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Can common knowledge of rationality make information incomplete? The case of the finitely repeated prisoners' dilemma

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Università Cattolica del Sacro Cuore, Via Necchi 5 - 20123 Milano

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Can common knowledge of rationality make information incomplete? The case of the finitely repeated prisoners' dilemma[1]

[1] Trattandosi di una prima stesura di appunti destinati a studenti, correzioni, suggerimenti e commenti sono particolarmente desiderati.

Abstract

Define reasonable both a strategy whose best response leads to a state Pareto superior to the Nash equilibrium and a player that always chooses a maximal reasonable strategy. In a finitely repeated prisoners' dilemma, reasonableness requires playing cooperative till almost the end of the game, supported by a threat of a just sufficient punishment if the other does not play cooperative. Assume players know both have the choice between following reasonableness or using backward induction in deciding which move to make at any stage of the game. This generates an underlying stag hunt game in which both choosing reasonableness is a Nash equilibrium which dominates the one in which both follow backward induction. It is argued that, given common knowledge of rationality, substantively rational players would choose reasonableness in the underlying game, and therefore cooperation in the overt one, for most of the hands, they would be uncertain about the rational choice towards the end of the game, and use backward induction only at the very end.

Common knowledge – rationality – backward induction – reasonableness – incomplete information – finite prisoners' dilemma

JEL: C72

Introduction

In most of game theory it is assumed that games can be defined in such a way as to admit only one reading. What is claimed is that this assumption is dubious for many cases of multi-stage games, and in particular for games that have inefficient Nash equilibria. If a game admits more than one reading, players must decide how to play not only the overt game,[2] but also an underlying one,[3] in which the choice is the reading of it to adopt. If the underlying game also admits more than one reading, one has to face a possibly infinite sequence of underlying games in which, at each stage, the choice is how to read the game of the preceding stage. Substantive rationality in the solution of these underlying games can disqualify what appears to be the substantively rational behaviour in the overt game.
In this paper I examine the case of the finitely repeated prisoner's dilemma.[4] The usual way to support the claim that substantive rationality requires defection from the start in this game relies on rationality implying backward induction (bi). But this dilemma is an example often used to show that it is doubtful that substantive rationality is instrumentally justified, that it is a, if not the, best mean for pursuing one's aims. If it is not instrumentally justified, and the adoption of substantive rationality is a choice, one has problems in claiming that a substantive rational agent should use substantive rationality in these conditions.
To avoid the dire predicament to which substantive rationality is taken to lead, one introduces some uncertainty about the rationality of the players. Player A can induce B to discard the assumption that A is substantively rational simply by playing cooperative at the first stage. In this way one allows some communication between agents, though the message is unclear. Simply to appear as not substantively rational leaves B with no hunches on what to do.[5] A needs to be

[2] That will also be called a level 1 game.
[3] A level 2 game.
[4] But a similar reasoning can be applied to the centipede game.
[5] See, for example, Reny (1992) and (1995).

taken as affected by a particular kind of "irrationality", as being a tit for tat player, to induce a substantively rational B to play cooperative till almost the end of the game.[6]

It is not clear A has a way to induce this belief in B, and, in turn, he has no reason to believe B is such a player, if B plays cooperative. But if he succeeds in this enterprise, it turns out that tit for tat is instrumentally superior to backward induction and yet is inconsistent with substantive rationality. Since the use of backward induction is not substantively rational, being instrumentally inferior to tit for tat, it would then seem unclear what substantive rationality actually requires.

What will be shown is that, in a world in which rationality is common knowledge, playing cooperative actually sends a much more readable and credible message, that of adopting consistently a method of choice which leads to implement what will be called a reasonable strategy. At the beginning of the game, a rational person has the choice between following reasonableness or backward induction. To the overt, later called a level 1, game, one attaches an underlying, level 2, game in which a player has to choose between these two options. If substantive rationality is used at level 2, it is consistent with playing reasonable in the level 1 game.[7]

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[6] This is the solution of Kreps - Milgrom - Roberts - Wilson (1982).

