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Natural Resource Policy Analysis and Rational Choice Theory: A Strategy for Empirical Research

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ABSTRACT

Natural resource policy analysis focuses on the context and consequences of collective decisions regarding the allocation and distribution of natural resources. Two concepts central to resource analysis are the nature of institutional arrangements and attributes of goods. Rational choice theory is well suited for resource analysis because these two concepts are important parts of the theory. The new resource economists have used elements of rational choice theory to analyze natural resource policy. Their application is deficient in its narrow use of the theory and in its methodological posture of defense of favored hypotheses. We argue that rational choice theory can be most usefully applied using a methodological strategy of strong inference—the derivation and testing of competing hypotheses. Competing hypotheses may be derived from within rational choice theory as well as from other theories.

"A failure to agree for thirty years is public advertisement of a failure to disprove."[1]

I. INTRODUCTION

The theory of rational choice applies the methods and postulates of economics to the study of political and other extra-market phenomena. During the last decade, rational choice theory has been employed increasingly in the study of natural resource policy. The focus of most natural resource applications has been evaluative. Indeed applications of rational choice theory to natural resource and environmental issues have generated a consistent set of policy prescriptions: where resources are publicly-owned, alienate them to the private sector; private ownership and management will almost invariably yield more desirable social outcomes than public ownership and management. Where public agencies

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1. Platt, *Strong Inference*, 146 Science 351 (1964).

regulate private firms to protect environmental quality, minimize the extent of regulatory requirements and design regulatory regimes to mimic market processes; attach a price to pollution and firms will economize on it. These solutions emerge whether the focus of analysis is air, water, forests, wilderness, or wildlife.[2]

Advocates of these positions have referred to their analytical framework as the new resource economics.[3] Their advocacy of privatization has generated considerable controversy within the field of natural resource policy. Such controversy is healthy for the development of an academic field and for the generation of policy alternatives. However, it is also important that the bases for such controversy be constructively addressed. If in thirty years natural resource policy analysts continue to talk past one another without having identified normative, logical, and empirical areas of agreement and disagreement, we will have failed as a scholarly community.[4]

Our purpose in this paper is to explore the extent to which empirical questions relevant to natural resource policy have been and can be addressed using rational choice theory. More specifically, we will focus on the central concepts and on the methods of empirical analysis associated with rational choice theory (including the new resource economics). We explore four related questions. What substantive concerns are central to rational choice theory? What methodological postures consistent with the theory would best guide its development? Are these concerns and postures appropriate for natural resource policy analysis? How can we, as resource policy analysts, make the most effective use of rational choice theory?

In the next section of the paper we review the core concepts of rational choice theory. In section three we propose a methodological position that is appropriate for policy analysis. Section four examines substantive issues that are crucial to analysis of natural resources and evaluates rational choice theory as a tool for resource policy analysis. We conclude by proposing a research strategy that will maximize the contribution of rational choice theory to resource policy analysis.

II. RATIONAL CHOICE THEORY

The body of research and writing that we refer to as rational choice theory comprises several schools or paradigms that have developed during

2. *See, e.g.*, T. Anderson, Water Crisis: Ending the Policy Drought (1983); Batten, *Toward a Free Market in Forest Resources*, 1 Cato J. 501 (1981); Baden, Saving the Wilderness: A Radical Proposal, 13 Reason 28 (1981); Smith, *Resolving the Tragedy of the Commons by Creating Private Property Rights in Wildlife*, 1 Cato J. 439 (1981).

3. Anderson, *supra* note 2, at 17-24.

4. As a field, we have made progress in identifying normative sources of disagreement. *See, e.g.*, Leman, *The Revolution of the Saints: The Ideology of Privatization and Its Consequences for the Public Lands*, in Selling the Federal Forests, University of Washington, Institute of Forest Resources, Contribution No. 50 (A. Gamache ed. 1984).

the last few decades. One is the property rights school in economics. Another is the public choice literature in political science. The following sections examine important concepts and concerns of property rights economics and of public choice, describe their synthesis as rational choice theory, and explain their application in the new resource economics.

A. The Property Rights Paradigm

The property rights paradigm has extended the explanatory scope of economic theory to extra-market decisionmaking.[5] This extension is the result of three insights. The first is derived from a shift in analytical focus from the firm level to the individual decisionmaker. Instead of positing the firm as a profit maximizer, property rights economists posit individual members of the firm as utility maximizers. Thus we should expect firms and other organizations to behave efficiently only to the extent that individuals within these organizations face appropriate incentives.

