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Introduction to the Special Issue

Strategic behaviour and environmental commons

ARIEL DINAR
Water Science and Policy Center, Department of Environmental Sciences, University of California, Riverside, CA 92521, USA.
Email: ariel.dinar@ucr.edu

GEORGES ZACCOUR
Game Theory and Management, GERAD, HEC Montréal, Canada.
Email: Georges.Zaccour@gerad.ca

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Recent years have been characterized with an increased awareness of the impacts of human behavior on the environment. The interaction between humans and environmental commons is seen at local, national, international and global levels. Many disciplines in both natural and social sciences are nowadays dealing with human–environmental issues, among them experimental economics and game theory, which focus on strategic interactions among decision makers and their impact on the environment.

This special issue is dedicated to the analysis of strategic behavior and environmental commons, and includes five papers. The first two papers involve experimental games (Zhosan and Gardner, this issue; Pevnitskaya and Ryvkin, this issue) and the remaining three apply various models of coalitional analysis (Pavlova and de Zeeuw, this issue; Caparrós and Péreau, this issue; Houba *et al.*, this issue).

Each of the papers, in its own domain, addresses institutional aspects that may make the interaction of humans with environmental commons less destructive, and promote cooperation. This is the message in the two experimental papers and in the three game theory papers. Namely, cooperation is possible under certain conditions and regulatory contexts. With

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such an overall conclusion, this special issue provides food for thought for governments and international bodies (UNFCCC, FAO and others). The role that would be played by these organizations could make a major difference to the performance of international environmental agreements (IEAs) in regional water treaties and in global public good treaties.

The contribution of the papers in the special issue

In the first paper in this issue, Zhosan and Gardner address the important question of how to avoid the tragedy of the commons in the context of open seas fishing. Applying an experimental approach with some unique features to the lobster industry in the state of Maine, they evaluate, in the laboratory, the effectiveness of several institutional settings. Institutions tested include: (a) apportionment of large commons to small commons with well-defined property rights; (b) provision of knowledge, information and experience to the appropriators; (c) establishing communication channels among the appropriators; and (d) establishing formal and informal sanctioning measures to group members. Some of these institutional features have been discussed in the literature and in practice elsewhere at a policy level (e.g., Jentoft *et al.*, 1998; Munro, 2008). However, having all of them tested in an experiment is a new addition to the literature.

Another interesting aspect that this paper introduces is the inclusion of and the ability to compare the behavior of students and professional fishermen in some of the experiments. Some of the most interesting results of the experiments reported in this paper suggest that: once the coordination problem is solved, the participants are able to get closer to socially efficient allocations; communications increase efficiency; introducing sanctioning was proved to be effective; professional fishermen played better than students; and well-defined institutions may help inexperienced players achieve better results. The paper concludes with several policy implications, among which are the relevance of the results to commons other than fisheries, the property right assignment problems that arise from having a large number of individual appropriators, and whether or not government intervention is necessary.

In the second paper, Pevnitskaya and Ryvkin experiment with the decisions of individuals who interact with a public bad (pollution, depletion) in a dynamic setting, as affected by the environmental context (experience) and uncertainty regarding the termination (e.g., the collapse of the environment/resource). Individuals can increase production (and benefits) and thus also increase emissions (pollution) and be negatively affected. The experiment evaluated the tradeoff between production and pollution. The main questions of interest are to what extent environmental context and uncertainty regarding termination promotes environmental conscientiousness and cooperation. Similarly, it was tested whether or not experience can substitute for context. At a methodological level, the paper differs from most of the literature in experimental games by adopting a dynamic-game framework. This means that the players' decisions influence the evolution of the state and do not play the same constituent game in all rounds (as

they would have done in a repeated game). The authors compute both perfect-Markov equilibrium and the social optimum.

Selected findings from the experiment(s) suggest that individuals choose lower production levels and thus lower pollution levels and higher payoffs when having a meaningful environmental context compared with the non-context case. In addition, it was found that experience substitutes for context (except in the near end rounds of the experiment). Experience plays an important role in the dynamic nature of the game with no difference between the situation where termination is uncertain and when it is deterministically known.

In the third paper, Pavlova and de Zeeuw develop a model where the countries involved in the negotiation of an IEA are asymmetric in both emission-related benefits and in environmental damage. Although the literature on IEAs is by now significant, it is noticeable that most of the contributions in this area have assumed that countries are symmetric, which clearly is not an empirical fact. The main research question of the paper is therefore: does asymmetry in benefits and damage lead to a large stable coalition? The authors derive the internal and external stability of an IEA in the general case, and then specify them for two types of country.