[7] If one wants to go on believing in the rationality of the other, one must find a way to make consistent playing cooperative at some stages, with the fact that one is sure that substantive rationality requires non cooperation at least at the last stage.

A definition of reasonableness

To be qualified as reasonable in the overt game, a strategy must be such that, coupled with its best response, leads to a state which is not Pareto dominated by that which would be reached if both used, in the case at hand, the Nash equilibrium strategy.[8] A reasonable player is one that adopts his best reasonable strategy, denoted as rea in what follows.

What a reasonable player does, is to give up the use of backward induction, since, when it has any scope, reasonableness dictates a strategy that is not a best response to the its best response.

Of course, it is sensible for A to act reasonable if and only if he can expect to be taken as such by B, which will then adopt a best response to the reasonable strategy of A, so B must know of the possibility of reasonableness and believe that it is rational for a rational A to follow it. Here, the fact that, in the usual rendering, the prisoners' dilemma is a symmetric game, helps.

A characterization of reasonable strategies

In a finitely repeated prisoner's dilemma, moves are simultaneous and common knowledge of substantive rationality is taken to imply the use of backward induction, and then non cooperation from the start, the (bi; bi) equilibrium. However, it is easy to show that reasonable strategies exist for both players.

The obvious one is the trigger strategy: start with cooperation and keep cooperating till the other does; from the stage in which the other turns non cooperative, play non cooperative till the end of the game. It is easy to see that it dominates any strategy which induces a best response with a shorter span of cooperation but, of course, one

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[8] Note that reasonableness requires to play a Nash equilibrium strategy in a one shot prisoners' dilemma, so that reasonableness does not rule out substantive rationality if circumstances are appropriate. In the relevant cases, however, reasonableness requires choices inconsistent with a Nash equilibrium in the overt game, and will be used in this sense in what follows.

knows that by itself the announcement of such a strategy will not produce any effect unless it justifies doubts about the rationality[9] the player that makes it intends to adopt; furthermore though it is a reasonable strategy, it is not the best of this kind and, more, it is not actually consistent with reasonableness.

It has the usual problems of credibility, indeed, when coupled with reasonableness, it exacerbates them. Would it be reasonable for a reasonable person to give up reasonableness when faced by a deviation by the other at the first stage of a long round? If one were known to be reasonable, such doubts would invite the other player at least to a period, possibly long, of testing of the resolve to reasonableness of the first.[10]

The advice never to use disproportionate threats here holds *a fortiori*. More lenient strategies can produce the same effects of the harsh strategy, at a much lower cost, allowing a best response which leads to Pareto superior results so that they accord better with reasonableness. The simplest is: start playing cooperative and go on with cooperation till the other does; after a defection by the other, play non cooperative for a number of stages just sufficient to reduce the gains of the defaulter below those he would have got if cooperation had gone on over that interval[11] and then go back to cooperation.[12]

With lenient strategies, a deviation only requires ministration of the threatened punishment. Going back to cooperation afterwards entails

[9] Actually, in the context of this discussion, the kind of rationality.

[10] The problems of such a harsh strategy are better seen from a different viewpoint on which we will come back later.

[11] Possibly making the length of the period of punishment conditional on the behaviour kept by the other in this span of the game, for example, shortening it if the other plays cooperative before the end of the announced round of punishments.

[12] For example, assume that one stage of non cooperation is sufficient to wipe out the gains obtained by defaulting a cooperator; then, punish the defaulter for one period by playing non cooperative and after that go back to cooperation. Such a strategy, while very similar, could avoid some unpleasant consequences of a tit-for-tat strategy, such as, for example, the possibility of consistent non cooperation.

no loss of face, but on the contrary, reasserts it; one can then be much more confident about using the past as a predictor of future behaviour in the underlying game.[13] The strategies just outlined allow then some communication and learning between the players, which is not cheap but neither very costly, about the kind of rationality they intend to use.[14]

The first step of the reasoning requires outlining how a reasonable strategy looks like.

Let c and nc be the cooperative and non-cooperative strategy in the stage game and normalize payoffs as in Kreps - Milgrom - Roberts - Wilson (1982). The payoff matrix is then:

1 \ 2	nc	c
nc	0 ; 0	a ; b
c	b ; a	1 ; 1

with $a > 1$ and $b < 0$, so that the Nash equilibrium in the stage game gives 0 to both players.