Second, property rights economists examine institutional arrangements, especially property arrangements.[6] Property, as a social institution, allocates rights and obligations to social actors in order to regulate the use of objects.[7] The set of rights and obligations that are associated with property ownership varies among societies and through time in the same society. Property rights economists evaluate the effects of the structure of property arrangements on the incentives faced by individuals and on resource allocation.

These two elements have facilitated economic analysis of the consequences of the separation of ownership from management in the private sector and of public ownership and government management. Property rights theorists argue that managers who are not owners will have an incentive to shirk because owners face information and enforcement costs. They also contend that shirking by managers in the private sector will be limited by market valuation of shares, managerial rewards for firm performance, and competition among managers.[8] Many property rights

5. *See* Alchian & Demsetz, *The Property Rights Paradigm*, 33 J. Econ. Hist. 16 (1973); Furubotn & Pejovich, *Property Rights and Economic Theory; A Survey of Recent Literature*, 10 J. Econ. Lit. 1137 (1972).

6. Of course property rights economists are not the first social scientists to examine institutional arrangements. There is a long tradition of institutional analysis in political science and in economics. Economists who have focused on institutional arrangements include: J. Commons, Legal Foundations of Capitalism (1924) and S. Ciriacy-Wantrup, Resource Conservation: Economics and Policies (3d ed. 1968). In political science institutional studies dominated the first few decades of the discipline. *See, e.g.*, W. Wilson, Congressional Government (1885). What property rights economists have contributed is a deductive theory that facilitates examination of institutions as both independent and dependent variables.

7. Hallowell, *The Nature and Function of Property as a Social Institution*, 1 J. Pol. & Legal Soc. 115 (1943).

8. *See generally* Furubotn & Pejovich, *supra* note 5.

studies have examined the behavior of managers in a variety of institutional settings.[9]

A third element of the property rights paradigm is the analysis of transaction costs. Transaction costs may be defined as any costs incurred in negotiating, contracting, or monitoring the terms of an exchange.[10] Property rights economists ask how transaction costs affect the development of institutional arrangements. For example, where the costs of negotiating or monitoring an agreement are high, contractual arrangements are unlikely to emerge.

The three analytical innovations described above have allowed property rights economists to explain a range of extra-market decisionmaking. Analysts have focused on the development of property arrangements,[11] the efficiency of alternative property arrangements,[12] and the incentives faced by individuals within firms and other organizations.[13]

B. Public Choice Theory

Public choice constitutes a second branch of rational choice theory. Analysis of political phenomena such as voting, electoral competition, and legislator behavior is the focus of public choice theory. While public choice theorists have appropriated economic principles to study decisionmaking in political contexts, public choice differs from neoclassical economics in its focuses on institutions and on the nature of goods.[14] Arrow examined the consequences of alternative rules for aggregating individual choices.[15] Other public choice theorists have explored the effects of legislative rules of procedure on policy choice; the underlying premise of this line of inquiry is that institutions affect outcomes.[16] Thus we should expect rules and procedures governing introduction of bills, legislative

9. *See, e.g.*, Crain & Zardkoohi, *A Test of the Property-Rights Theory of the Firm: Water Utilities in the United States*, 2 J. Law & Econ. 395 (1978); Davies, *The Efficiency of Public Versus Private Firms, the Case of Australia's Two Airlines*, 14 J. Law & Econ. 149 (1971).

10. De Alessi, *The Economics of Property Rights: A Review of the Evidence*, 2 Res. Law & Econ. 1 (1980).

11. S. Cheung, The Myth of Social Cost (1978).

12. Furubotn & Pejovich, *supra* note 5; Crain & Zardkoohi, *supra* note 9; Davies, *supra* note 9.

13. De Alessi, *supra* note 10.

14. Sproule-Jones, *Public Choice Theory and Natural Resources: Methodological Explication and Critique*, 76 Am. Pol. Sci. Rev. 790 (1982).

15. Arrow's work gave impetus to a branch of public choice called social choice theory. Social choice theorists examine the properties of social choice functions (rules for aggregating individual preferences) in order to evaluate the consequences of alternative rules with respect to social welfare. Arrow's analysis generated an impossibility theorem, which asserts that no fair voting rule can produce a stable and consistent ordering of social preferences; K. Arrow, Social Choice and Individual Values (2d ed. 1963). A generation of social choice theorists has challenged, elaborated, and explored the consequences of Arrow's theorem; W. Riker, Liberalism Against Populism (1982).

16. Shepsle, *Institutional Arrangements and Equilibrium in Multidimensional Voting Models*, 23 Am. J. Pol. Sci. 27 (1979).

committees, the extent of floor debate, and administrative and judicial hearings to have implications for the substance of public policy.[17]

Mancur Olson's analysis of the collective action problem gave impetus to another line of public choice inquiry.[18] Olson observed that provision of collective goods often requires individuals to incur costs that are not directly linked to benefits received from the good. If an individual chooses not to contribute, she can still benefit from the good if it is provided. Thus individuals will often choose to free ride. When these individual choices are aggregated, the result is suboptimal provision of the collective good. The question Olson raised and many others have explored is: under what conditions will rational individuals cooperate in the provision of a collective good?[19]

This focus on collective action in pursuit of collective goods has emphasized the analytical role of the nature of goods. Public choice theorists have focused on two characteristics of goods that influence resource allocation; the extent to which goods may be jointly consumed[20] and the ease with which others may be excluded from their use. Economists have traditionally used the attribute of jointness of consumption to define a public good.[21] Public choice theorists argue that public goods are defined by both joint consumption and costly exclusion. Furthermore, it is the attribute of costly exclusion that creates collective action problems. The public choice analysis of goods facilitates identification of the conditions under which particular goods will be optimally provided and suggests institutional arrangements appropriate for provision of each type of good.

C. The Theory of Rational Choice

The lines of research outlined above differ in substantive focus but share fundamental premises and concepts. These common elements make it useful to treat the public choice and property rights paradigms as a single theory, the theory of rational choice. Three elements define this theory: (1) the postulate of purposive individual choice; (2) the presumption that institutions matter; and (3) the focus on the nature of goods.[22]

17. Again, the focus on institutions is not new to political science. See *supra* note 6. What is new is the use of deductive theory to predict how particular procedural rules affect policy outcomes.

18. M. Olson, The Logic of Collective Action (1971).

19. Some theorists have asked this question with regard to state formation; M. Taylor, Community, Anarchy, and Liberty (1982). Others have posed the question in the context of participation in interest groups; M. Olson, *supra* note 18; T. Moe, The Organization of Interests (1980).

20. Goods are jointly consumed when individuals use the same good or service without affecting the level of satisfaction derived by other users; Ostrom & Ostrom, *Public Goods and Public Choices*, in Alternatives for Delivering Public Services 7-49 (E. Savas ed. 1977).

21. Samuelson, *Diagrammatic Exposition of a Theory of Public Expenditure*, 37 Rev. Econ. & Stat. 550 (1955).

22. Sproule-Jones, *supra* note 14, has used a similar formulation to define public choice theory.

Rational choice theory employs the individual as the basic unit of analysis and postulates that individuals behave purposively. At the most general level, rational choice theory may be characterized by methodological individualism, a focus on the individual decisionmaker.[23] The premise underlying this focus is that firms and bureaucracies do not make decisions, only individuals do. Organizations and other social institutions provide incentives that guide individual choices as well as rules for aggregating those choices. But all collective actions may be reduced to a set of individual decisions. Thus the appropriate unit of analysis for rational choice theory is the individual decisionmaker.[24]

The postulate of purposive choice asserts that individuals maximize an objective function. The nature of this function is determined by an ordering of tastes or preferences that is assumed to be transitive and stable.[25] Maximization is constrained by limited resources. In order to predict behavior in particular contexts, the rational choice analyst must identify a decisionmaker's objective (for example, wealth accumulation, status, re-election), specify an objective function, identify constraints, and analyze the institutional setting.

A second defining element of rational choice theory is the presumption that institutions matter. Rules and norms that define procedures for making collective choices favor some interests over others and some outcomes over others. Whether it be public versus private ownership or unanimity versus majority voting rules, the nature of institutional arrangements affects individual behavior and subsequent collective action. Thus rational choice theorists devote considerable effort to analysis of social institutions.

Finally, the nature of goods and services is a focus of analysis. Can a good be supplied exclusively and consumed privately facilitating market allocation? Does a good have collective elements that promote free riding and militate against market allocation?

The three elements outlined above—the postulate of purposive individual behavior, a focus on institutional arrangements, and frameworks for analyzing the nature of goods—are central to rational choice theory. They invite exploration of three kinds of questions. How does the nature of a good affect the development of institutional arrangements? How do institutions affect individual decisions regarding resource provision and use? What are the social consequences of particular choices?

