The Determinants of Property Rights In U.S. Marine Fisheries

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ABSTRACT

Using a sample of fisheries managed under the Magnuson Act, a probit model of the probability of property rights adoption is estimated. The probability of adoption increases as ex–vessel revenue increases and as proxies for transaction costs decrease.

Subject headings: Fishery Management, Property Rights, Natural Resources

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Introduction

Is the economic value of a fishery enhanced when exclusive property rights are defined and enforced? In the United States the legal authority to create such rights has existed since the passage of the Magnuson-Stevenson Fishery Management and Conservation Act of 1976. Over the years property rights have been created to some – but not most – U.S. fisheries. If property rights are in fact critical to the economic viability of fisheries, why then, despite a legal framework designed to ease their creation, are most fisheries still lacking even rudimentary property rights?

This questions' breadth suggests more questions than answers: A full accounting of the determinants of property rights in fisheries will be constructed from the answers to many narrower questions. In this note I investigate whether there are important spatial and economic characteristics of fishery stocks that affect the decision to establish property rights to fisheries managed under the Magnuson Act.

Literature Review

The general theory of property rights is well established (See Barzel 1989 and Libecap 1989). The creation of property rights is viewed as an economic decision because their design, monitoring, and enforcement consumes real resources. This view allows for a rational reconstruction of the choice process using marginal analysis (Anderson and Hill 1975). Within the marginal framework one can not, *a priori*, demonstrate the universal adoption of property rights: The extent of property rights adoption will depend on the marginal costs and benefits. A core proposition of this literature holds that efforts to create property rights will, *ceteris paribus*, increase as either transaction costs fall or the value of resources increase. Empirical investigations lend support to this proposition (See Demsetz 1967, Cheung 1970, Field 1989).

Several authors have incorporated these propositions into models of fishery management. Anderson and Lee (1986) show that positive transaction costs generate situations where fishery managers "failing" to fully enforce property rights may increase social welfare. Others have come to similar conclusions (Milliman 1986, Sutinen and Andersen 1985, Anderson 1989.)

Institutional Background

The Magnuson Act extended U.S. jurisdiction over marine resources from 12 to 200 nautical miles. The Act authorizes three agencies to manage fisheries in this 200–mile zone. Eight quasi–independent regional fishery management councils representing commercial, recreational, and consumer fishing interests, develop fishery regulations that are presented to the Secretary of Commerce in the form of Fishery Management Plans (FMPs). In turn, the Secretary either approves or rejects each FMP. Much of this review process is delegated to the National Marine Fishery Service, a sub–agency in the Department of Commerce, that, along with the United States Coast Guard, enforce regulations contained in the FMPs. (For a detailed analysis of this Act and the regulatory review process see Kincaid (1999)).

Construction of the Data Set

Drawing on data contained in these FMPs I developed a set of forty–five fisheries to serve as observations in my data set. My review of these plans revealed the existence of two basic categories of property rights: Limited–entry programs and Individual Transferable Quotas (ITQs). In the sample, entry is limited in twenty–one fisheries. Sixteen fisheries have permanent limited–entry programs, while the remaining six have 5–year entry moratoriums. Four fisheries have individual transferable quota (ITQ) programs. ITQs assign a specific share of a fisheries harvest (the 'quota') to individual fishermen who, in turn, may harvest this quota or transfer it to others.

Each program creates rents by limiting access to a resource that was heretofore (essentially) open to all takers. However, under limited–entry programs, these rents are unassigned and, in the absence of other regulations (e.g. restrictions on vessel size), remain at risk because of the strong incentive each fisherman has to capture as large a share of the harvest as possible. Thus, simple limited–entry programs run the risk of converting the problem of the fishery from one of too many fishermen chasing too few fish, to one of a few fishermen with too much gear chasing too few fish. Because ITQ programs assign specific shares of the harvest to fishermen, these perverse incentives are dulled.

Notwithstanding these differences, each program confers some property interest and so, for this analysis, I treat their presence as an indication of property rights adoption. A binary variable, RIGHTS, summarizes this fact; where zero indicates no property rights, and one indicates some form of property rights adoption. RIGHTS serves as the dependent variable in a probit model of the determinants of property rights.

The adoption of property rights hinges on a standard cost–benefit calculation, where property rights are adopted if the net benefit is positive. The variable REVENUE, a three–year weighted average of ex–vessel revenue (millions of 1995 dollars), proxies the benefits of adoption.

