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Who acts more like a game theorist? Group and individual play in a sequential market game and the effect of the time horizon ☆

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ABSTRACT

Previous experimental results on one-shot sequential two-player games show that group decisions are *closer* to the subgame-perfect Nash equilibrium than individual decisions. We extend the analysis of intergroup versus interindividual decision-making by running both one-shot and repeated sessions of a simple two-player sequential market game (Stackelberg duopoly). Whereas in one-shot markets we find no significant differences in the behavior of groups and individuals, in repeated markets we find that the behavior of groups is *further away* from the subgame-perfect equilibrium of the stage game than that of individuals. To a large extent, this result is independent of the method of eliciting choices (sequential or strategy method), the matching protocol (random- or fixed-matching), and the econometric method used to account for observed first- and second-mover behavior. We discuss various possible explanations for the differential effect that the time horizon of interaction has on the extent of individual and group players' (non)conformity with subgame perfectness.

1. Introduction

Many decisions in private, public and business life are not taken by individuals but by groups of individuals. Think, for instance, of households, public authorities, court juries, boards of directors or management teams. However, much of economic theory does not distinguish between decisions taken by individuals or groups. Moreover, until recently, experimental economists were mainly concerned with testing economic models by employing individuals as decision-makers. Various authors rightly point out that in the presence of systematic differences in decisions made by individuals and groups, it would be risky to export results observed in interindividual decision-making to domains where groups interact with each other (see, e.g., Cooper and Kagel, 2005).

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One result that emerges from the recent experimental literature on interindividual–intergroup comparisons is that often, groups appear to be more selfish than individuals. This has mainly been shown in the context of simple, sequential-move, two-player games such as the ultimatum game (Bornstein and Yaniv, 1998, and Robert and Carnevale, 1997), the trust game (Cox, 2002; Song, 2006, and Kugler et al., 2007), the centipede game (Bornstein et al., 2004), and the gift-exchange game (Kocher and Sutter, 2007) and the Stackelberg game (Cardella and Chiu, 2012). Bornstein (2008, p. 30) summarizes much of this literature by stating that "*Groups, it seems, are more selfish and more sophisticated players than individuals, and, as a result, interactions between two unitary groups are closer to the rational, game-theoretical solution than interactions between two individuals*." Similarly, in their more recent review, Kugler et al. (2012) stated "*Our review suggests that results are quite consistent in revealing that groups behave closer to the game-theoretical assumption of rationality and selfishness than individuals*."[1]

Note that the literature Bornstein (2008) summarizes in his quote (and, to a lesser extent the study reviewed in Kugler et al., 2012) is based on experimental two-stage games in which individuals and groups interact only *once*. But what if such a game is played repeatedly? Will interacting groups still have a tendency towards more selfish behavior in comparison with interacting individuals, as suggested by the earlier literature? Or will there be a trend towards more cooperation in intergroup interaction, as this, in the longer run, promises higher profits? That is, will groups be better than individuals at achieving higher payoffs through cooperation in repeated interactions, as suggested, for instance, in the psychological literature (see, e.g., Rabbie, 1998; Lodewijkx et al., 2006, or Meier and Hinsz, 2004)?

In this paper, we study the behavior of groups and individuals in a simple two-stage market game (a Stackelberg duopoly) in both one-period and multiple-period experiments. Our results are in (partial) contrast to the quotes given above. In fact, in our one-shot markets we find no significant differences between the behavior of groups and individuals. However, and more importantly, in our repeated markets we find that the behavior of groups is *further away* from the subgame-perfect equilibrium than that of individuals. More precisely, in the repeated markets, the average leader quantities chosen by groups are often significantly lower than the average leader quantities chosen by individuals, and follower groups punish leader groups who are "greedy" harder, and reward leader groups who behave collusively more than individual followers. That is, we show that once a simple sequential-move game is repeated, the behavior of groups relative to that of individuals goes in the opposite direction to that stated in Bornstein's summary. Moreover, in our repeated markets, group play *diverges* from the (refined) game-theoretic solution.

The Stackelberg (1934) model is among the most frequently applied models of oligopolistic competition, featuring a first- and a second-mover who compete in quantities.[2] We chose a Stackelberg game because it has a very attractive feature: for each of the first-mover's quantity choice, a second-mover can, by its own quantity choice, express a wide range of preferences over their own and the other player's income (Cox et al., 2007).[3] We implement this market game both as one-period and as multiple-period games by having either individuals or groups of three subjects act in the role of the first- and second-movers. Subjects acting in groups have to agree unanimously on the quantity produced. The decision-making process within the groups is aided by access to a chat tool. The members of a group are able to exchange written messages until they reach a joint decision.

Since individuals and groups partly choose markedly different quantities as first-movers, the differences we observe in individual and group second-mover decisions might be driven by different experiences second-movers make in the individual and the relevant group-player treatments. We control for this by also eliciting choices in four additional treatments employing the strategy method (Selten, 1967) in which, simultaneously with the first-movers making their decisions, the second-movers have to indicate how they would react to each of the first-movers' quantities. Thus, this method gives us the complete-response function of the second-movers. The results of the control treatments largely confirm the results obtained in the main treatments with truly sequential play. In the one-shot sessions, the behavior appears to be in line with the results reported in the literature, as group leaders and followers are closer to the prediction of subgame perfectness, although the differences are insignificant. In the multiple-period treatments, we find, again, that in comparison to individuals, groups choose lower leader quantities and employ response functions that are further away from the best-response function.

Our paper makes two main contributions. The literature has reported, so far, that in the class of simple, two-player, sequential-move games, groups often appear to be *closer* to the game-theoretic prediction than individuals if the game is played only once. We show for a game belonging to this class of games that once it is repeated, the result is turned around in the sense that groups are shown to be *further away* from the game-theoretic prediction. Regarding a first possible explanation of our results and those reported in the literature, we note that the Stackelberg market game, like other sequential

[1] Moreover, Charness and Sutter (2012, p. 173) state that "*The existing literature that compares group and individual decision-making provides considerable evidence that groups make choices that are more rational in a standard game-theoretic sense than those of individuals*." Additional evidence comes from games that authors characterize as having a "Eureka" component, meaning that once the solution or equilibrium is found, it is recognized as a clear solution of the game. Based on results from, e.g., signaling games (Cooper and Kagel, 2005) and beauty contests (Kocher and Sutter, 2005; Sutter et al., 2009, p. 391) state that "*It can be considered a stylized fact in the literature that teams are generally closer to game-theoretic predictions than individuals in* (*interactive*) *games in which rationality and correct reasoning are the predominant task characteristics*." Moreover, to the extent that groups and individuals converge to the same equilibrium in these repeated "Eureka"-type games, groups are found to do so much faster than individuals.

[2] In case of linear market demand and symmetric and constant marginal costs, in the subgame-perfect equilibrium the first-mover produces and earns twice as much as the second-mover. Moreover, the second-mover's best response is a linear and downward-sloping function of the leader's quantity choice. Experimental evidence on individual-player Stackelberg duopoly markets and how they compare to simultaneous-move Cournot duopoly markets is reported in Huck et al. (2001).

[3] This feature distinguishes the Stackelberg game from other sequential games such as the ultimatum game or the trust game.