23. Lukes, *Methodological Individualism Reconsidered*, in The Philosophy of Social Explanation 119-29 (A. Ryan ed. 1973); Sproule-Jones, *Methodological Individualism: Challenge and Response*, 28 Am. Behav. Sci. 167 (1984).

24. This position may be contrasted with one adopted by many sociologists who argue that social groups often constitute a basic unit of analysis; R. Merton, Social Theory And Social Structure (1957).

25. N. Frohlich & J. Oppenheimer, Modern Political Economy 6-9 (1978).

D. The New Resource Economics

During the last decade the new resource economists have addressed these questions in the context of natural resource management and use.[26] They have elaborated rational choice theory in order to develop an argument against public ownership and regulation and in support of market allocation. The fundamental conclusion of the new resource economics is that public sector decisions almost always yield outcomes that are less efficient and less equitable than those associated with the private sector. The argument upon which this conclusion rests is as follows.[27]

The private owner of a resource has an incentive to use the resource in a manner that will yield the greatest private return. If property rights are well-defined and enforced, this use will also maximize the social value of the resource. This result occurs because, with perfect definition and enforcement, the parties to any exchange bear all of the costs and receive all of the benefits of the exchange. Thus a resource will go to the actor who values it most (she who is willing to pay the highest price).[28] The resource will be used in the manner that yields the greatest return. Thus, an economy in which all property rights to resources are well-defined, enforced, and privately owned will yield an efficient allocation of resources.

In contrast, the government bureaucrat responsible for the management of productive resources faces a different incentive structure. The bureaucrat has little incentive to maximize the social value of resource use because he cannot claim the private return. The bureaucrat's interests are served by increasing the budget he controls or the size of the staff he supervises. He has neither the incentive (profit) nor the information (prices) to manage resources efficiently. Thus the new resource economists conclude that public ownership and bureaucratic management foster inefficiency. Political influence replaces social value (measured by prices) as the determinant of resource use. This produces not only inefficiency but inequity. By manipulating the political process, special interests force the average taxpayer to subsidize their lifestyles. Finally, government allocation is characterized by conflict and coercion rather than the voluntary exchange associated with markets.

26. T. Anderson, *supra* note 2; R. Stroup & J. Baden, Natural Resources: Bureaucratic Myths and Environmental Management (1983). Anderson characterizes the new resource economics as an application of conclusions from property rights economics, public choice, and Austrian economics. The primary contribution of the last is its focus on entrepeneurs. Stroup and Baden define the paradigm similarly though they do not use the term "new resource economics."

27. This argument summarizes the model proposed by new resource economists. *See* T. Anderson, *supra* note 2; R. Stroup & J. Baden, *supra* note 26; and J. Baden & R. Stroup, Bureaucracy vs Environment: The Environmental Costs of Bureaucratic Governance (1981).

28. In order to accept that the individual who values a resource most is the same as the one who is willing to pay the highest price, one has to accept the validity of the existing distribution of wealth.

Numerous authors have criticized the logic, the normative foundations, and the empirical validity of the preceding argument. Criticisms of the new resource economics may be of four types. First, one may challenge the new resource economists' value positions with regard to efficiency, equity, and the sanctity of private property rights. This type of criticism involves social philosophy and there is much to be debated in this regard.[29] Second, one might question the assertion that bureaucrats maximize budgets.[30] Third, one could criticize the analysis of public and private institutional structures presented by the new resource economists. Worldly institutions may differ from their portrayal by the new resource economists and in many situations bureaucrats in the public and private sectors may face similar incentive structures.[31] Finally, the new resource economists may not have correctly analyzed the nature of particular goods.

Our concern in this paper is with the last three types of challenges. Each of these is subject to empirical testing. Empirical tests can challenge assumptions regarding the nature of individual choice, institutional structure, and characteristics of goods. Does rational choice theory lend itself to such tests? Have the new resource economists presented the results of such empirical challenges? In the next section of this paper we propose a methodological strategy that will aid us in addressing these questions.

III. STRONG INFERENCE AND POLICY ANALYSIS

The field of policy analysis focuses on why, how, and with what consequences collective choices are made.[32] Policy analysts examine the interplay of historical and contextual factors with political actors; the institutions and procedures that structure choice; and the effects of particular choices on individuals, groups, and the political economy. Policy research is intended to advance social science and to provide useful information and conceptual frameworks to decisionmakers. To achieve these ends research must be methodologically appropriate.

29. *See, e.g.*, Furniss, *The Political Implications of the Public Choice—Property Rights School*, 72 Am. Pol. Sci. Rev. (1978); Leman, *supra* note 4 at 93-98.

