Towards a Formal Definition of Social Dilemma

What is a social dilemma in formal terms?

A non-cooperative normal form game is a social dilemma if there is a rationalizable pure strategy profile which is (weakly) Pareto inefficient.

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Despite the importance of social dilemmas, a single unified and well-accepted formal definition of social dilemma has yet to be presented.

We contend that a non-cooperative normal form game is a social dilemma if there is a rationalizable pure strategy profile which is (weakly) Pareto inefficient. By proposing this definition we are applying the broadest and most well-accepted notion of collective rationality and the less stringent requirement for the exercise of individual rationality.

With this definition we argue that social dilemmas should be perceived as social settings prone to conflict instead of settings in which conflict is certain. Furthermore, we hold that situations in which long-term social inefficiency can arise in the pursuit of the short-term best interest of both the individual and society should be considered social dilemmas.

The Definition of Social Dilemma Through Time

1975

“Situation in which actions that are individually rational can lead to outcomes that are collectively irrational.” (Huckathorn, 1990).

1983


1996

The stability of the inefficient outcome in social dilemmas.

“Situation in which actions that are individually rational can lead to outcomes that are collectively irrational.” (Huckathorn, 1990). The use of the verb “can” denotes the possibility but not the certainty, of the inefficient outcome in social dilemmas.

2011


Formalizing the concept of social dilemma

PROPOSITION

A repeated or iterated non-cooperative game is a social dilemma if it is is one-stage version is a social dilemma.

PROPOSITION

A repeated or iterated non-cooperative game is a social dilemma if its representation as a one-stage game is a social dilemma.

Individual Rationality: Rationalizability as the less stringent requirement.

Collective Rationality: Weakly Pareto efficiency as the most authoritative and broadest optimality definition.

DEFINITION: Non-cooperative one-stage social dilemma

A normal form non-cooperative game is a social dilemma if there is a profile composed of pure rationalizable strategies which is (weakly) Pareto dominated by another pure strategy profile.

Why rationalizable profile of pure and not mixed strategies?

A rationalizable profile of mixed strategies must forcibly have a support set of rationalizable pure strategies.

Why the Pareto dominance by a pure strategy outcome and not a mixed or correlated profile?

Pure strategies are the only ones with a positive probability to occur in a one-stage game.

In some social dilemmas the postulate of individual rationality and the one of collective rationality may prescribe a course of action in the short run which may not yield in the long run the best possible outcome for society!

DEFINITION: Non-cooperative social dilemma

A normal form non-cooperative game is a social dilemma if there is a profile composed of pure rationalizable strategies which is (weakly) Pareto dominated by another mixed strategy profile.

Iterated Deadlock

CC     DD     CD     DC

2.2     16.2     9.0     9.0

CC     DD     CD     DC

-2.16    0.0     -1.8     -1.8

CD     DD     CD     DC

1.1     8.1       1.1     7.7

CD     DD     CD     DC

0.9     8.1       7.7     1.1

C     D

1.1     8.1

-2.16     0.0

0.9     8.1

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Rationality:

Collective Rationality:

Collective Rationality:

Collective Rationality:

Collective Rationality: