

The regulations of a common pool resource with heterogeneous agents: an experimental investigation

Stefan Ambec, Alexis Garapin, Laurent Muller and Carine Sebi*

GAEL, INRA-Université Pierre Mendès France, France

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Worldwide, many natural resources such as fisheries are exploited under free-access. Since Gordon (1954), it is well-known that the free-access extraction of a common-pool resource (CPR) leads to over-exploitation. To improve resource management, the fishing industry has been regulated with various instruments such as quotas, fees and subsidies. These regulatory instruments have various impacts on fishermen, depending on their technology and opportunity costs. Some may gain or lose more than others compared to the free-access extraction regime. The feasibility of a given regulation should take into account its acceptability by fishermen, driven by the fishermen's welfare.

Ambec and Sebi (2007) model that examines three regulatory instruments when fishermen differ with respect to their cost of fishing: non transferable individual fishing quotas, transferable individual fishing quotas and a fee/subsidy scheme. All instruments must be acceptable in the sense that *all* fishermen must be better-off under the regulated extraction regime than under free-access. They provide necessary and sufficient conditions for the implementation of a targeted fishing effort. In their set up, a fee/subsidy scheme and transferable quotas are equivalent. They dominate non-transferable quotas because (i) they select the more efficient fishermen and (ii) they achieve a higher reduction of fishing effort.

In order to test these results, we design an experiment based on this model, thereby contributing to the recent experimental approach to CPR extraction (Margreiter 2005, Ostrom 2006). We set the experiment with two groups of eight participants and two types of players (the players differ from their opportunity costs). Each session consists of a *within-study* with four distinct treatments: the free access regime and the three above regulations (non transferable quotas, transferable quotas and a fee/subsidy scheme). The experiment allows us to compare the performance of the three regulations using several criteria. We measure:

*e-mail: carine.sebi@grenoble.inra.fr, tel: 04 56 52 85 98.

(i) individual and social welfare (acceptability condition and inequality) by comparing profits in the four treatments; (ii) the assessment of effort reduction (the achievement of the regulator's target and the convergence to it); (iii) the selection of the less costly fishermen (sorting effect).

As observed in other experiments, our findings first support non-cooperation under FA (over-exploitation). While on average fishermen increase their profits with the regulation instruments, the acceptability condition is more rarely met for the lower opportunity cost type. Consequently, the profit acceptability condition is reached only for the type B and not for the type A fishermen. The market based instruments (FS and ITQ) are also the most acceptable instruments. We observed in the experiment that the three regulatory mechanisms (namely FS, ITQ and NTQ) enabled to achieve the targeted fishing effort, consisting in reducing by half the aggregated effort compared to FA. However, the FS instrument involved much higher variance in aggregated effort, while in the ITQ treatment, though more complex, induced a remarkably stable effort level close the NE for regulation. The market based mechanisms select the most efficient fishermen (type A), i.e. type A still extracts resource whereas type B prefers to exit the resource. Actually, according to the chosen criteria to compare overall efficiency of the regulatory instruments, market based instruments are the best (higher acceptability and profits) and select the most efficient fishermen.

Key Words: common pool resource, experimental economics, regulation, heterogeneity.

JEL classification: Q22, Q28.

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