

*THE ECONOMICS OF OCEAN POLICY IN THE ERA OF  
EXTENDED JURISDICTION*

# The Economics of the Oceans: Environment, Issues, and Economic Analysis

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The purpose of this paper is to review briefly the changing ocean environment, ocean policy issues, and some of the areas of economic theory and measurement most relevant to ocean economics.

## I. The Environment

From the seventeenth century until the end of the nineteenth century, ocean politics and law reserved the oceans as open space. The necessary conditions for the maintenance of this open system were the military and economic domination of the world by the powers who were best served by open access, and the relatively slowly evolving technology of sailing ship construction and fishing methods which underlay the techniques of use and exploitation of the oceans.

Signs of movement away from the open system can be detected as early as the nineteenth century with, for example, the early recognition of the need to conserve fish stocks (see Giulio Pontecorvo and the author). By the 1930's, improvements in the technology of catching fish created the first long-distance fishing fleets. The dramatic shift away from resource abundance to resource scarcity, however, has come since the end of World War II. Under the pressure of increased population and national economic development throughout the world, and especially from the impact of the rapidly increasing capability to exploit ocean resources, the open ocean system is being transformed, substantially circumscribed, until it stands today in peril of elimination.

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At this point in time, the full extent and the form of national domination of ocean space and resources is not fully apparent. But it is fair to say that the question of international income distribution which has, since its inception, underlain the specific issues at the Law of the Sea Conference is in large part being resolved by the extension of coastal states' rights over ocean space. This situation represents an increase in the potential income of ocean states at the expense of states not so geographically fortunate. Thus far all participants in the sea law debates have denied the possibility of restrictions on trade and commerce, yet the extension of jurisdiction raises the possibility that in time restrictions may be imposed. For many states, the national interest is consistent with a set of complex regulations with respect to fisheries, minerals, pollution, and supervision and maintenance of straits.

## II. Policy Issues

Almost all economic policy issues essentially involve the design of a regulatory mechanism to promote more rational management of ocean resources (see Pontecorvo, D. Johnston, and the author). Unfortunately, the history of economic regulation of the oceans has generally been characterized by incorrect management goals, improper regulations, inadequate information, and neglect of the research that must support proper regulation.

### A. *Issues Concerning Extended Economic Zones*

At the present time the most serious policy issues involving the management of resources

in extended economic zones concern fisheries, coastal zone management, and petroleum. Conflict is highest with regard to fisheries, which currently have the highest economic value and the longest history of exploitation. The principal issues concerning management of fisheries within economic zones of developed countries continue to be the following: 1) the formulation and analysis of bioeconomic models of multispecies fisheries; 2) the characteristics of the supply functions for individual fisheries; 3) the cost and benefits of regulating fisheries; 4) the organization, structure, and political effectiveness of the fishing industry.

1) Bioeconomic control has as its objective the maximization of net revenue from utilization of the resources of the biomass. Focusing biological management on the biomass rather than individual fish stocks is a departure from most existing practices. Explicit recognition is given to the possibility that there may be a set of possible biomasses and the purpose of bioeconomic control is to define and implement criteria for choosing the particular biomass that will maximize social welfare. The common property characteristic of fisheries results in inefficient allocation of resources if exploitation is undertaken with a competitive market organization.

2) At the present time most species in U.S. and Canadian fisheries that have been commercially exploited are on the endangered species list compiled by the National Marine Fisheries Service (salmon is one exception). Individual stocks have been successively depleted as fishermen move from one stock exhibiting falling yield to the next most economically promising species. Offshore fishing by long distance travelers from the USSR, Japan, etc. has also had a considerable impact upon all the fish stocks. Biologists are not able to accurately analyze the relative impact of domestic and foreign fishing on the stocks. Furthermore, it is not clear whether these stocks have been subject to general biological overfishing or an uneconomical level of exploitation. That is, the management criterion utilized during the last two decades has been "maximum sustainable yield." This

principle does not result in an optimum economic result for domestic fishing industries, nor perhaps for foreign fishing. In short, there is considerable uncertainty concerning the long-run supply functions of individual species due to both a lack of biological knowledge and a lack of economic analysis in the management of fisheries.

3) A third key issue concerning fisheries is the benefits and costs of regulating multispecies fisheries. Given the lack of biological knowledge, the cost of acquiring additional empirical observations, the administrative expense of managing complex regulatory schemes (taxation and/or artificial markets), and the uncertainty concerning potential supply (and the generally poor prior performance of past efforts to manage fisheries), many fisheries might be better consigned to "benign neglect."

4) The present and future structure of the fishing industry (degree of integration, capital stock, marketing and distribution, etc.), its relationship to the growing state and federal regulatory bodies (regional councils), and its performance relative to foreign fishing fleets need examining as a basis for economic policy toward this industry. The traditional industrial organization studies (with the emphasis on institutional and empirical analysis) that provide the underpinnings for business and government relations in other areas of the economy are lacking for this industry. It is not an extreme question to ask whether a country such as the United States should employ foreign fishing fleets for harvesting and retain only domestic processing and distribution.

The principal remaining policy issues concerning extended economic zones are mineral exploitation (gas and petroleum) and coastal zone management (recreation and pollution). Offshore petroleum fields are a publicly held asset currently being explored by domestic oil companies. The regulatory mechanism adopted largely duplicates that used for exploration on public lands. Competitive bidding for extended leases is intended to capture for public use the excess profits or economic rent. The deficiencies of this arrangement include the small number of

private companies involved (particularly the lack of new entrants to the industry), the lack of analysis of the allocative implications of alternative bidding schemes, and the proprietary nature of information regarding petroleum fields.