Four variables proxy transaction costs. VESSELS, the number of fishing vessels in a fishery, proxies exclusion costs. PORTS, an ordinal variable ranging from 0 to 4, proxies land–based enforcement costs; where zero indicates a fishery with between 1 and 20 landing sites, one indicates 21 to 40, 2 indicates 41 to 60, 3 indicates 61 to 80, and 4 indicates 81 or more sites. (**Insert CORNES AND SANDLER REFERENCE**) EXTENT is an ordinal variable that proxies at–sea enforcement costs. EXTENT takes on the values 0, 1, and 2, and captures the geographical extent of a fisheries range. A value of zero denotes a fishery with a 'small' range, 1 denotes a 'middling' range, and 2 denotes a 'large' range[1] Finally, PART is an ordinal variable keyed to the type of fishermen found in a fishery; a value of zero indicates a fishery with mostly full–time fishermen, one indicates a mix of full and part–time fishermen, and two indicates a fishery with mostly part–time fishermen. PART is motivated by the fact that fisheries prosecuted by full–time fishermen is likely to be less susceptible to 'hit–and–run' tactics, are likely to have more established norms of behavior, and other attributes which will tend to make monitoring effects more effective (Wilen, Anderson, Cructhfield...)

[1]This index is based on a location of fishery. Fisheries found in a single management councils waters were set to 0, fisheries found in multiple council waters, but remained within the EEZ were set to 1, and fisheries found in international waters are set to 2.

Empirical Model and Results

The following equation is estimated using probit methods,

$$\text{Prob}(\text{RIGHTS}{=}1) = \alpha_0 + \beta_1 * \text{REVENUE} + \beta_2 * \text{VESSEL} + \beta_3 * \text{EXTENT} + \beta_4 * \text{PORT} + \beta_5 * \text{PART} \quad (1)$$

This specification allows for testing two hypotheses: Increases in REVENUE should increase the probability of property rights adoption and increases in transaction costs, as proxied by increases in VESSELS, PORTS, EXTENT or PART, should decrease the probability of adoption.

Table One summarizes the results of the probit estimation. Both coefficient estimates and marginal effects (calculated at the mean of the independent variables) are presented. Overall the specification performs well: 91% of fisheries not having property rights and 95% of those with property rights are correctly classified. Each of the marginal effects has the predicted sign: transaction costs proxies enter with negative signs, while REVENUE enters with a positive sign. In terms of statistical significance only EXTENT has a p-value greater than 0.1. A more important question turns on the empirical significance of the independent variables; that is to say, the magnitude of each variable's marginal effect. Table 1:

Changes in the variables significantly affect the probability of adoption. A one million dollar increase in REVENUE will, *ceteris paribus*, increase the probability of property rights adoption by 1.5%. An increase of 100 VESSELS decreases the probability of adoption by 2.6%. A unit increase in EXTENT decreases the probability of adoption by 47%, a unit increase in PORTS decreases the probability of adoption by 32%, and a unit increase in PARTICIPATION decreases probability of adoption by 44%.

Because the marginal effects are non–linear functions of the data, a more complete assessment of their magnitudes requires one to calculate their values over a range of the other variables values (See Greene 1999 for details.) For example, the impact of PORTS may be quite different in fisheries with high levels of REVENUE compared to those with low levels. Fig. 1.—

To consider this question I use the probit coefficient estimates to calculate the probability of adoption as a function REVENUE and the mean values of EXTENT and VESSELS. This results in three distinct CDF's; one for each value of PORTS and are plotted in Figure One. As illustrated in figure one, the marginal effect of PORTS is calculated as the difference between any two probability functions for a given level of REVENUE. As one can see, PORTS has a substantial affect on the probability of property rights adoption, but its magnitude depends substantially on REVENUE. Table two summarizes the marginal effect of PORTS for three different values of revenue. At the mean value of REVENUE (4.5), the probability of adoption falls 37% (from 0.8 to 0.5) as PORTS increases from 0 to 1, and by 60% as PORTS increases from 1 to 2. Table 2:

At low levels of REVENUE, changes in PORTS has a relatively small impact on the probability of adoption. Except for fisheries with more than 80 landing sites (PORTS = 2), the same can be said for fisheries with relatively high levels of REVENUE. Because most fisheries are in the central region of the distribution of REVENUE, the impact PORTS, and by extension, enforcement costs, is likely to be an important factor affecting the probability of property rights adoption. This point is re–enforced when one considers that 42% of the fisheries in my sample have more than 80 ports.

Conclusion

The passage of the Magnuson Act was heralded as a historic shift away from traditional and inefficient regulatory management of fishery resources to a system of management that would, on the one hand, enhance fishermen's income by creating property rights to fishery resources, and on the other, preserve fishery stocks though the stewardship that resource ownership affords. The fact that, 26 years after the Act's passage, only a small number of fisheries have some form of property rights defined has lead to disappointment in many quarters, and a search for answers to why traditional management practices seem so entrenched.

The fact that my sample is one of convenience justifies a cautious appraisal of my findings, the results presented in this note suggest a partial explanation of why so few fisheries are currently managed using exclusive property rights: given the benefits that they would confer, the costs of defining, monitoring and enforcing these rights may be too high.

This should not, however, be viewed as a Panglossian statement that fisheries are managed in the best of all possible worlds. The net benefits of property rights are a function not just of the characteristics of the fishery stock, but also of the institutional structure of fishery management and the technology of monitoring and enforcing property rights. Changes in either could lead to the further adoption of property rights.

The limited findings in this note suggest that efforts to more closely measure transaction costs and correlate these costs with the incidence of property rights will be fruitful. The results of such research would provide useful information to policy makers as they reassess the history of fishery management since the passage of the Magnuson Act and seek to better the economic standing of both fishermen and the resources that sustain them.

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Tables

Variable	Estimate	Std. Error	P–Value	ME
(Intercept)	2.67600	0.857	0.0018	—
REVENUE	0.03432	0.015	0.0294	0.015
VESSEL	−0.05777	0.031	0.0679	−0.026
EXTENT	−1.04378	0.640	0.1032	−0.473
PORT	−0.71640	0.278	0.0099	−0.324
PART	−0.98607	0.444	0.0266	−0.447

Table 1: Results of the Probit Estimation. The final column, ME, presents the marginal effects (calculated at the mean values of the all of the independent variables) for each of the independent variables.

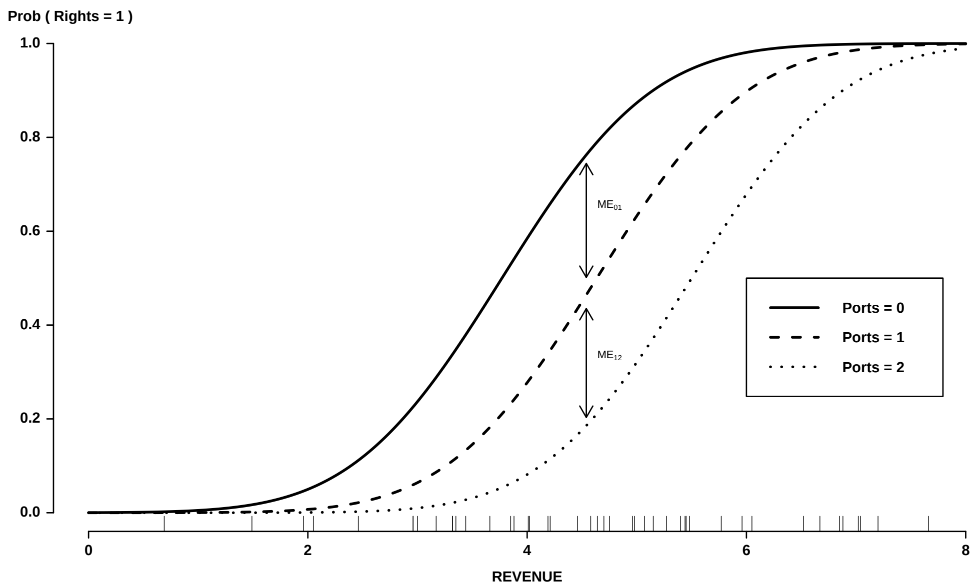
REVENUE	ME_{01}	ME_{12}
1.98	-0.13	-0.04
4.56	-0.30	-0.30
6.25	-0.05	-0.25

Table 2: Marginal Effect of PORTS. Each marginal effect is calculated for REVENUE one Std. Dev. below its mean, at the mean, and one Std. Dev. above. ME_{01} is the marginal effect of PORTS as it increases from 0 to 1, ME_{12} is the marginal effect of PORTS as it increases from 1 to 2.

Figure Captions

Fig. 1.—. CDFs for each value of PORTS as a function of REVENUE. Tick marks above the x–axis indicate observed values of REVENUE.

Figures



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