Let n_a be the smallest integer greater than a, n_{a-1} the smallest integer greater than $a - 1$, the length of a just sufficient punishment in case of deviation by the other, and n_b the smallest integer greater than $|b|$.[15]

[13] The fact that, with "just sufficiently harsh" strategies, establishing one's character is advantageous for a player allows to dispense with the infinite hierarchy of threats of punishments of the player who does not minister punishment when he should.

[14] It allows a distrustful player to test whether the other is playing rea, and each knows he too can be tested. And if one meets a substantively rational player who does not see any room in his world for reasonableness, one has means to try to convince him, though they will not necessarily be successful.

[15] It is assumed that $a + b > 1$, and that $n_a \geq n_b$. If $a + b < 2$, one has also that $n_a - n_b \leq 1$. If $a + b > 2$, rational cooperative players would use a more complicated strategy than the "always cooperate unless …" here considered, for example they could agree on 1 playing c and 2 nc at even stages reversing roles at odd stages, but it is easy to adapt the reasoning to consider also this case.

Suppose the game is repeated N times. What has to be justified in this setting is the emergence of cooperation, and this must be based on the rationality of reasonableness.

At stage $n > N - n_b$, no player has a reasonable strategy, since there is no strategy which coupled with its best response gives a player a payoff at least as great as that associated to consistent use of nc and so rationality requires they play nc.[16]

From stage $n = N - n_a$ to stage $n = N - n_b$, both have a reasonable strategy, and, in this situation, reasonableness simply requires to play always c till the end of the game.[17] Sticking to the reasonable strategy till the end, even if both do so, does not give better results than using bi from stage $N - n_a$,[18] and gives worse results to the player that does so if the other shifts to bi before the end. Furthermore, both know that rationality requires defecting as soon as one reaches $N - n_b + 1$.

Note however that this last step requires the use of backward induction. If they are rational and have always played nc in the preceding stages, they must have justified their choices through backward induction. Not only adoption of reasonableness from any of these stages onward is not credible by the other player, but is inconsistent with the reasoning followed up to that stage and therefore irrational for the player that considers whether to adopt it.

What is usually claimed is that in a world of rational players in which rationality is common knowledge, the only possible history is one of consistent non cooperation. What is claimed in this paper is that, if they can choose, rational players can adopt reasonableness. If this claim holds, they must consider how to play if the history from which they come is one of a sequence of cooperative stages. For a rational player, to play c is to have given up the use of backward in-

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[16] Notice that, if $n_b \geq 2$, there is an incentive to delay playing out the conflict about being the one that defects just before the other does, but there are no means to convince each other that it is credible the conflict will be delayed.

[17] Note that the best response to this strategy is to play nc only at N.

[18] And does not promise better results than playing successfully a trick at any of those stages, i. e., in this case, playing c at the current stage while planning to play nc next stage and then till the end.

duction in the previous stages; if this has been done intentionally, consistency requires one to have a reason not for going on to play c, but for revising this choice, for starting to use backward induction and therefore shift to using nc.
The use of backward induction requires and implies taking what has gone on before the stage one is considering as irrelevant to the decision one has to make at that moment. In fact, however, if rationality implies consistency of the criteria used in one's decisions, what has gone on before, if cooperation has been observed, can question the rationality of using backward induction.
Persisting in reasonableness till n_b included, even if the other plays accommodating against such a strategy, gives better results to both than playing nc consistently from $N - n_a$ onwards.

2 \ 1	bi	rea	ac
bi	0 0	a b	a b
rea	b a	N-n_b-n+1; N-n_b-n+1	N-n_b-n+b; N-n_b-n+a
ac	b a	N-n_b-n+a; N-n_b-n+b	N-n_b-n; N-n_b-n

Fig. 1

Actually, as the payoff matrix for the remaining stages in fig. 1 shows, for $N - n_a \leq n < N - n_b$, the accommodating strategy not only requires the same sequence of moves required by the reasonable one, except in the last step, but dominates the reasonable one and is the best response to the other playing accommodating. So, at least at these stages, the game in which the choice is between playing accommodating till $N - n_b$ or using consistently bi has the form of a stag hunt game with both players opting for accommodation[19] and both using consistently bi are the two Nash equilibria in pure strategies. Furthermore, it is common knowledge for the players that they must face such a symmetric game. One can[20] then give a positive probability to players using accommodation or reasonableness, and therefore to their playing c.

