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Revision proofness

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Abstract

We analyze an equilibrium concept called *revision-proofness* for infinite-horizon games played by a dynasty of players. Revision-proofness requires strategies to be robust to joint deviations by multiple players and is a refinement of sub-game perfection. Sub-game perfect paths that can only be sustained by reversion to paths with payoffs below those of an alternative path are not revision-proof. However, for the important class of quasi-recursive games careful construction of off-equilibrium play can render many, and in some cases all, sub-game perfect paths revision-proof.

JEL classification: C72; C73; E61

Keywords: Dynamic games; Repeated games; Renegotiation-proofness; Equilibrium refinements

1. Introduction

We consider infinite horizon repeated and dynamic games played by a sequence or dynasty of strategic players. These players may be interpreted as distinct individuals or as the selves of a single individual with time inconsistent preferences. Following Kocherlakota [10], they may be interpreted as policymakers in a reduced form representation of a macroeconomic policy game. Infinite horizon dynastic games often admit large sets of sub-game perfect equilibria. Moreover, some sub-game perfect equilibria are unappealing severe and potentially vulnerable to coordinated reforms that make all participants weakly better off and some strictly so. In this paper

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we explore an equilibrium refinement called *revision-proofness* that requires robustness to such reforms. A strategy is revision-proof if there is no alternative strategy that weakly raises the payoffs of all players in a sub-game and strictly raises the payoffs of some. A path of actions is revision-proof if it can be implemented with a revision-proof strategy. This concept was previously proposed by Asheim [3][1] and, in finite games, by Caplin and Leahy [7].[2] However, as yet limited characterization of the concept has been given. Our goal is to fill this gap. Our main result is that in the important class of quasi-recursive dynastic games many and sometimes all sub-game perfect equilibrium paths can be supported by revision-proof strategies. Consequently, to the extent that our assumptions are satisfied, concerns about vulnerability of sub-game perfect outcomes to coordinated reform are not warranted.

Sub-game perfection in dynastic games requires that a strategy be robust to a rather limited set of "revisions", namely those that involve a single player altering her action and taking the response of her successors to this alteration as given. Since players do not fully internalize the effect of their actions on other players' payoffs, sub-game perfection often permits strategies that all players agree are weakly inferior and some think are strictly inferior to alternatives. The latter, however, can only be reached via coordinated reforms and these are not possible. Revision-proofness requires that a strategy be robust to a much larger set of alternatives. Now, all feasible paths of actions are candidate revisions. However, revision-proofness permits a path to disrupt a strategy only if *every* player along the path weakly prefers continuing with it to returning to the strategy and at least one player strictly prefers this.

The extent to which revision-proofness refines sub-game perfection, depends upon the structure of player preferences. We show that if (i) a player strictly prefers path A to path B and (ii) players are deterred from joining A only if their successors receive payoffs below those implied by A, then B is not revision-proof. We give two implications of this result. First, if in every sub-game there is a path whose continuation is optimal for the current and later players, then a strategy is revision-proof if (and only if) it attains such an optimum in every sub-game. Sub-game perfection does not ensure this.[3] Second, if a sub-game perfect strategy uses an exploding sequence of punishments to deter players from unilaterally joining a revision, then it is not revision-proof. If sub-game perfect implementation of a path requires such a sequence, then the path is not revision-proof.

In the remainder of the paper, we focus on quasi-recursive dynastic games. In these games a player and her successor may have differing preferences over the successor's choices, but conditional on the successor's choice, identical preferences over future play. We give examples including a pension game of Hammond [9], a macro-policy game of Kocherlakota [10] and a savings game with quasi-hyperbolic discounting. We provide conditions that ensure many, and in some cases all, action paths in quasi-recursive games are revision-proof. Consequently, to the extent that the conditions we give are satisfied, sub-game perfect paths and outcomes are robust to coordinated mutually beneficial deviations.[4] Our procedure for showing that a given

[1] Although formulated quite differently.

[2] Hammond [9] gives an earlier variation on the definition. Alternative renegotiation-proof concepts for repeated games have been provided by, inter alia, Kocherlakota [10], Pearce [12] and Farrell and Maskin [8]. We discuss these briefly below.

[3] It does so under the stronger condition that player preferences are time consistent and satisfy a "continuity-at-infinity" condition.

[4] Although this implies revision-proofness is a weak refinement with respect to paths and outcomes, it remains restrictive with respect to off-equilibrium play.

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