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Why Fishing Fleets Tend to be "Too Big"

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Why fishing fleets tend to be "too big"[1]

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Abstract:

The aim of fisheries management is to avoid over-investment in fleet capacity and over-exploitation of economically exploitable fish stocks. In this paper a model is developed where a (big) share of rents created by control accrues to boat owners while costs are covered by the general public, which also gets a (small) share of the rent. The distribution of rent is governed by administrative rule which opens the possibility of profitable rent seeking. Cost of control is assumed to increase as rent per boat increases. Control outlays are assumed to be determined so as to maximize gains to the general public. It is shown that the optimal size of the fishing fleet exceeds the size that maximizes fishery rent. It is also shown that the higher the share that accrues to the general public, the closer the optimal fleet size is to the rent-maximizing fleet size.

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1 Introduction

Economists have known for a long time that the fact that the most economically viable fish stocks are held in common implies a tendency towareds over-investment in fishing capacity.[2] This tendency is accelerated by the dwindling cost of fishing effort due to rapid technological progress. Hence, modern fishing technology is far too efficient to allow all those who are skilled to try their luck on the fishing banks. In response to this over-capacity several modes of fisheries management have been subject to consideration and experimentation in various parts of the world. But a common defect can be observed with most systems: In spite of regulation, fleets tend to remain larger than optimal. Fishery management systems that are designed to optimize the size of the fishing fleet in fact do not do so, if judged by experience so far.[3] Hence, it seems that there are forces at work that affect the size of fishing fleets that do not respond "correctly" to the instruments of fisheries management.

The present paper tries to explain the problem of big fishing fleets by taking into account that gains from control mostly accrue to the boat owners while the lion's share of costs are covered by the public at large.[4] In this paper a model is developed where a share of rents

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[2]For an early account of the problem consult Warming (1911). Later references include Smith (1969), Clark (1976), and Hannesson(1978), to name just few.

[3]For a comprehensive overview of effectiveness of various management programs see Townsend (1990).

[4]Control costs and cost of rent seeking are not easily estimated. A rough estimate is that the Icelandic government spends about as much on fisheries management as, for example, on the University of Iceland. Gains from the management system adopted in rudimentary form in 1984 and refined almost every year since, have hardly begun to accrue to public funds.

created by control accrues to boat owners while costs are covered by the general public which also gets a share of the rent. The distribution of rent is governed by administrative rule, which opens the possibility of profitable rent seeking. Cost of control is assumed to increase as the rent per boat increases. Control outlays are assumed to be determined so as to maximize gains to the general public. It is shown that the optimal size of the fishing fleet exceeds the size that maximizes fishery rent. It is also shown that the higher the share that accrues to the general public is, the closer the optimal fleet size is to the rent-maximizing fleet size.

Few attempts have been made to incorporate government regulations as an endogenous part of models of commercial fisheries. The paper by Homans and Wilen (forthcoming) is an exemption to that rule. They develop a dynamic model where regulators decide season length depending on fleet capacity and stock abundance. Hence their model is tailored to address questions concerned with the North American regulatory regime where season length is a fundamental parameter. Season length is not fundamentally a concern in pure Individual Transferable Quota systems. But the ITQ system does not solve the rent dissipation problem either.

2 The model

Assume that steady state[5] quantity of catch can be written as:

$$y = n(\hat{n} - n) \tag{1}$$

Here y is quantity of fish brought ashore and n is an index for fishing capacity (also referred to, in an inexact manner, as number of boats). The bigger the parameter $\hat{n}$, the bigger is the catch that can be sustained with a given fishing capacity. This is a very simplified version of the real life relation between capacity and steady state catch but captures the basic idea that if effort is not extended there is no catch (i.e., if n=0 then y=0) and that the stock is overexploited at high utilization levels and may even disappear, at least in an economic sense.

Harvesting costs increase with increased capacity, so with output prices normalized to unity, gross profits (or before tax profits) for all fishing firms may be written as:

$$\Pi = y - kn \tag{2}$$

Here k is a constant. Free access to the fisheries implies that whatever extra profits that might exist in the industry at a given time will be lost through competition, so that: $\Pi_{FA}=0$. Here the subscript *FA* relates to Free Access. Simple calculation show that:

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[5]By choosing a steady state formulation many important aspects are sidestepped. In a dynamic setup rational agents might choose to conduct fishing now rather than conserve and reap proceeds later. The model presented does not take account of considerations of this kind. These considerations have been left out in the present model for the purpose of simplification. Reformulating the model to take account of these inter-temporal considerations would, the author believes, entail unnecessary complications.

$$n_{FA} = \begin{cases} \hat{n} - k & \text{if } \hat{n} > k \\ 0 & \text{else} \end{cases} \tag{3}$$

Comparing this to the number of boats that would maximize aggregate gross profits (sometimes called the sole owner solution, see Hannesson[1978, p. 75]):

$$n_{\Pi} = \begin{cases} \frac{\hat{n} - k}{2} & \text{if } \hat{n} > k \\ 0 & \text{else} \end{cases} \tag{4}$$

Observe that if the trivial case of n=0 is ignored it can be stated that the free access situation implies that all profits are lost through competition.[6] Thus, if it were possible to restrict access to the fisheries some extra profit could be earned. Proceeds might accrue to the general public as well as to the boat owners, but this will depend, among other things, on how regulation is organized. Regulation can possibly increase the welfare of some citizens without reducing the welfare of others.

3 Regulation, apportioning rights at virtually no charge

Assume now that a government establishes a regulatory regime that restricts access to the fishery by administrative rules. Assume further that the profits from the fisheries are divided between the owners of the fishing firms and the others in the proportions P and (1–P) respectively. How this division comes about is not important, but it might be useful to think of

[6] In this simple model free access implies that the fishing fleet is twice the size of the optimal fleet. Note that this result should be interpreted qualitatively rather than quantitatively.

the portion accruing to the general public as taxes generated from the *general* tax system that would not be generated in the absence of regulation. In other words, there are no industry specific taxes on the fishery in this setup.

Rights to fish are regulated by some kind of licensing. Licensing is worthless if it is not followed up with control. Controls are not performed without cost. The control unit must keep at bay any would-be boat owners and established boat owners that want to extend their activity.[7] The intensity with which those "newcomers" bother the control unit will, at least partly, depend on the profit (or more correctly the rent) generated in the industry. Successful fisheries management create rents as illustrated in paragraph 2 above. The higher the rent generated per boat the more valuable is a license to operate in the industry and the more would a rational actor spend on a rent-seeking activity like that of acquiring an extra license. The administrative rules created to govern the capacity of the fishing fleet also govern the distribution of the rent. As is usual where rent seeking is worth while: High profits induce increased rent-seeking activity and induce increased incentives to circumvent the rules. Thus both cost of control and lobbying expenses soar with increased profits per boat (or per efficiency unit). Thus we have:

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[7]The type of annoyance that a would-be entrant might create for the control unit varies with the type of regulation used. Suppose that a vessel's fishing effort is used as the control variable, and the rule is that a new vessel is only allowed to replace older vessels of equal capacity. There is no obvious rule to regulate how a vessel with up-to-date equpment is to be measured against (sometimes many) outdated ones. Thus much bureaucratic effort must be put into rule making in this area, and moreover the would-be boat owners would have every incentive to challenge and re-challenge the rules with every technological advance. Using other variables as control variables could alleviate the need for rules defining fishing effort but would of course create other definitional problems. It should be kept in mind that rule making at this level commands high-level skills in a number of fields, including law, economics, engineering, communication technology, so that activity quickly becomes costly.

$$L_S = S\left(\gamma \frac{\Pi}{n}\right), \quad S'(\cdot) > 0 \text{ and } S''(\cdot) > 0 \tag{5}$$

Here L_S is total cost (measured in man-power units, say) of both inspection and surveillance of the fishing fleet and in addition to lobbyist expenses. The parameter γ is a shift parameter that will be put equal to 1 for most of the analysis. Cost increases as profits per unit increase and that at an increasing rate.

Often fisheries management is presented as the act of fixing the number of licenses, n say. But in the present model the capacity of the operating fleet will be related to the amount of regulation. Consider the following examples: A trawler can increase its capacity by reducing the mesh size in its trawls. If control is lax it will not be costly for trawlers to evade the mesh size regulation. Another example: A given area may be closed for given types of gear and/or given types of boats for specified periods of time. If control is lax it is relatively cheap to evade those rules. Such evasion would literally increase the number of boats operating in the given area. Thus a lax control regime will increase the real capacity of the fishing fleet. These examples should indicate that the conduct of fisheries management is a question of amount, viz. of how much man-power and other resources society is willing to forego on controls in stead of using them in productive activities. Or in other words: Fisheries management is not satisfactorily conducted by announcing a target for y or n. Some active surveillance and control is also needed. Thus when the government announces its target for n (or y) it has to take into account that such announcement commits resources both for control and on rent-seeking. Resources used on control and rent-seeking reduce resources available for productive use:

$$Y = F(L - L_S) \tag{6}$$

Here Y is the income generated in sectors other than the fishing sector and $L\text{–}L_S$ is available resources for use in sectors other than fishing.[8] $F()$ is a well behaved production function with $F'(\cdot)>0$ and $F''(\cdot)<0$.

