ECONOMICS OF ENVIRONMENTAL REGULATION

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Contents

1. Introduction
2. A Lake Management Problem
3. Uncertainty, Values, Political Considerations, Regulatory Costs
4. Conclusions
Glossary
Bibliography
Biographical Sketch

Summary

This entry develops some economics of the management of ecosystems where the ecosystem’s dynamics are nonlinear, where there is a hierarchy of temporal and spatial scales of activity, and where multiple basins of attraction can be present. These features, for which there is increasing scientific evidence, generate difficulties for management agencies because data and other sources of evidence seldom allow confidence that one has specified the right model, but the policy consequences of wrongly specifying a single steady state model in a world of multiple steady states can be serious.

1. Introduction

This entry gives a brief explanation to some recent literature in the economics of environmental management and regulation, where modeling of the ecological side is more detailed than usual, and where stress is placed upon the hierarchy of temporal and spatial scales that appear to be present in actual ecosystems. Here “management” and “regulation” will be taken as analytical synonyms. Similar analytical structures are useful in both management and regulation. However, the regulatory area focuses more on issues such as relative efficiency of different modes of implementation of desired goals. For example, the regulatory area stresses issues such as comparison of decentralized and market based modes of implementation, in contrast with centralized and command/control modes of implementation.

The economics of environmental regulation may be viewed at several levels. At the highest and most abstract level, the question is how the peoples of Earth want to organize activity at the macro-scale of planet Earth to maximize the level of well being of human beings and their descendants (including all future generations). Indeed, at this abstract level, the concern includes the well being of other organisms such as the great apes, the chimpanzees, and other “charismatic” species, but probably not the direct well being of “nuisance” species like malarial mosquitoes. It is currently a great debate
where the web of caring ends across species, but the web of caring surely includes human beings and that posture is taken here.

At a more specific and concise level of abstraction, the goal might be to manage human activities in order to maximize the well being of the current population of human beings and their descendants (including all future generations). Since human welfare is coupled to the environment, one must face the issue of managing coupled economic/ecosystems to achieve goals. The area of science that this entry attempts to exposit is vast. Therefore, the exposition is specialized to the very narrow area of the economics of regulation of dynamic ecosystems whose dynamics may display multiple basins of attraction.

There will also be emphasis on complications and considerations due to a hierarchy of time scales of ecosystem activity, where there is a rough order of magnitude in difference in speed across each time scale clump of activity. This issue is raised here because it turns out that evidence is suggestive of “clumping” structure of temporal speeds of ecosystem activity, with each “clump” roughly separated from the next by an order of magnitude difference in speed. Furthermore, similar “clumping” is observed in spatial domains of ecosystem activity, with the temporal speed and the spatial size being positively correlated. This kind of evidence is summarized in ecosystem studies in various ways. A popular method of presentation is a Stommel diagram. This diagram represents the results of a type of spatial/temporal spectral analysis where height of spectral power, or some other measure of frequency of activity at a particular location, on the floor of the diagram is represented by iso-spectral height lines. The axes represent the logarithms of time duration and spatial size. References are given in the annotated bibliography.

It will turn out that much recent research in ecology suggests that the specialization taken here is not so narrow after all. It is necessary to clarify a point on the use of language before beginning. This entry uses the language of “optimization” for expository purposes. It is important to always keep in mind that environmental problems usually do not submit to simple maximization of some numerical objective function. At the minimum, the heterogeneity of interests would demand something like a vector-valued criterion, not a numerical one. In some important cases, there is no compensatory tradeoff between material goods and deeply held spiritual or environmental values.

Consider a dramatic example of a native tribe in Amazonia facing a multinational wishing to desecrate their sacred rainforest by oil drilling. The tribe will commit suicide if the rainforest is invaded by such a commercial interest. The multinational offers to make each one of them a millionaire in compensation, yet each tribal member decides to commit suicide anyway. Examples almost as dramatic as this one come up all the time in environmental issues, and the environmental policy economists who ignore these kinds of issues do so at their peril. In cases like this, where there are no substitution possibilities available to design a compensatory mechanism, and there is no technology available with which one can drill without desecrating the rainforest from the tribe’s point of view, any sensible and moral criterion of “optimization” would probably demand that the tribe’s rainforest be left alone.
To put it another way, in benefit/cost language, the “willingness-to-accept” (WTA) for drilling rights for this tribe is plus infinity. Morality, ethics, and the material poverty of the tribe (even though it may be spiritually rich) demand use of a WTA criterion rather than a willingness-to-pay criterion in making the decision of whether to drill the rainforest. Hence, in this case, since the true WTA of the tribe is plus infinity (we assume that there is no strategic “posturing” by the tribe in this hypothetical example), and since the WTA of non-drilling of the rest of the world is finite, WTA-based benefit/cost analysis delivers the decision: do not drill. In view of this and other difficult ethical and moral issues involved in the interaction between environmental regulation and the distribution of incomes, optimization of some numerical criterion is not likely to be appropriate. Nevertheless, this entry will use the language of optimization for expository purposes, even though the general theme of the entry is regulation in the “overall public interest,” and even though that criterion is difficult to define.

To put it another way, one could imagine that society as a whole sets a vector of goals such as some concept of efficiency, ethics, fairness, and sustainability. In this view, the economist’s job is to design best ways of achieving the targets set by society. This problem could potentially be framed as a conditional type of optimization problem. Hence, this entry will continue to use the language of “optimization” in the exposition that follows. Concepts such as “utility” will be interpreted more broadly than usual in order to encompass notions of “conditional optimality,” where the problem is to find the most effective way to reach a goal set by other mechanisms such as democratic political choice rather than economic valuation analysis.

This entry develops the economics of environmental regulation for a coupled economic and ecological system, where ecological dynamics seriously incorporates an ecological scientific knowledge base requiring the special expertise of a natural science such as limnology. The example of management of a lake and its watershed is used as an expository example. The emphasis will be on problems raised by non-convexities in the underlying dynamics in this kind of ecological management problem. Discussion will be intuitive and heuristic. References are given in the annotated bibliography for details.

The lake example will be used as a contextual framework to give a general discussion of problems faced by the economics of regulation of realistic ecosystems at all levels, ranging from the micro-level of a small lake to the meso-level of large lakes and landscape systems, to the macro-level of world carbon, nitrogen cycles, and global climate change. The discussion includes practical issues such as the use of regulatory tiering, copayment schemes, and other regulation modes besides the standard “market-based” schemes such as user charges, tradeable permits, and “Pigouvian” taxes.

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goals and ends, while specialized experts such as economists find the best way to achieve those goals and ends.


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developed methods in computational Bayes analysis.]
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**Biographical Sketch**

**Professor William A. Brock** teaches economics at the University of Wisconsin, Madison. He received his Ph.D. degree from the University of California at Berkeley and his AB degree from the University of Missouri, Columbia. His major interests include economic dynamics, econometrics, and complexity theory.