The good news is that asymmetry in environmental benefits and vulnerability can indeed lead to large stable coalitions, even in the absence of a transfer mechanism to compensate the would-be loser from such an agreement. However, the asymmetry needs to be strong for this result to hold. A next natural question is whether allowing for transfers can soften the condition for a large coalition. Here Pavlova and de Zeeuw replicate the result in Barrett (2001), namely, that transfers do not play an important role in achieving a large coalition. What really matters is the (strong) degree of asymmetry. In a nutshell, the message of this paper is that we can get large coalitions, but unfortunately the latter essentially include countries that do not contribute much to environmental damage, and hence the cooperation gain with respect to a stable small coalition, the typical result in the literature, is rather modest.

In the fourth paper, Caparrós and Péreau also deal with IEAs with, however, a notable difference with respect to the literature on IEAs. Whereas in the previous paper a coalition is a group of countries that have decided to determine jointly their greenhouse gas abatement effort, here a coalition is a group of countries, either northern or southern, that have decided to join forces in international negotiations over a public good. Put differently, there is a negotiation with each group of countries, and next a negotiation between the two groups. This idea is consistent with empirical observations where we see countries making some coalitions, e.g., EU countries and G77, before engaging in negotiation aiming at the reduction of emissions, preservation of biodiversity and rainforest, or the determination of fishing quotas to save fish stocks.

The paper precisely analyzes the incentives for northern and southern countries to form negotiation coalitions at each side of the bargaining table and their impact on the final outcome. Interestingly, the authors separate these incentives into direct efficiency gains (fixed-costs savings), and indirect bargaining power gains. The main result of the paper is that the

equilibrium of the four-stage game representing intra- and inter-groups negotiations depends on the relative values of these gains. More specifically, the authors obtain that bargaining power gains encourage southern countries to negotiate separately, while they encourage northern countries to unite. This asymmetry hinders the prospect of having a grand coalition.

In the last paper in this issue, Houba *et al.* develop a river basin cooperation model to address the multilateral aspects of cooperation in an international river and apply it to the Mekong River Basin. In a simplified version of the actual upstream–downstream relationship, the authors divide the basin into two regions: China, as the upstream country, and all Lower Mekong Basin countries (Vietnam, Laos, Thailand and Cambodia) as the other region. At present no cooperation exists between China and the Lower Mekong Basin countries. The Lower Mekong Basin is governed by a treaty and managed by the Mekong River Commission. The model compares possible welfare improvements: from strengthening the Mekong River Commission without China; from strengthening the Mekong River Commission with China included; and improved governance of the Mekong River Commission before being engaged in negotiations with China. The model applies a welfare-improving bargaining approach to a hydro-economic model of the basin.

Economic activity in the basin which is captured by the model includes industrial and household sectors, irrigated agriculture, fishing and hydropower production. The results of the model suggest that the Lower Mekong Basin countries have no incentive to have China be part of the Mekong regime. China, on the other hand, has strong incentives to join the Mekong River Commission. An interesting finding is that, since the Lower Mekong Basin countries have different levels of marginal benefits and damage from use of the water in the basin (especially the countries at the lower part of the Lower Mekong Basin), it is less likely that cooperation will prevail.

References

Barrett, S. (2001), 'International cooperation for sale', *European Economic Review* **45**: 1835–1850.

Caparrós, A. and J.-C. Péreau (2013), 'Forming coalitions to negotiate North–South climate agreements', *Environment and Development Economics* **18**; doi: http://dx.doi.org/10.1017/S1355770X12000411.

Houba, H., K.H. Pham Do, and X. Zhu (2013), 'Saving a river: a joint management approach to the Mekong River Basin', *Environment and Development Economics* **18**; doi: http://dx.doi.org/10.1017/S1355770X12000435.

Jentoft, S., B.J. McCay, and D.C. Wilson (1998), 'Social theory and fisheries co-management', *Marine Policy* **22**(4–5): 423–436.

Munro, G.R. (2008), 'Game theory and the development of resource management policy: the case of international fisheries', in A. Dinar, J. Albiac and J. Sanchez-Soriano (eds), *Game Theory and Policy Making in Natural Resources and the Environment*, London and New York: Routledge.

Pavlova, Y. and A. de Zeeuw (2013), 'Asymmetries in international environmental agreements', *Environment and Development Economics* **18**; doi: http://dx.doi.org/10.1017/S1355770X12000289.

Pevnitskaya, S. and D. Ryvkin (2013), 'Environmental context and termination uncertainty in games with a dynamic public bad', *Environment and Development Economics* **18**; doi: http://dx.doi.org/10.1017/S1355770X12000423.

Zhosan, D. and R. Gardner (2013), 'Problems of the commons: group behavior, cooperation and sanctioning in a two-harbor experiment', *Environment and Development Economics* **18**; doi: http://dx.doi.org/10.1017/S1355770X12000381.