Then, if one comes from a history of reasonableness or accommodation, in a sense, one can go on following the same rule or leave to chance the decision on whether and when to stop using c.[21] Anyway, keeping alive the probability that c will be played is profitable for both with respect to both shifting to the use of backward induction. But if bi is played, trying to resurrect accommodation is irrational if $n_a \leq 2\, n_b$,[22] and seems unlikely to be successful even otherwise.

From stage $n = N - n_a - n_b$ to stage $N - n_a$ both have a reasonable strategy, that in this case requires playing c if the other has played c in the previous stage but playing nc for n_a stages from the stage in which the other plays nc as a punishment, reverting to c as soon as the punishment period is over. Punishing allows to reaffirm one's image as a reasonable player, but at a stage in which reasonableness is doubtful.

For $n < N - n_a - n_b$ both know that they have a reasonable strategy and that, for both, ministering a just sufficient punishment allows to reassert one's image of reasonableness at a stage in which having such an image is worthwhile.

Then, playing rea is the announcement and actual adoption of the strategy of cooperation and persistence in cooperation till the other cooperates; replying to a non cooperative move with a just sufficient punishment with reversion to cooperation at the following stage at least till $N - n_a - n_b$, possibly till $N - n_a$,[23] leaving uncertain how one

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[19] To reasonableness, of course.

[20] Though not necessarily must.

[21] With the chance of shifting to bi increasing as one moves from $N - n_a$ to $N - n_b$.

[22] One needs to punish, in the attempt to re-establish credibility in applying the reasonable rule, but the period of punishment would end at a stage in which reasonableness itself requires the use of bi.

[23] If the other always plays cooperative in these stages.

will play in the stages from $N - n_a$ to stage $N - n_b$.[24]
If N is sufficiently large, then, one has the possibility to follow reasonableness in alternative to using immediately backward induction. It is known that reasonableness must be abandoned at some point, but the point at which it is rational to do so is uncertain, and anyway very near the end of the game. They can both use reasonableness, or one of them just an accommodating strategy to reasonableness; for most of the game, however, accommodation and reasonableness will be indistinguishable. Both have the means and the incentives to acquire the image of a reasonable player, and they can do so at a limited cost.
As for the second step of the reasoning, assume to be at the beginning of the game, so that $n = 0$, and consider the choice between following backward induction from the start or following reasonableness. In the underlying game, they are facing a stag hunt game in the choice of the interpretation of the overt one and the rule to follow when choosing the strategy in playing it.[25] They know that this is just the first occasion in which they have to choose the kind of rationality each will follow, the first of a finite sequence of choices of the same kind; furthermore, they know that, as n reaches $N - n_b$, the stag hunt game degenerates into a prisoners' dilemma in which following backward induction becomes the only choice consistent with rationality, and will dictate playing nc in the overt game. In a stag hunt game, of the possible Nash equilibria, reasonableness selects the one Pareto efficient. However, the fact that these games have more than one equilibrium makes at least uncertain how they will be played by rational players. In all cases, it will anyway be uncertain the exact point at which the sequence will degenerate into a prisoners' dilemma. So, they are not forced to solve backwards the sequence of underlying games and this gives both players a reason to

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[24] Provided one reaches these stages from a sequence of cooperative moves.
[25] Depending on the choice they make, this will decide whether they will play c or nc at the current stage of the overt game, remembering that, whether they choose rea or ac, they must anyway play c, at this stage.

