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Giulio Pontecorvo

Roger Mesznik

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ROGER MESZNIK**

INTRODUCTION

The analytical systems of the classical economists, Smith, Ricardo, Marx and their contemporaries, were unduly complicated by their reliance on the labor theory of value. The marginalist revision of the latter third of the 19th century, by equating value and market price, moved toward a "solution" of the analytical difficulties encountered in a labor theory and before the end of the century, the economic analyst could make the statement that, given a competitive economic system in which price is equal to cost of production, it follows that the allocation of resources in the system is an optimum.[1]

* Mr. Pontecorvo is a Professor of Economics and Banking at the Graduate School of Business, Columbia University; a member of the Ocean Policy Committee of the National Academy of Sciences; a member of the Executive Committee of the Law of the Sea Institute, University of Rhode Island.

** Mr. Mesznik teaches economics and finance at the City University of New York, Baruch College. He is a doctoral student at Columbia University, Graduate School of Business.

1. In economic theory, a "normal profit" is included in the costs. The adequacy and shortcomings of this concept of optimality—generally called Pareto Optimum—has been dealt with extensively.

This paper will consider one aspect of the valuation problem. The focus is on the implications of rapid changes in the value of ocean and ocean related resources on social control (management) of ocean activity. Most often, economists, in order to analyze a problem, use the concept of equilibrium under static or comparative static conditions.[2] However, it is the dynamics of the rapidly changing (increasing) value of ocean resources that is one of the driving forces behind the rising interest in ocean management programs. Accordingly, these changes will be considered in a dynamic framework with due consideration to the related methodological difficulties.

Disequilibrium in the Economics of the Oceans

The nature of these dynamics may be suggested by a simple model, expressed in non-quantitative terms, that will help sort out the complexities of the ocean environment. This approach will allow conceptualization of the issues. But in using this model, it should be borne in mind that it must accommodate different national positions as well as the dynamics of changes in the value of ocean resources. This forces the model to a high level of generalization and eliminates any possibility of measurement and quantification. Despite these limitations, the authors believe the model is useful in organizing our thinking about the ocean resource problem.

To begin, it may be assumed that the economic system (income and output) is growing at an approximately constant growth rate (compound rate of growth).[3] It may be further assumed that the demand for ocean space and ocean resources is growing at least as fast as the overall economic system. A significant influence on demand will be the "income elasticity" of demand, the measure of the response of demand to a change in income. Here we will assume that the income elastisity of demand for ocean resources is positive and high. This means that as the system grows (income and output increase), the demand for ocean resources will grow even faster than the GNP. As indicated in Appendix I, there is considerable evidence which is consistent with this assumption, even though, eventually, stronger evidence than a simple inspection of data will have to be developed.

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2. In simplest form, a static analysis starts with a position of equilibrium—analogous to such a position in mechanics—and analyzes the forces of supply and demand that yield the equilibrium. Comparative statics is the examination of the changes in equilibrium positions resulting from changes in the underlying forces.

3. This assumption can be easily verified by looking at long term aggregate economic data.

Against the growth on the demand side is an increasing scarcity of supply. The usual description of scarcity is in terms of increasing costs, diminishing returns. The concept of diminishing returns involves the idea of pushing on a frontier—or margin. A fixed factor to which ever increasing quantities of variable inputs are applied will ultimately result in diminishing returns, *i.e.*, increasing costs of production per unit of output. A fixed stock of fish which is attacked by an ever growing fishing fleet is one way of visualizing diminishing returns.

However, such a vision of diminishing returns leading to economic calamity, while often invoked, is much too simplistic to be meaningful. There are two main forces that keep driving the wolf of diminishing returns away from the door—at least as far as the street. These two are, of course, technological change which tends to lower costs and the substitution of one good for another if the price of one rises relative to another.

In the long run, in the Western economies, these two factors have operated to more than overcome diminishing returns. But, long run tendencies do not suffice to explain all problems, and, in the short run and in particular segments of the economic system, increasing costs may present a real problem in management. Such seems to be the case with the oceans at the moment. It should also be emphasized that the condition of keeping the wolf from the door requires a high rate of technological change, a condition that suggests the importance of investment in research in ocean management problems.

