

# Game Theory in Economics

## A Response

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Adding to the ongoing debate on how best to understand game theory and its relevance to economics, a response to Atanu Sengupta and Abhijit Ghosh's "Non-cooperative Game Theory and Pay-off" (*EPW*, 28 January 2017).

In the article, "Non-cooperative Game Theory and Pay-off" (*EPW*, 28 January 2017), Atanu Sengupta and Abhijit Ghosh question the contributions of game theory to economics. They do this by setting up examples to show how game theory is case-specific, and thus cannot be generalised.

While we disagree with multiple aspects of the paper, we will focus on two examples which are instrumental in the formulation of the authors' argument. The first part of this response critically evaluates these two problems and the second will discuss the relevance of game theory in economics.

### Technical Problems

In their first example, Sengupta and Ghosh attempt to show how the famous prisoner's dilemma game applies only to the story of convicts. The prisoner's dilemma game itself has been usefully applied to other contexts such as understanding overuse of common pool resources, pollution, lack of contribution to public goods, and other such situations, but that is beyond the purview of our current concerns. Even on their own assumptions, their conclusions are mistaken.

Sengupta and Ghosh set up a game with two researchers who need to collaborate to finish a joint project. They claim that in a set-up such as this, the Nash equilibrium solution that the two researchers would not cooperate is hard to accept, as each researcher is aware that their non-cooperation would lead to their partner finding another researcher who would cooperate with them and "take away all gains." Based on this set-up we have constructed a matrix shown in Table 1.

Since we do not have any utility functions to work with, we are assuming that the pay-off for both researchers

cooperating would be (6,6). If one researcher cooperates and the other does not, in accordance with their set-up, the researcher that chooses to cooperate would find another researcher and would receive a pay-off of 6, leaving the non-cooperator with a pay-off of zero. Lastly, both researchers not cooperating would result in both receiving no gains.

The authors' difficulty in accepting that the researchers would choose to not cooperate is justified, as it is simply not the Nash equilibrium. In fact, the game that they have proposed is not a prisoner's dilemma game but rather an assurance game, where the Nash equilibrium is to cooperate-cooperate. Game theory never claimed to fit all its varied situations into a prisoner's dilemma framework and the stories behind popular game types exist not to constrict the game to that particular situation but as an explanatory tool.

However, Sengupta and Ghosh would have a problem with our set-up (Table 1) as we arbitrarily assigned cardinal values to the pay-offs. In their second example they try to show how despite maintaining the order, a change in cardinal values can alter the Nash equilibrium. They do this by altering the pay-offs in the battle of sexes game (Table 2). The fundamental problem here is that they have not maintained the ordinal ranking between each strategy but rather within one strategy, namely, Bach-Bach. Doing this changes the entire meaning of the game. In the initial set-up (Table 3), the game is between two players who have conflicting preferences between listening to Bach and Stravinsky, but value

**Table 1: Researcher's Dilemma**

Player 1/Player 2	Cooperate	Non-cooperate
Cooperate	6,6 (Nash)	6,0
Non-cooperate	0,6	0,0

**Table 2: Sengupta and Ghosh's Battle of the Sexes Game**

Player 1/Player 2	Bach	Stravinsky
Bach	-3,-4	0,0
Stravinsky	0,0	1,2 (Nash)

**Table 3: Battle of the Sexes Game**

Player 1/Player 2	Bach	Stravinsky
Bach	2,1 (Nash)	0,0
Stravinsky	0,0	1,2 (Nash)

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listening to music together (thus, when one picks Bach and the other picks Stravinsky they both receive a pay-off of zero). In the authors' modified version of the game it would imply that both players value listening to Stravinsky more. In which case, the Nash equilibrium solution that they both will listen to Stravinsky is expected. If the goal was to keep the ordering the same, then the relative ordering between choosing Bach–Bach and Stravinsky–Stravinsky must be maintained and thus, the Nash equilibrium would remain unchanged.