choose reasonableness[26] or at least accommodation, and to believe that also the other player will do so.
Attaining the efficient equilibrium requires both players to coordinate on this choice. In a one shot stag hunt game there is no mechanism which can produce this coordination. But till there are enough stages to go, players know that they can test and be tested[27] for the resolve to abide by reasonableness without destroying the justification for following it in the rest of the game. Abiding by the rule is not costless[28] but neither too costly with respect to the prospective gains reaped if one's reasonableness is believed. Prospective gains diminish as n moves towards $N - n_b$; one knows that a stage will be reached in which it is no longer possible to support belief in the respect of the rule associated to reasonableness by punishment, in

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[26] Play c, unless the other played nc at the previous stage, in which case play nc for a number of stages just sufficient to worsen the payoff of the other and then go back to c.
[27] The fact that one is playing a sequence of stag hunt games gives further reasons for using lenient strategies with regard to punishment in case of deviation. In a one-shot stag hunt game, there are no ways to send credible signals to the other. But in a sequence of games of this kind, behaviour at one stage, especially if potentially costly, allows signalling on the equilibrium in the game in rationality on which coordination is sought and, at least at the beginning of a sufficiently long sequence, a round differs very little from that immediately following. When using the harsh strategy, one needlessly limits the usefulness of these signals in the event the other deviates. The behaviour kept before the deviation by the player defaulted upon will not work as a signal about future behaviour since the announcement would now require the defaulted always to play according to bi. In a sense, it would truncate what will be shown to be a sequence of stag hunt games in the choice of rationality, as playing down does in the centipede game, and yet truncation is not credible much for the same reasons for which the threat was not. By using a harsh strategy, one puts one's image at risk. One can go back to cooperation, or to reasonableness, only by loosing one's face but a loss of face introduces a discontinuity in the sequence of stag hunt games in the sense that one cannot actually refer to what has gone on before in the underlying game to form ideas about how it will be played after a deviation has occurred.
[28] One has to run the risk of being defaulted.

which, therefore, coordination on the efficient pure strategy equilibrium in the stag hunt game cannot be taken for granted. But, till almost the end of the game, the exact point at which the underlying game will degenerate into a prisoners' dilemma remains uncertain.
At difference from the centipede, in which, to reason backward, one needs to use a counterfactual which is inconsistent with the premises,[29] in the finite prisoners' dilemma, no such counterfactual is needed, so one can, consistently with rationality, either reason backward or reason forward.
In the first case, backward induction, or equivalently, in this case, iterated delation of dominated strategies, leads to the use of bi from the start. In the second, at each stage, they must decide how to play a stag hunt game which will be followed by another, slightly different,[30] stag hunt game and so on in a sequence; though they both know this length has an upper bound, how long the sequence will go on, or better which behaviour rationality dictates in playing this game is uncertain.[31]
Using bi from the start, but also both using reasonableness[32] can then be seen as pure strategy equilibria of this game. In the case of the repeated prisoner's dilemma, this choice is repeated stage after stage so that both have incentives and means to induce each other to coordinate on the efficient equilibrium.
Uncertainty about the way in which it is rational to play arises here endogenously but anyway allows to use the reasoning of Kreps - Milgrom - Roberts - Wilson (1982), just substituting rea for the tit-for-tat strategy.[33] In this latter reading, the possibility of reasonableness transforms a game of complete information into one of incomplete, though symmetric, information by associating to the choice of strategies in the overt game a sequence of games in which the choice

[29] A fact that forces to reason forward if one wants to avoid this inconsistency.
[30] Since maximal pay-offs decrease stage after stage.
[31] Which makes impossible to use backward induction.
[32] Or just one of them doing so, with the other playing accommodating.
[33] But if $a + b < 2$, rea dictates a strategy very near to tit-for-tat, that furthermore avoids perverse loops.

concerns the kind of rationality to use.[34]

The fact that, till almost the end, the kind of rationality it is substantively rational to use is uncertain blocks backward induction. Choosing bi by both players at each stage is an equilibrium, but if just one of the two intends to use rea, he has means to signal this fact to the other, indeed means to falsify the expectation of the other and to induce him to revise his priors about the choice of the former. Actually, one can claim that, since rea is instrumentally superior to bi, rational players must use rea. Notice that what one is signalling is the reading of the game one adopts, and though maximal payoffs decrease as N approaches, the reasons for adopting a given reading do not change, so it is debatable also whether the value of these signals depends on the number of stages still to go, till almost the end of the game.[35]