Given the assumption of disproportionate increases in demand and relative scarcity, an upward price movement, and a rise in the value of the stock of oceanic resources should be observed.[4] Again, the Appendix indicates some limited evidence on those phenomena. Thus, in the short run and in the absence of any visible massive changes in technology or rapidly developing substitutes for ocean resource, the price of ocean resources may reasonably be expected to continue to rise, since the shifting demand curve and the inelastic supply function combine to yield a dynamic disequilibrium situation. Such disproportionate movements in prices create shifts

4. This suggests a first approximation to a definition of disequilibrium. In the foreseeable future, limited technological change and substitution possibilities will result in price movements which do not converge towards an equilibrium.

in the relative shares of income and emphasize problems of income distribution.

This condition of disequilibrium should be recognized as the salient feature of today's economics of the oceans. The model suggests that a legal system that fails to provide the necessary flexibility to accommodate future changes in value and future problems of distribution of income will court major economic difficulties and instability.

The Demand for Ocean Resources

The growing catch value of living resources, the increasing value of deposits of hydrocarbons and mineral resources, the rapid rise in the price of coastal real estate, the conflicts arising from multiple use of the restricted space in coastal zones, the changing role of ocean transport, and the growth in other uses of the ocean are one source of the growing participation and tension in international and national debates on the uses of the oceans.

In the long run, changes in the rate of economic activity and the entry and departure of new businesses or even new industries are in themselves neither a reason for dislocations in the economic system nor a reason for conflict and heightened interest. A steady growth pattern (technically speaking, a slow upward shift in the demand and supply functions) will reallocate resources, change resource use and generate new equilibrium prices and quantities without conflict.

However, problems associated with changes in economic conditions may indeed arise for any of several reasons. Almost any change, if too rapid, will cause significant economic dislocation because the normal processes of adjustment (the mobility of capital and labor, and the substitution of one good for another) operate with a lag. Too rapid a change may, therefore, go beyond the system's capacity to adjust in the given time frame.

A second source of trouble is when the supply and demand conditions do not shift together. These shifts will result in price fluctuations which, if substantial, may be disequilibrating. An illustration of this effect is the impact of wide swings in the world price of fishmeal resulting from either supply or demand changes on the foreign exchange position of Peru.

As has been noted, the principle force on the demand side is embodied in the concept of income elasticity. This may be clearly seen in the demand for ocean space for recreation in the coastal zone. The rising level of demand for sport fishing, second

homes and attractive beaches all reflect the rising affluence of society and our concomitant concern with the quality of life. Less obvious but also important in the demand for coastal zone ocean space is the impact of increases in GNP on the demand by industrial and public sector users.

Income and population growth require more transportation, power generation and the full range of output and services required to support the rising standard of living. Since population and industry have historically occupied and utilized the coastal zone because it offered lower operating costs, their growth tends to add significantly to the demand for coastal zone ocean space.

This litany may be extended to a wide range of industrial activities—for example, the development of superports, additional refineries and the demands on ocean space for the transport of petroleum products and liquified natural gas.

THE SCARCITY OF OCEAN RESOURCES

The 19th century view of ocean resources was that they were inexhaustible, *i.e.*, the supply functions for the resources then in greatest demand—fish and transportation—were infinitely elastic.[5] By the 1880's the fisheries management problem had emerged. However, while from the turn of the century, and even before, specific fisheries were in trouble, the general problem of scarcity was concealed by the extensive growth of fisheries in general.

> Accurate assessment of the physical dimensions of the depletion problem in Alaska was made much more difficult by the dual nature of the expansion of the fishery—geographically and in terms of the species exploited. Examination of the literature on the Alaskan fishery clearly indicates this extension process. In its most generalized form it involved a shift from a red salmon fishery to a red, pink, and chum salmon fishery.[6]

Since 1945 the opportunity for extensive growth in supply has been steadily diminishing, while the upsurge in world trade and the drive for industrialization in all nations, together with the greatly increased ability to utilize and exploit resources that has resulted from rapid technological advance, have greatly increased

5. Infinite elasticity refers to a situation in which any desired quantity of the good in question may be purchased for the same price per unit.

