Farsightedness in a coalitional Great Fish War

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The paper "Farsightedness in a coalitional Great Fish War" was published in *Environmental and Resource Economics*. It has been written by Michel Yevenunye Keoula, Ph.D. student, and Michèle Breton, professor at the Department of Management Sciences at HEC Montréal and GERAD member.

Fisheries are a crucial source of livelihood for hundreds of millions of people around the world. According to the Food and Agriculture Organization of the United Nations, there is an increasing trend in the proportion of overexploited, depleted or recovering fish stocks, which increased from 10 percent in 1974 to 32 percent in 2008. This depletion of the world fish stocks has been related to the well-known "Tragedy of the commons" described by the ecologist Garrett Hardin in 1968: individual rationality predicts that multiple individuals acting independently will ultimately deplete a shared resource, even when it is clear that it is not in anyone's long-term interest for this to happen.

One possible avenue to avoid this over-exploitation is coordination among users, in order to exploit the resource in a sustainable way. Indeed, a large number of regional fishery management organizations, typically including many countries, are presently involved in the management and coordination of international fisheries. In the case of the high seas, because of their open access nature, the existence of an agreement among a group a countries to preserve the fish stock (that we call a *coalition*) does not preclude any other interested country to have access to the fisheries. Our paper analyzes the profitability and stability of such coalitions in a non-cooperative game theory setting, assuming that members can freely access or leave the organization and that they act in their own best interest.

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A coalition is profitable if players in the coalition are better-off than if no agreement existed. It is stable if no member has an interest in leaving the coalition, and no non-member has an interest in joining it. In general, stability of coalitions for the management of common resources is difficult to achieve, and additional features are needed to explain the actually observed level of participation, for instance, monetary transfers, punishments, or leadership. However, these features entail institutional arrangements that are often difficult to achieve for international fisheries.

In this paper, we rather explore the implications of conjectures by players about the impact of their eventual defection from an agreement. Most non-cooperative models use *Nash conjectures* as a stability concept: a country contemplating a deviation supposes that this deviation will have no impact on the decision of others to join or to leave the coalition. Rational conjectures imply that the country takes into account the impact of its deviation on the size of the coalition: thus, a country contemplating a deviation knows that this may trigger others to do the same, so that the size of the coalition may change by more than one player. For example, a Nash player contemplating leaving a coalition asks: Would I be better-off inside or outside this coalition? while a rational player asks: Would I be better-off inside this coalition, or outside the much smaller one that will result if I leave?

We study coalition stability in the stylized Great Fish Wars model, where fishery owners are characterized by their discount factor, and the fish stock is characterized by its growth potential.

While with Nash conjectures, the maximum coalition that can be achieved in that model is of size 2, and this can only happen for very high discount factor and low growth potential, with rational conjectures we find stable coalitions of large size for an important range of parameter values. The farsightedness of players, or their ability to foresee the consequences of their decisions on the coalition structure, may explain the formation of large regional fisheries organization. We find that this is also true in models where deviations are not immediately detected and in models where the coalition has a first-mover advantage. ■

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An exact algorithm for solving clusterwise regression problems

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The paper "Extensions to the repetitive branch and bound algorithm for globally optimal clusterwise regression" was published in *Computers and Operations Research*. It has been written by Réal A. Carbonneau, Ph.D. student, Gilles Caporossi and Pierre Hansen (co-directors), both professors at the Department of Management Sciences at HEC Montréal and GERAD members. Moreover, this paper received the Esdras Minville price 2012 for the best student paper at HEC Montréal.

Clustering helps researchers understand the core information underlying data by grouping observations in clusters according to some criterion. These criteria usually aim at grouping observations that are similar (homogeneity criterion) or to separate those which are different (separation criterion). In both cases, the criteria are usually based upon the concept of distance between observations.

However, clustering may also be used to find patterns in data and group observations that share a similar pattern. The clusterwise linear regression belongs to this category.

Clusterwise regression separates observations into k clusters and associates a linear regression model to each of them. Each observation is associated to the cluster whose regression model fits best and while simultaneously fitting at least squares regression model for each cluster computed from its observations. As opposed to regression, the goal of clusterwise regression is not to find a model that could be used for prediction, but to identify some patterns in the data and to group observations according to the patterns that characterizes them.

One special property of clusterwise regression is that very different observations (in term of