In this model we have divided the public into two groups: The owners of fishing firms (also referred to as boat owners) and the general public. The general public provides the resources for conducting fisheries management and receives (1–P) of profits generated in the fishing sectors. Thus total income accruing to the general public (excluding the boat owners) is given as:

$$V^P = (1-P)\,\Pi + F(L-L_s) \tag{7}$$

Number of units that maximizes V^P is given by the following conditions:

$$\frac{dV^P}{dn} = \left\{1-P-\gamma\frac{F'(\cdot)S'(\cdot)}{n}\right\}\frac{d\Pi}{dn} + \gamma\frac{F'(\cdot)S'(\cdot)}{n}\cdot\frac{\Pi}{n} = 0 \tag{8}$$

The entity $\left\{1-P-\gamma\frac{(F'S')}{n}\right\}$ reflects gains to the public as boat owner profits increase by one dollar. (1–P) indicates increase in taxes accruing, while $\gamma\frac{F'S'}{n}$ reflects increased costs of controlling as fishing gets more attractive with increased profitability. The

[8] It is assumed that the fishery sells its product and buys inputs from "foreigners" at fixed (world market) prices. This assumption reflects the situation in small fishery dependant economies as Iceland and the Faro Islands.

entity $\gamma\frac{F'S'}{n}\cdot\frac{\Pi}{n}$ reflects costs of control per fishing unit. Utilizing (1) and (2) to calculate $\frac{d\Pi}{dn}$ and $\frac{\Pi}{n}$ and inserting into (8) yields:

$$\left\{1-P-\gamma\frac{F'(\cdot)S'(\cdot)}{n}\right\}\{\hat{n}-2n-k\} \; + \; \gamma\frac{F'(\cdot)S'(\cdot)}{n} \; \{\hat{n}-n-k\} \; = \; 0$$

Solving for n yields optimal number of boats of the managed fishery, n_{FM} (where *FM* is short hand for Fisheries Management):

$$n_{FM}=\frac{\hat{n}-k}{2} \; + \; \frac{\gamma F'(\cdot)S'(\cdot)}{2(1-P)} \tag{9}$$

Thus, from (3) and (9):

$$n_{FM}>n_{\Pi} \text{ if } \gamma\frac{F'(\cdot)S'(\cdot)}{2(1-P)}>0 \tag{10}$$

In other words, it is not optimal for the general public to supply so much surveillance and control that aggregated boat-owner profits are maximized. The wedge between the number of licenses that would maximize boat-owner profits and number of licenses that maximizes general public income depends on i) productivity of resources in alternative use [F'()], ii) effectiveness of controls [S'()], iii) the share of the fishery rent that accrues to the general public ($1-P$) and iv) the shift parameter γ.

4 Effects of changing the distribution of rent and of a shift in control avoidance

According to the present model government has to balance costs and benefits when allocating funds to fishery management control and administration. It is therefore natural to ask: How will changes in division of rents affect level of control and optimal number of boats. The answer is given by:

$$\frac{dn_{FM}}{dP} = \gamma \frac{F'(\cdot)S'(\cdot)}{2(1-P)^2} > 0 \tag{11}$$

Thus, the higher is the share of regulation-created rents that accrues to the boat owners the higher is the number of boats that the government will tolerate at the fishing banks. Observe also that as long as $\gamma F'(\cdot)S'(\cdot) < \hat{n}-k$ it will be possible to find a value of P that is such that $n_{FM}=n_{\Pi}$. This implies that if the share of regulation-created rent that accrues to the general public is below some minimum then the general public will not supply enough control and surveillance so as to create rent.

One of the methods of fisheries management that has been discussed is some form of auctioning out the right to catch a ton of fish. If all would-be bidders were free to enter any number of bids and if the auctioneer would be free to accept any bid, potential rents would accrue to the auctioning body. In other words, the effect of such auctioning could be traced in the present model by setting P=0. Equation (9) yields that the no other value of P would give lower value for number of boats. Put differently, this regime would maximize rents created by the regulatory system.

It was assumed that the government restricts access to the fishery by administrative rules. The regulated actors will have incentives to search for loopholes in those rules. Eventually, as time goes by more and more loopholes will be found. As number of known loopholes increases the cost of control will shift upward. In the present model that could be simulated by increasing the value of the shift parameter γ. We find that:

$$\frac{dn_{FM}}{d\gamma} = \frac{-\gamma F''(\cdot)[S'(\cdot)]^2 + \gamma F'(\cdot)S''(\cdot) + F'(\cdot)S'(\cdot)}{2(1-P)} > 0 \tag{12}$$

Thus, as boat owners gain more knowledge of the administrative systems the government will find it optimal to increase number of licenses.

There are two important lessons to be drawn from the present model: a) When control of fishing capacity is costly, the method used to hand out the rights to utilize the resource affects efficiency. Put differently: Conclusions drawn from models were management costs are ignored may not hold when such costs are taken into account. And b) the willingness of the government to supply a fisheries management scheme will hinge on the amount of rents accruing to the government as compared to the amount of control and rent-seeking-activity costs that the government will have to cover. The cost of control is likely to increase as boat owners and would-be boat owners learn how to exploit the regulatory regime.

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