6. J. CRUTCHFIELD & G. PONTECORVO, THE PACIFIC SALMON FISHERIES 61-62 (1969).

demand. This moved the scarcity issue from the wings to center stage.

Today, the ocean community is slowly coming to grips with the concept that ocean resources are indeed exhaustible. It is now widely accepted that certain resources like the output of reproductive stocks, the throughput capacity of straits and the ability of the ocean to ingest pollution without damage are limited.[7]

Despite the emergence of this view of ocean space, policies continue to treat the oceans as if the supply of resources were infinitely elastic, and as if expectations of future price changes were zero. As long as the demand was far below the level of the stock or its regenerative abilities, the above assumption was a satisfactory approximation to reality. But as the resources' potential is diminished, a resource allocation system must change to adapt to the new supply conditions.

As long as the assumption of a perfectly elastic supply is maintained when such is not the case, the rationing of use has to be by some sort of bargaining (non-price) basis. This rationing process may take many forms and even be involuntary as is true of the congestion in straits and on beaches. Usually, however, it takes the form of interstate compacts, bilateral or multilateral fishery agreements, and treaties on pollution.

In addition, the strong and rapidly increasing interdependence of different uses is further complicating the issue. Stated in simple terms, the supply of ocean resources is increasingly scarce (becoming more inelastic in supply) not only because of each resource's own characteristics but also because the ocean uses are not independent nor are their supply conditions. Thus, besides rationing different users of the same resources, there also exists the necessity of rationing different uses in relation to each other.

Without knowing how different uses impinge upon each other, the price system is not very effective in allocating ocean resources. The inadequacy of the price mechanism forces the allocation mechanism back into the bargaining process with the usually resulting allocative inefficiency.

At this point it is appropriate to digress and spell out several options available for resource allocation of goods and services.

7. It is instructive that managerial practices derived under conditions of scarcity common in other areas are just now being imposed on the uses of ocean space. For example, air traffic has long been controlled around busy airports. Systems of this type are only now coming into use in harbors and straits. A single engine aircraft may have more electronic equipment for communication and control than some very large vessels.

As noted earlier, a certain pattern of income distribution and the assumption of a competitive market will yield an optimum allocation. If there is reason to believe that the market will not yield the defined optimum, one may fall back to a second best solution, for example, a market solution which may be constrained in various ways by regulating, a de facto rationing by congestion, purely political allocation and others.

In all these second best solutions, it is important to consider the nature of the decision making matrix and the costs of decision making. In general, purely political decision making is more costly, and less responsive to the underlying economic and physical reality. This is particularly true at the international level where protracted negotiations are often a necessary pre-condition for modest changes in agreements. The history of action in international fishery commission negotiations, such as ICNAF, is illustrative of this problem.

At first, it seems that the possible (probable) extension of national jurisdiction associated with the Law of the Sea Conference will internalize some of these problems. At the national level, the price mechanism, particularly if constrained by regulation, can be used to protect certain interest—at least theoretically. Even here, however, second order problems will arise that will defy easy solution. If by jurisdiction, a country gains control over a fishery, it must assume the cost of management. Furthermore, if the stocks have been utilized by other nations, there will be a problem of "phasing out." This will include the difficulties faced by those "phased out," the reallocation of effort to other fisheries, the exclusion of third parties elsewhere as well as other problems. For instance, the Icelandic solution, combined with a similar solution for the Faroes plus extended Canadian and U.S. jurisdiction, may well result in a massive reallocation problem in the North Atlantic, both East and West, the effects of which may extend to the Pacific. For example, if the Russians' fishing effort in the North Atlantic should be heavily affected by jurisdictional extension, they may be forced to re-examine their own position in the Pacific.