### Relevance to Economics

While there are multiple definitions of what economics is, one can agree with the broad understanding that economics studies how people interact with one another and the world around them. Game theory thus is a tool to model how these social interactions take place. As is the case with any model in economics, it cannot represent the gamut of complex social interactions that take place in an economy and needs to be simplified so that it can be understood. However, problems may arise when these assumptions are too unrealistic.

One such assumption is that all economic agents are rational. Rationality in this context refers to individuals who are aware of their preferences and use this to make choices so as to optimise their preferences. Rationality here means completeness<sup>1</sup> of preferences and transitivity.<sup>2</sup> Since humans have limited computational capacities, it is unrealistic to assume that every individual can have a clear preference ordering for multiple commodities and assess how to maximise these sets of preferences optimally. Another assumption is that every individual is self-seeking and has no consideration for other agents and whose preferences are separate from them. This is simply not true in the real world, where individual decisions are affected by society. Even within these restrictive assumptions, game theory has been most successfully applied in two situations. The first being in understanding and thus designing auctions (as can be seen in Klemperer 2004) that governments use to allocate certain resources. The second

is that of matching markets (Roth 2008a, 2008b, 2015) which have novel uses, an extremely useful example being that of matching kidney donors to recipients. These uses themselves are a satisfactory argument to not dismiss the role of game theory, but to improve upon it and hope that it leads to more such important discoveries.

The field of game theory is nowhere close to stagnation and has been improving upon the neoclassical assumptions that governed its applications. For instance, a simple fix for the self-regarding assumption would be to use indifference curves that reflect non homo-economicus behaviour like altruism, inequality aversion and reciprocity. The question of rationality can be dealt with in part with the more realistic concept of bounded rationality, in which there are bounds on the ability of people to take traditional “rational” decisions and where actions are based on heuristics. In addition to this there have been many extensions to game theory in the realm of experimental economics such as evolutionary game theory and neuro-economics based game theory. Both these approaches try to expand upon the understanding of human behaviour in the hope of arriving at a more realistic framework.

Do the problems in the assumptions that game theory make require it to be deemed irrelevant in the field of economics? We strongly disagree. Even if

the real world applications of game theory are limited, game theory in economics is still emerging, and the effect that it has had on the way we look at conflict and think about social interactions is undeniable.

Our view of the contributions of game theory in economics is best expressed in the words of Anatol Rapoport (1992: xii):

It is the shortcomings of game theory (as originally formulated) which force the consideration of the role of ethics, of the dynamics of social structure, and of social structure and of individual psychology.

### NOTES

- 1 Given preferences A and B, completeness refers to the ability of a person to pick A, B or neither.
- 2 Given preferences A, B and C, transitivity refers to the consistency in preferences that a person is expected to maintain. For instance, if A is preferred to B and B is preferred to C, then A must be preferred to C.

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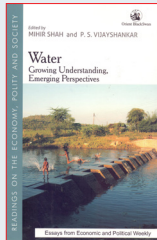
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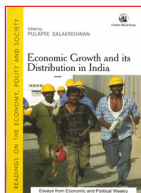


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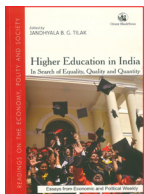


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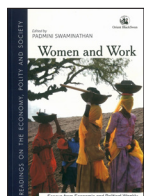


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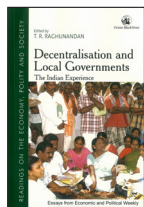


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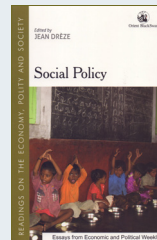
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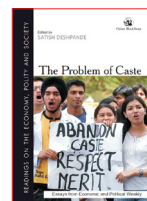


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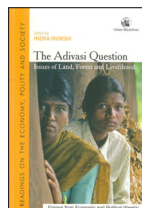


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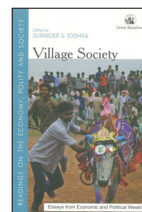


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