As to the overt, level 1 game one has attached an underlying, level 2 game, one can attach to the level 2 game a level 3 game in which one has to decide how to play the level 2 game, and to the level 3 a level 4 game, the sequence going on to infinity. But in this sequence, the level n game is identical to that of level n-1, for $n > 2$. How to behave in this sequence is decided privately by each agent, and con-

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[34] When the number of rounds to play is very high and one associates each round with an underlying game in the choice of rationality, one will fall in the domain of the Folk Theorem. One can support abiding by an agreement which distributes payoffs in a different way than at the (cooperate, cooperate) equilibrium with a reasoning similar to that employed above but notice that, as one moves away from that equilibrium, even the most lenient but sufficient punishment must become harsher, if the defaulter is the one which is made worse off by the agreement with respect to the (cooperate, cooperate) equilibrium; it must require non cooperation by the one defaulted upon for a higher number of rounds, and therefore it will be both more costly for the defaulted to minister the punishment and it will cease to be effective as a threat sooner.

[35] Furthermore, the strategy required by rea becomes a substantively rational strategy in the overt game, if a player is faced by an appropriate punishment threat in case of deviation, when the number of stages becomes indefinite. In this sense, the (rea; rea) equilibrium converges to a substantively rational equilibrium strategy of the overt game as the number of stages tends to infinite.

sistency requires the same choice is made, stage after stage, confirming the choice made at stage 2, which however depends on the information the agent has at the stage reached in the overt game.[36]

A dilemma of an economic theorist

In the repeated prisoners' dilemma, players can talk to each other, can announce they intend to play reasonable and, if the argument given above holds, the announcement is credible. If both players are substantively rational and have common knowledge both of rationality and of the possibility of reasonableness, the announcement is however unnecessary: common knowledge of substantive rationality must induce them to believe each will play either reasonable or accommodating. Both these alternatives lead to the same sequence of moves in the overt game, except for the very last stages, but what one will do at that stage is immaterial, since they will be reached while both play c.

When the game is put in normal form, what reasonableness does is to question the rationality of using iterated deletion of dominated strategies. But iterated deletion of dominated strategies is used also to solve games which require players to make just one move, to take a once for all decision which cannot be revised afterwards but based on the solution of games played inwardly by each agent.

A simple example is Basu's traveller game. Two players are asked to choose separately a number in the interval [150; 300]. The player that chooses the smallest wins and gets a payoff equal to the number chosen plus 5, while the other receives a payoff equal to the smallest number chosen minus 5. If both choose the same number, the get a payoff equal to the number chosen.

Iterated deletion of dominated strategies leads both players to practically the worst possible result. In fact, at each stage of the process, they are simultaneously solving a prisoners' dilemma, and the final result is the one expected when playing a finite sequence of prison-

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[36] Note that, attaching an underlying game in the choice of rationality to a one-shot prisoner's dilemma, leaves the substantive rationality of substantive rationality unaffected.

ers' dilemmas, in which, in the stage game, the strategies are: push backward induction one step farther (P), stop backward induction (S). The payoff matrix of this stage game is that given in fig. 2.

1 \ 2	P	S
P	- 1 ; - 1	+ 4 ; - 5
S	- 5 ; + 4	0 ; 0

Fig. 2

Each stage of iterated deletion is simply the decision to push backward induction one step farther, a step forced by the fact that the other too must do so. In this case, the only reasonable strategy is to give up any use of backward induction since the game of choice of rationality is not going to be repeated. The accommodating strategy is to use backward induction for just one step, trusting in the reasonableness of the other.

Rubinstein (2004) gives some very interesting statistics about the way people actually play this game. In a population made up of university students from different faculties, the percentage using what appears to be the unique equilibrium strategy is exceedingly low; by far the highest plays strategies that are far from the "equilibrium" one, mostly however concentrated around the strategies which, if played by both agents, would grant them nearly the highest gain which could be obtained, the reasonable and the accommodating ones coming out on top.