Another aspect of extension of jurisdiction is that the coastal state must not only assume the management burden for what heretofore has been an international fishery but also the burden of "full utilization" of the resource. Since this would imply a signi-

ficant expansion in fishing effort in the case of the U.S. and Canada, it may be expeditious for these states to create a market of sorts in fishery quotas. The existing system of national quotas in ICNAF provides the basis for the development of such a system—a system which seems *a priori* to be preferable to continuous political negotiation over "phasing out" and "full utilization" of stocks.

Theoretically, the price mechanism could also be utilized at the national level to obviate the conflicts that arise from multiple use of the coastal zone. Imperfections in the markets for ocean resources, however, provide severe obstacles to the simple reliance on the market system for optimum allocation. The concentration of population in urban coastal areas and the resulting competition for scarce ocean space for power generation, waste disposal and recreation serves as an example. The market for this space is imperfect; public purchasers (municipalities) may not be as well organized or as knowledgeable as private buyers (utilities); there may be economies of scale in certain private uses; certain purchasers may have longer time horizons or different social discount rates than individuals or local governments and different uses might have substantial externalities. Left to the market, this situation might lead to a condition where the supply of recreational land in proximity to an urban center would decline. Yet, it may be vital for the political and social stability of the city that the population retains easy access to recreational space. The failure of the market to accommodate these political and social needs is one of the reasons why society cannot rely on the working of the price mechanism in these circumstances.

The same difficulties exist at the international level. But there they are compounded by several additional problems. The most obvious of these is that different nations have different value systems and different price structures. Equally important is that there is at least one use of the oceans, the military use, for which no practical price proxy can be established. Both the U.S. and the U.S.S.R. have indicated that they are unwilling to trade off their military positions for any other package of goods at least within any relevant range.

The Economics of the Management Process

The preceding argument suggests the economic constraints that must be considered in developing an ocean management program. The high income elasticity of demand for ocean resources, particularly in view of different national growth rates, is highly rele-

vant when predicting future development. Given the assumption of a disproportionate rate of growth in demand, assessments based on linear extrapolation from the past are bound to be too low.

Perhaps of even greater importance are the limitations imposed by changing supply conditions. These will be the proving ground for the quality and durability of international ocean agreements. The option of bypassing the deterioration in quality and reduction in quantity of one resource by shifting to readily available close substitutes, as was done in fisheries, is disappearing. The availability of substitutes and the degree of substitutability are diminishing. Also, the increasing interdependence of different uses is rapidly restricting such solutions.

The interdependence of the different supply functions suggests that one solution to the management problem may be in broadly based agreements covering different competing uses. These broad agreements would become not only a mere bargaining convenience but a necessity required for the sake of effectiveness and stability. One may consider the different uses as joint products and one must, therefore, allow different countries to decide upon the relative rates of output in accordance with the country's own priorities, factor prices, time horizons and states of development. In sharp contrast, partial agreements, which cover a limited range of resources and their accompanying outputs and which fix present shares, will necessarily become less and less satisfactory to the signatory nations and, in time, will promote instability rather than stability in the ocean management system.

Furthermore, it will be useful to have a trade off mechanism by which different countries may exchange their different "allotments" of different uses in accordance with their needs without the necessity of re-opening the general contract or agreement. Such an ability to trade different outputs of the ocean among users and over time presupposes the presence of a "pricing system"—at least an implicit one. This, in turn, implies ethical judgments about the adequacy of the existing wealth distribution and the shifts in the distribution resulting from the bargaining (allocation) process.

There should exist no illusions about the likelihood of the establishment of such a "pricing" system. Therefore, there will be a

strong tendency to settle on second-best solutions, such as a broad definition of national jurisdiction. A broad definition of territoriality would correspond to a situation in which the pricing problem has been "solved" by internalizing it into every country's decision-making process. Under the best of circumstances, this would reduce the pricing problem to an internal issue and remove the problem of trade-offs between different uses from international consideration. If a setting in which countries maintain a widespread foreign trade covering many goods and services is assumed, the multiple uses of the ocean whose relative shares have been established internally, become but one aspect of the foreign trade matrix that underlies bilateral and multilateral trade agreements. Furthermore, assuming a reasonably efficient market for ocean output, such a solution would reduce the need for international involvement in day to day problems of regulation and, potentially, increase the pressure for extractive efficiency.

