

Review of: "The Uncertainty of Fairness: a Game Theory Analysis for a Debt Mutualization Scheme in the Euro Area"

Jan Snellman¹

¹ Aalto University

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In this article the authors apply game theory to the practical case of debt mutualisation in the Euro Area. In particular, the authors present three different economic scenarios in the form of games that model the interactions of an EU member state receiving some form of economic rescue package from EU and EU itself. The scenarios and corresponding games are:

1. An EU member state requests EU to cover a portion of its debts. This scenario is studied using the standard ultimatum game, where the country makes a proposition and the EU either accepts or rejects the proposition.
2. An agreement is made between EU and a country in which the former provides the latter with debt relief in exchange for economic reforms. Having agreed to this deal, the country in question can choose to either implement or not implement the reforms, while the EU can choose to withhold the economic aid in the same way. This scenario is studied using a version of the repeated prisoners dilemma presented in [\[1\]](#) in which one of the players can sympathise with or develop antipathy to the other in case of unexpected cooperation or defection, respectively. In this case it is the member state that can develop sympathy for or antipathy to EU, while EU plays the role of a manipulator that tries to make the member state comply with the deal.
3. EU creates a debt mutualisation scheme which the member states are allowed to benefit from with the expectation that they make an effort to pay their debts. This scenario is modelled by a gift exchange game presented in [\[2\]](#) in which the EU decides the benefit level that the member states taking part in the scheme get and the member states can choose to either make the economic effort as expected or just take the benefits without expending any effort on their part.

These scenarios are relevant, since all of them have either been played out or proposed during the course of the Eurozone sovereign debt crisis in the early 2010s and more recently with the economic shocks caused by the global COVID-19 pandemic. Personally, I find the first scenario particularly interesting, as the ultimatum game is usually about dividing rewards, as opposed to debts. This article the only one I know of where the “reward” to be divided in the ultimatum game is something people often think of as to be avoided, which makes it a unique application of the game. The two other scenarios are straightforward applications of examples given in earlier work, the main novelty being the application to debt mutualisation.

The authors have chosen to approach the subject matter from the game theory perspective of fairness, and give an impressive review of the previous work in the field. Since all of the scenarios studied in the article are between EU and a member state, it could be asked how realistic this is given that EU is a continent wide economic block with multiple

member states. Not only is the economic weight of the EU much greater than any of its members, but all of the members have influence on the decision making of the block. However, questions of fairness pop up as soon as one considers the fact that a deal that is considered fair by a member state with a weak economy might not seem so fair to a member state with a strong economy, and so I think that the perspective is warranted. A very interesting prospect for future work would be to make a similar study using games in which all the member states could be taken to be players at once. The public goods game would be a great object of research in this context, especially since considerations of fairness play a role in it as well.

All in all, the article deals with the topical question of the debt mutualisation in the Euro area and presents interesting applications of the game theory to the subject utilising a perspective of fairness. My suggestions for improvements are:

- On a general level, the article would benefit from a language check with a native English speaker. A few parts of the article are hard to understand.
- In section 2.2 I find several mathematical expressions in which I think that symbol \times has been used where the cartesian product symbol \times has been meant. Please check that the written forms of the expressions correspond to the intended meaning.
- There seems to be an implied assumption in section 3.1 treatment of the ultimatum game that player 2 (EU) has already agreed in principle to the division of the debt with player 1 (country i), as the payoffs for the players are the portions of the debt they need not pay under the proposed division, i.e. $1 - s$ and s , respectively. I think that this assumption should be stated explicitly for the following reason: If player 2 were to take his/her payoff to be pure nothing but costs, the payoff would be $-s$ for him/her. Repeating the same analysis in this case would yield the result that player 2 would not agree to any division of debt. While almost trivial, this result is relevant given how difficult the negotiations on debt mutualisation have been to date in the euro area, and mentioning it would give readers a larger view of the practical situation under study.
- I find the lines of thought in section 3.2 particularly hard to follow and confusing, and feel that the dynamic prisoners dilemma and its equilibria should be explained better. For example, the sympathy stock α is said to increase by $k(1 - p)$ in case of unexpected cooperation by player 1, EU in this case, where $k = 2$ is a constant describing how fast α grows, and p is “the probability assigned to each action”, which is not specific enough for my liking. Nevertheless, p is then given value of $1/2$, and it is stated that it means that the EU will cooperate with that probability. Next, it is stated that if player 1 (EU) chooses to cooperate unexpectedly in the first of three rounds, α is increased to a value of 2 from an initial value of 0. Obviously, with the given values of k and p it is not possible to increase α by 2 in a single round, so what is possibly meant here is that in this context p actually stands for the expectations of player 2, or country i in this case: If player 2 expects player 1 to defect, then he/she assigns probability $p = 0$ to player 1 cooperating, and so we arrive at the increase of 2 for α in the case player 1 cooperates. Also, further down the line in the discussions on the equilibria of the game it is stated that in this new context player 1 will actually change his/her strategy according to the state of the game, which makes one wonder why p was given a value in the first place. Unsurprisingly, I think that especially the interpretation of the parameter p and its exact dynamics in the game should be clarified. It would also be helpful to the reader if the different equilibria of the game could be illustrated with figure(s) of some kind.

- In section 3.3 the payoff for EU π_{eu} contains term $-\gamma$, where γ is the disutility for country i if it makes a high effort to pay its debts. I thought that γ is a specific burden for country i to bear, so its appearance in the payoff for EU is strange. Is this a typo?

References

1. [^] John Geanakoplos, David Pearce, Ennio Stacchetti. (1989). *Psychological games and sequential rationality*. *Games and Economic Behavior*, vol. 1 (1), 60-79. doi:10.1016/0899-8256(89)90005-5.
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