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Optimal sharing rules in repeated partnerships ☆

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Abstract

This paper extends a model of repeated partnerships by Radner et al. (1986) allowing heterogeneous partners to choose their sharing rule. A sharing rule is *optimal* if the repeated game under the sharing rule has a public strategy equilibrium whose payoff sum is not improved by any public strategy equilibrium under any sharing rule. Two key factors for the analysis are the efficiency loss from allowing only the more productive partner to work and the efficiency loss in any cooperative equilibrium from imperfect observability. If the latter loss is smaller than the former, a threshold discount factor exists below which an asymmetric sharing rule inducing only one partner to work every period is optimal. At the threshold, an optimal sharing rule uniquely exists that is also optimal for any greater discount factor. The latter sharing rule reduces to the equal sharing rule for identical partners. The optimal equilibrium payoff sum as a function of the discount factor is a step function whose jump occurs at the threshold discount factor.
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1. Introduction

A well-known result in the literature on repeated games with imperfect observations is the *uniform inefficiency result* by Radner et al. (1986) (RMM hereafter). In a model of repeated partnerships with two partners, the authors show that any public strategy equilibrium payoff vector is bounded away from full efficiency, however patient the partners are. This result is a prominent example of the failure of the folk theorem by Fudenberg et al. (1994). While RMM assume that partners are identical and share output equally, we extend their model to allow heterogeneous partners to choose and commit to an output sharing rule before initiating production.

Our model has the same structure as RMM except that the partners may be heterogenous and their effort levels are binary (in RMM, the set of effort levels is an interval). Every period, two partners decide whether to work for the partnership or shirk. The outcome of production is stochastic. The outcome is either good or bad, and its probability distribution depends on the partners' actions. The two partners are rewarded only for a good outcome and divide the reward according to the sharing rule that both partners committed to at the beginning of their interaction.

Given the technology and discount factor, the sharing rule determines the repeated game the partners play.[1] We call a sharing rule *optimal* if the corresponding repeated game has a public strategy equilibrium whose payoff sum is not improved by any other public strategy equilibrium under any other sharing rule. Given an optimal sharing rule, we call the equilibrium achieving the maximum payoff sum *optimal*. Our primary objective is to derive the optimal sharing rule and the optimal equilibrium payoff sum.

We focus on interesting cases where any sharing rule elicits effort from at most one partner in a one-shot environment. In these cases, we distinguish between two types of inefficiency that determine the optimal sharing rule. One is *productive inefficiency*, the efficiency loss from allowing only the more productive partner to work every period. The other is *monitoring inefficiency*, the efficiency loss corresponding to RMM's uniform inefficiency result. As in RMM, the loss from monitoring inefficiency is strictly positive, and it is independent of the sharing rule and the discount factor.

Only technological parameters determine which efficiency loss is greater. Monitoring inefficiency exceeds productive inefficiency if the partnership is *unproductive* in the sense that eliciting the less productive partner's effort is too costly because the incremental probability of success is small. In this case, we show that an asymmetric sharing rule giving the whole share to the more productive partner is optimal under any level of discounting.[2] Thus, repeated interaction does not help. In the case of *productive* partnerships, where productive inefficiency dominates, a threshold discount factor exists below which the above asymmetric sharing rule is optimal. We also show that an optimal sharing rule at the threshold uniquely exists, and it is optimal for any greater discount factor. The sharing rule treats the partners more evenly than the asymmetric sharing rule and reduces to the equal sharing rule if the partners are identical. Our result, therefore, justifies RMM's use of the equal sharing rule from the perspective of incentives.

We also show that the optimal equilibrium payoff sum depends simply on which of the above cases applies. If the partnership is either unproductive or productive and impatient, the optimal equilibrium payoff sum equals the partners' total payoffs when only the more productive partner works. This is exactly the total payoff from full cooperation minus the loss from productive

[1] We are grateful to a referee for providing helpful suggestions on exposition and terminologies in the paragraphs that follow.

[2] If the partners are equally productive, either partner may receive the whole share.

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