But this solution with its highly appealing features has severe drawbacks. For some countries, certain uses of the ocean are of such importance to their national economies and/or to their foreign trade that the internalization of the pricing problem and the incorporation of ocean use into the general foreign trade matrix is theoretically a possible solution, but not particularly practical. Also, the broader the definition of territorial claims and the resulting internalization of the pricing problem, the more detrimental will the agreement be to land- and shelf-locked countries, unless the agreement provides for explicit wealth redistribution. To the extent that the extension of territorial claims is perceived as a means of wealth redistribution from the richer to the poorer nations, it will be based on many precedents which will give it a broad base of support and may make it acceptable. However, it is not necessarily the most effective way to achieve this end. In accepting the territorial claims, nations will be awarded the present value of the future returns of the corresponding outputs with all the attached uncertainties. There is strong reason to believe that this process is easily palatable because of substantial overestimates of the present values and/or underestimates of the costs of making the claims. The overestimates occur because simultaneous increases in output by many countries eager to exploit their newly allotted wealth are, for obvious reasons, incompatible with present prices. On the other hand, when costs of staking claims are disregarded or assumed to be zero, any possible source of revenue, as uncertain and as low as its present value may be, is worth claiming. Thus, facing the option of either bargaining over the hard core issue of wealth distribution or accepting the risky outcome of a mechan-

ical allotment process, most countries settle for the latter. Hence, the hypothesis is offered that simple extension of territorial claims will tend to worsen, not improve the international distribution of income and wealth.

APPENDIX

I. Total worldwide oceanic gross product $60 billion.
II. The five main components of the total are:
  1) Shipping and other surface uses;
  2) Fishing and other exploitations of living resources;
  3) Petroleum and gas exploitation;
  4) Mining of minerals, and;
  5) Recreation.

III. 1) The use of the oceans for shipping—estimated at $40-50 billion is by far the biggest component of the total. The shipping of oil, gas, and bulks constitute 67% of the total tonnage. Recent data have shown that international trade tends to grow faster than the economies of the trading nations. Accordingly, one would expect that the demand for shipping will increase at a disproportionately high rate. However, the rapid increase in air freight—a close substitute—and the fact that bulk freight has exhibited substantial economies of scale in the recent past will tend to act in the opposite direction. Also, recent time series tend to be biased upward because of the closure of the Suez Canal with its resulting increases in costs and short term dislocations.

  2) Fishing and other exploitations of living resources are estimated at some $8 billion per year. At first, the seeming stability of the per capita fish consumption in the U.S. (around 11 pounds per year) seems to suggest that the income elasticity of fish is below one. Even under these circumstances though, the total demand will keep shifting to the right because of the increase in population. However, the constant overall per capita consumption of fish covers distinct shifts in the demand patterns for individual species. There has been a substantial shift toward species which have exhibited substantial under-utilization in the past (mainly tuna and fishmeal), thus substantially alleviating the price pressure. To the extent that the substitutability of under-utilized species will diminish, the price behavior will change drastically.

  3) Offshore oil represents about 20% of the reserves and some 15% of the output. Present capital spending is at the rate of over $1 billion per year. The value of offshore output is estimated at some $6-8 billion per year. The high income elasticity of the demand for energy and the disproportionately high rate of growth of offshore fields combine to sustain a high growth rate of this sector of ocean use.

  4) The mining of minerals is a negligible component. It is presently estimated at $1 billion per year. Of this total, 20% is derived in the U.S.; 35% of the total is estimated to be in the form of coal mined through tunnels which start on land. An additional

40% is derived from minerals extracted from the water column.

5) The recreational use of the ocean is estimated at some $4-5 billion per year in the U.S.

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