeks not just one, but all suspects' confessions all the time; and that if one suspect confesses, the investigator always provides a second chance to the other who has refused to confess. The game tree is thus extended to the one in Figure 2, where the red node and the yellow node are added as the second chances given to suspect A and suspect B respectively.[1]

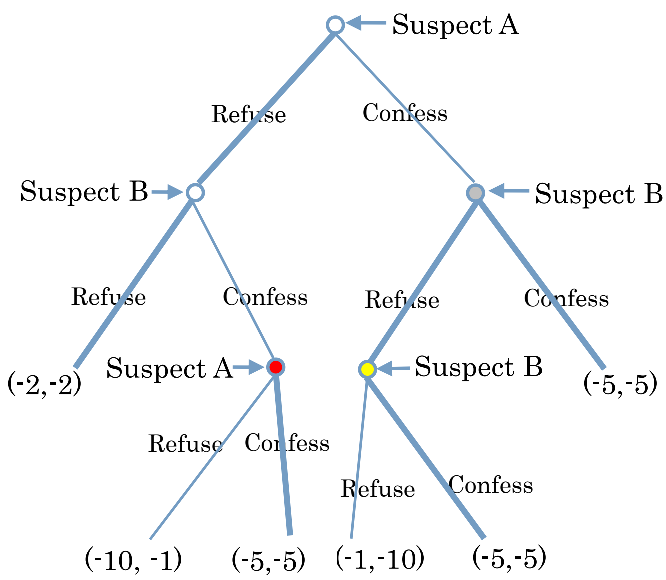

Figure 2

[1] Note that, at the stage of the red and yellow nodes, it is rational for the investigator to give a second chance, since it certainly leads to the suspect's confession.

Then, we have the following proposition:

Proposition 1: Suppose that second chances are provided to disadvantaged players in the extensive form prisoner's dilemma game. Then, the subgame perfect equilibrium becomes (Refuse, Refuse),[2] and the pair of payoffs becomes (-2, -2), that is, Pareto efficient one.

Thus, the investigator fails to obtain confessions.

2.2. Simultaneous action in the first stage

Let us consider a slightly modified case where these suspects make initial choices simultaneously, and suppose that, after their choices have been made, a disadvantaged suspect who has refused to confess is provided with a second chance, together with the information of the other suspect's confession. In this case, the payoff matrix evaluated at the initial stage is given by Table 2.

Table 2

		Suspect B: Refuse	Suspect B: Confess
Suspect A	Refuse	-2, -2	-5, -5 (Suspect A confesses at the second chance)
Suspect A	Confess	-5, -5 (Suspect B confesses at the second chance)	-5, -5

Then, we have the following proposition.

Proposition 2: Suppose that second chances are added to the simultaneous-move prisoner's dilemma game. Then, the pair of actions (Refuse, Refuse) is a weakly dominant and trembling-hand perfect equilibrium.

Thus, cooperative actions are very likely to happen.[3]

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[2] At the gray node, "Refuse" and "Confess" are indifferent choices to suspect B, and anyway, suspect A chooses "Refuse" at the root node.

[3] Wagner (1983) discusses the prisoner's dilemma by using an example similar to ours,

3. Conclusion

While many devices have been proposed for breaking the prisoner's dilemma, the simplest may be to give a second chance to the disadvantaged player placed in an asymmetric payoff situation. Comparison between Table 1 and 2 sheds light on two effects of the second chance. First, the second chance makes the choice of "Refuse" safer, since a later revision becomes available when the other player chooses "Confess." Second, it makes the choice of "Confess" less attractive, since the other player can change its action from "Refuse" to "Confess" later. The framework of the prisoner's dilemma with the second chance is expected to have a wide area of application.

References

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although Wagner does not use subgame perfection in the case of the extensive form and does not analyze the case of simultaneous moves in the initial stage.