Given these shortcomings there is little reason to expect the auction price to approximate the present value of any rents. This has led to the proposal that the regulatory agency have the authority to impose a profits tax to ensure that the public shares any "unanticipated profits." Actually implementing such profits taxes, however, would not be easy since much of the information on costs and revenues are not currently public. Corporations may therefore attempt to disguise profits by shifting costs from less profitable operations and by expanding into other areas of economic activity (including other energy sources). The possibility of such problems has suggested to some observers the need for a public authority to engage in exploration and production (similar to the Tennessee Valley Authority in electrical power).

### B. *International Issues*

Economic policy issues concerning ocean space outside extended economic zones are deep sea mining (manganese nodules—manganese, copper, nickel, and cobalt—oil and gas), shipping (pollution from ships), fishing (migratory species such as whales and tuna), and military uses of the oceans. The first three issues are all a direct reflection of the increasing value of ocean resources that was discussed above in Section I. The increased political activity with regard to these issues parallels the rising market value of the resources involved.

The control of the profits and technology from deep sea mining, the characteristics of the supply functions for individual minerals, and the impact upon world prices (and hence the economies of several LDCs) are major issues at the Law of the Sea proceedings. The technology only exists in the hands of private concerns in a few countries (the United States and France). Consequently, many developed and less developed nations favor an interna-

tional authority to control both the distribution of profits *and* the technology. Potential control over deep sea mining by private monopolies raises many of the same issues as offshore oil and gas exploration.

### III. Economic Analysis

The two most relevant bodies of literature for the analysis of ocean problems are the theory of economic externalities or public commodities (see for example Robert Russell and the author, ch. 18) and the optimal control or management of natural resources (see for example L. G. Andersen, ch. 6). The implications of economic externalities or public commodities for ocean problems were first investigated in the context of fisheries management. The literature that followed provides the theoretical basis for the regulation of fisheries in order to prevent their overexploitation (see for example, Andersen, chs. 4–5; Pontecorvo, Johnston, and the author, pp. 66–77). The existing propositions concerning endowment of property rights, optimal taxation, and artificial markets are equally relevant for the regulation of ocean mining, pollution, and shipping, although these problems have yet to receive the attention devoted to fisheries.

Optimal control or management models for natural resources are an application of modern capital theory. Such models seek to identify the possible deficiencies of static analysis under conditions of certainty by introducing dynamics (intertemporal profit or net social return maximization) and uncertainty concerning technology and demand. The crucial question is how deficient are traditional static models for actual resource management? The principal conclusion derivable from static analysis of fisheries is to reduce fishing effort by taxing output (see for example, Andersen, ch. 5). Exactly how this is to be accomplished is left to actual management experience. Dynamic models under uncertainty confirm this general conclusion and in addition promise to specify exactly how taxes should be altered over time in response to changing biological and economic conditions. However, most existing bioeconomic

control models generally resemble Keynesian macro-economic growth models and exhibit the same deficiencies: they are long-run steady-state models that do not specify the rate of adjustment of the biomass; furthermore most models have never been estimated with actual data. Hence at this time they are not useful management tools.

What of future research? The combination of the complexity of the underlying biological processes together with the economics of common property resources results in extremely difficult optimal control problems. Analytical results will not be possible except for extremely simplified cases, and numerical solutions will be expensive and very sensitive to error in functional specification and assumed parameter values. For example, concave criterion functions give rise to steady-state policies while nonconcave functions (for example, increasing returns to scale) give rise to cyclical fishing policies. In this situation management will have to operate in the near future with simpler rules of thumb (such as reducing fishing effort in response to reductions in yield and revenues from harvesting) until additional research is completed with regard to both data collection and empirical econometrics.

Data on ocean economic activity are gathered by individual nations and compiled by UN agencies such as the Food and Agriculture Organization. No nation currently produces a consistent set of estimates of the income and product resulting from ocean economic activity. The United States has made one prior attempt to estimate "the value of its oceans" and the National Income Division of the Department of Commerce is currently attempting to create a subdivision, "The Ocean Sector," of the national accounts. This will be derived for the year 1972 from those industries where the contribution of the oceans' resources to GNP may be measured. Finally, the United Nations publishes some estimates of general ocean output.

Empirical studies of the demand and supply of ocean output are for all purposes limited to fishing and to a lesser extent shipping. The literature contains a few exam-

ples of demand studies that analyze separate food commodities (see for example Anderson and the author). There has been little estimation of supply and cost functions for individual fisheries. (Some exceptions are quoted in Andersen.) Empirical models for the management of individual fisheries are also few in number.

Finally, there are no econometric models of the fishing industry comparable to those that have been developed and utilized for policy analyses in related commodity markets such as agriculture (see Enrique Arzac and the author, 1979a, b, c).

The shortage of empirical research largely reflects the lack of biological knowledge and data. The consequences of this situation are that policy decisions are resolved in an arena devoid of the benefit (or constraint) of estimates of the economic benefits and costs of alternative courses of action.

Domestic and international political conflicts proliferate in such a setting where no competing party or interest group is really informed about the economic value of the resources involved. In the end the value of economics may be that it defines the economic dimensions of tradeoffs and compromises and thus encourages agreement. The growing conflict over ocean space and resources just might be reduced by this knowledge.

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