If one accepts the reasoning usual in game theory, one can wonder whether university students are rational. Of course, one can devise reasons which make their behaviour rationally justifiable. If most had used backward induction for just one step, this would be consistent with all players being substantively rational when facing the overt game, but most of them thinking that substantive rationality is quite uncommon. Doing so for a few steps would be consistent with knowledge that iteration is usually followed only for a very few rounds.

But it can also be that they are substantively rational, that they believe that substantive rationality is very common, but is applied in the underlying game of choice of rationality, and therefore choose either a reasonable or an accommodating strategy.[37] From this point of view, students would be substantively rational just because they do not play the "equilibrium" strategy in the overt game, and even when they choose a best response to the best reasonable strategy, they trust in the substantive rationality of the other.

Closing remarks

The use of reasonableness allows to introduce uncertainty endogenously, in a "natural" way and captures most of what one wants from imperfect knowledge about the type of the other player, or bounded or ε-rationality (Radner (1980), but it allows for a wider variety of reasonable equilibria due to the characteristics of the set of equilibria of the underlying games which it generates. Though a reasonable strategy cannot be substantively rational in the usual sense, it can be justified much on the same ground as the one used to defend the latter, that of instrumentality in the pursuit of one's aims.

In experimental situations, it is perhaps not always easy, but it is presumed possible, through a careful description, to control how a player reads the overt game. Control of the existence, and more of the characteristics, of an underlying game a player can add to the overt one can be substantially more difficult.

Discovering what reasonableness requires in the overt games examined, though it may have alternatives, seems to have a natural candidate. In different games, what reasonable means can be much more obscure. This by itself does not destroy the point one has been trying to make but there are at least two *caveat*.

The fact that the overt game can be endowed with two or more equally tenable, but inconsistent, criteria of reasonableness, can give

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[37] Reaction times of those choosing the reasonable strategy are lower than those of students choosing the "rational one". Of course, the reasoning to do once reasonableness is chosen is shorter but one must first compare reasonableness and rationality. May be there is some unknown mental mechanism which distinguishes and separates automatically situations in which reasonableness is better. Could it be that evolution implanted reasonableness in our brain?

rise to an infinite regress of decisions about the rationality it is rational to use to define what reasonableness means.

There is the possibility that what reasonableness means could be quite clear for both players, but both have reasonable strategies that are however inconsistent with each other, at least for some of the initial stages, and imply best responses inconsistent with each other.

In both cases, the game in the choice of rationality would loose the simple structure here exploited.

The fact that one follows substantive rationality in the choice of rationality, but then, the substantively rational kind of rationality to use can turn out to be reasonableness can make difficult to read the world one lives in. Consider the statistics about the way people play Basu's game. Do they support the view we live in a world of irrational or of somewhat sophisticated[38] persons?

In the circumstances examined above, playing reasonable is behaving nice to the other agent. But is this niceness anything but shrewd and unrelenting selfishness?

One can choose one type of rationality over another on the basis of its instrumental value in playing the overt game, but also because they give it some sort of intrinsic merit. Does the reasoning behind a choice, the justification and meaning one gives to it, in a sense, the why and the way a state is reached, besides the properties of the state itself, have an independent merit which should be considered?

Questions of this kind suggest that Newcomb's paradox situations may be more common than one thinks.[39]

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[38] Assuming reasonableness requires some sophistication.

[39] Far from playing malicious, what the genie seems to be asking to his subject is to abide by the politeness rule of never choosing the unique best (See Baigent - Gaertner (1996)). Assume the genie is indifferent between putting a million pounds in the second box or nothing. Opening the second box only would be a reasonable behaviour as opposed to that substantively rational of opening both. A rational person would then choose to be reasonable. But in so doing he would choose the unique best in the game of rationality. Since that would entail the genie to put nothing in the second box, opening the first would be again to go for the unique best. Should the genie put a million in the second box only if the subject does not open any of them?

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Should one appreciate the politeness of a guest which does not take the largest slice of a pie, if the guest knows that by being polite he will get one's appreciation and is, perhaps strategically, bent on getting it? Should one give one's appreciation only to impolite guests or to guests who do not care for it?

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