

## Hunting for stags: On some optimal incentive policies for the coordination of collective action and their empirical relevance

*Theme:* Natural resources, ecosystem services and environmental quality  
*Sub-theme:* 2.2. Natural resources: management, use and conservation, *alternatively*  
2.1. Economics, incentives and institutions for ecosystems and biodiversity

### Summary (150 words):

Ecological challenges often entail collective action problems. It is known that incentives matter for the likelihood of successful cooperation and that ecological problems are often characterized by the presence of multiple equilibria. We study the optimal incentive policy using stability set analysis of multiple equilibria collective action games with payoff heterogeneity. Stability set analysis offers an interesting possibility to draw comparative statics in multiple equilibria games by combining the payoff structure with players' beliefs. Our initial results suggest that the optimal incentive scheme is a mixture of insurance policy and a selective incentive policy that favors players who have less incentive to coordinate on the Pareto-efficient outcome. We discuss our theoretical findings in light of common-pool resource cases.

### Extended Abstract (600-1200 words):

Ecological challenges often entail collective action problems. Classical studies on commons (Ostrom 1990; Ostrom et al. 1994), collective action (Olson 1968; Hardin 1982) and norm emergence (Ullman-Margalit 1977, Opp 2001, Heckathorn 1996) have repeatedly confirmed two results: (1) incentives matter for the likelihood of cooperation and (2) collective action problems are often characterized by the presence of multiple equilibria. In addition, the role of incentive schemes (concerning e.g. selective incentives, cost and benefit allocation or insurance policies) varies depending on the type of collective action game in question. We study the theoretically optimal incentive scheme for collective action games and how it varies depending on the type of game in question. After the theoretical work we discuss our findings in light of a meta-analysis of common-pool resource cases.

Game theory has provided a variety of analytical tools to model interdependent action situations. All theoretical models, game theoretic models included, can serve many purposes. Therefore, models can also range from simple descriptions of causal mechanisms to more complex attempts to account for several relevant aspects of the action situation. A brilliant example of the former is Schelling's (1978) segregation model, which explains how a mild preference to live next to same kind of people as oneself can lead to heavily segregated neighbourhoods. Examples of the latter include, for example, work by Weissing and Ostrom (1991a, 1991b, 1993) in which authors study counterintuitive consequences of selective incentives in various common-pool environments. Literature on commons has repeatedly demonstrated how the overreliance on theoretical models in policy design can lead to dangerous policy failures as has been the case with the 'Prisoner's Dilemma' attached to the alleged 'tragedy of the

commons' (Runge 1981; Ostrom 1990). This overreliance is especially problematic, when there is a mismatch between models' assumptions and local conditions. Precaution to choose an adapted, situation-specific, empirically grounded model has been demonstrated (Ostrom 1990). In addition, self-governance and institutional design by resource users themselves can even transform a Prisoner's Dilemma and create cooperative equilibria (Crawford and Ostrom 1995; Kollock 1998). The 'Assurance Problem' (Sen 1967), for example, also known as the Stag Hunt, has been claimed to fit many common-pool conditions much better (Runge 1981; Kollock 1998). Students of collective action have also reached similar conclusions outside common-pool cases (e.g. Heckathorn 1996; Medina 2007).

Multiple equilibria games are analytically challenging as players' best replies depend on the likely actions of others. In order to draw comparative statics for studying the effects of incentives it is necessary to combine the incentive structure of the game and players' beliefs on likely actions of others. No clear-cut strategic dominance criteria exist for such games in order to predict outcomes, and the equilibrium refinement program has so far not yielded a satisfying method. Following theoretical work of Harsanyi and Selten (1988) and Medina (2007) we study stability sets of collective action games. Stability set analysis provides an interesting analytical tool for drawing comparative statics and to study effects of various incentive schemes in the presence of multiple equilibria.

Generally speaking, the optimal incentive scheme, understood as the policy that maximizes the likelihood of collective action, depends on the type of collective action game in question. This means that the optimal policy depends not only on players' other incentives, but also on the success-function of the game mapping the number of cooperators to the likelihood of successful collective action. We draw a benchmark result for a simple two-player coordination problem using relative stability set estimate. The result suggests that the optimal policy is a mixture of an insurance policy and a selective incentive policy that favors the player who has less incentive to coordinate to the Pareto-efficient outcome. We then turn to n-player problems and discuss the robustness of the benchmark result in large games.

The findings confirm, but also make more explicit three of the design principles that Elinor Ostrom (1990) developed. Congruence between provision and appropriation rules with respect to contributions is one of these principles. In Spanish irrigation systems, Ostrom found that "those who receive the highest proportion of the water also pay the highest proportion of the fees" (p.92). While congruence is a crucial prerequisite for the common-pool resource, related public goods from which all profit equally may not be provided without selective incentives. The second bundle of principles, monitoring and graduated sanctioning, relates to this public good problem. A monitoring system and respective rules as a public good may require graduated contributions according to the different levels of incentives that each resource user has. In fact, Elinor Ostrom has analyzed exactly such incentives, where those who monitor receive private benefits. A term that she uses multiple times is "contingent strategies", which indicates the coordination problems involved. These principles can thus be theoretically derived from the optimal incentive schemes for coordination problems. We could, however, not find a principle that relates to insurance, which would add to the optimal mix.

In the empirical part of the paper we conduct a meta-analysis of common-pool cases focusing on rules and norms that address allocation of costs, benefits and risks of collective action. We are especially interested in whether rules and norms aim to decrease the risk of participating in collective action and whether there are arrangements favoring people who have less to gain from collective action. We draw from a sample of in-depth case common-pool resource studies, as these carry more detailed information. Sources are the Digital Library of the Commons and other abstracting databases. We also analyze examples from macroeconomics, as coordination failure has been more frequently and explicitly studied in this context.

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