30. R. Behan, *The "Privatization" Alternative for the Future of the Federal Public Lands: A Penultimate Comment*, Paper presented at the annual meeting of the Western Political Science Association (Mar. 1983). *See infra* note 46.

31. For example, one new resource economics position is that public owners (citizens) of a resource face high costs in enforcing their preferences, whereas private owners need only buy and sell stock to enforce their preferences. Denning argues that, while this may be true, private owners face higher information costs to monitor the behavior of corporate managers than public owners face to monitor the actions of public bureaucracies. Thus the relative efficiency of public and private bureaucracies can only be determined empirically. M. Denning, *The Public Ownership of Productive Resources: An Economic Analysis of Government Enterprise*, Paper presented at the annual meeting of the Western Political Science Association, (Mar. 1983).

32. A. Heidenheimer, H. Heclo & C. Adams, Comparative Public Policy: The Politics of Social Choice in Europe and America 3-6 (1983).

A. Strong Inference

We contend that three methodological requisites are consistent with the purposes of policy analysis. First, analysts should be concerned with prediction and explanation not prescription. When we prescribe particular policies we take on the role of citizen or public official. To the extent that we attempt to impose our values and beliefs on policy makers we forfeit our roles as analysts and as social scientists. When we explain policy-making processes, define alternatives, or predict consequences, we contribute to the development of a science of politics and we provide useful information to decisionmakers.

In order to explain and predict, analysts must subject theories to empirical tests. Thus our second methodological position is that policy theories should permit falsification. Theories are tested by deriving refutable implications from them and then collecting data that could be inconsistent with those implications.

Public policies lend themselves well to empirical tests because hypotheses are implicit in all policies.[33] If we wish to analyze the consequences of a land use policy that employs tax incentives to reduce conversion of open space in urbanizing areas, we may do so by testing a proposition that relates a policy tool to the solution of a problem. The content and form of the proposition will depend on how the research question is formulated, the specific elements of the policy, and the conditions under which it is applied. Hypotheses that might be relevant to this situation include: if costs of holding open space decrease, then the probability of conversion will decrease; if tax assessments are lower, then fewer acres will be converted; if tax costs are a minor decisionmaking factor for landholders, then lower assessments will have little impact on conversion rates. Each of these hypotheses links a particular set of institutional arrangements to some social outcome. Each hypothesis is also associated with a more general theory of decisionmaking. The process of formulating hypotheses focuses attention on relations between decisionmaking variables and alternative policy tools, thus promoting more rigorous policy analysis.

Our third methodological position is that strong inference is an appropriate strategy for the development of policy science.[34] Implementation of strong inference requires: (1) formulating alternative hypotheses; (2) devising an experiment (quasi-experiment or simulation) with alternative possible outcomes, each of which excludes one or more of the hypotheses;

33. For discussions of policies as hypotheses, see A. Wildavsky, Speaking Truth to Power 16, 389-94 (1979); S. Kelman, Making Public Policy 6-8 (1987). For a more technical discussion of the implications for policy analysis, see Campbell, *Reforms as Experiments*, 24 Am. Psychologist 409 (1969).

34. Platt, *supra* note 1, at 347.

and (3) rigorously carrying out the experiment (quasi-experiment or simulation). Strong inference provides an appropriate standard both for guiding and for assessing progress in social science. Its logic is especially compelling.

The best analogy is the act of shaping a tree by pruning it. Each fork provides an opportunity for growth to continue in a given direction. Alternative paths for future growth are eliminated by tests that falsify competing hypotheses. Sequential development of surviving hypotheses and subhypotheses give shape to theory, just as surviving branches give shape to the tree. Natural resource policy analysts seeking to advance rational choice theory are primarily involved in shaping the development of that theory by challenging a series of branching hypotheses. Secondarily, they may challenge hypotheses derived from competing theories, other major stems or even separate trees (disciplines).

B. Stages of Methodological Development

Methodological progress in a theory may be assessed by utilizing as a standard of comparison the stages through which more mature theories have developed: ruling theory, working hypothesis, and multiple working hypotheses.[35] These stages represent a progression from defense of favored ideas to strong inference. At each successive stage, empirical evidence assumes a greater role in the evaluation of theoretical statements.

During their formative stage, theories are elaborated and extended to encompass many events and phenomena. Scientists take pride of authorship in the theory and initially seek facts that will support the application of theory to a variety of phenomena. The intellectual offspring becomes an object of affection and is defended against competing ideas. Plausible explanations are adopted as theories and, when rigorously defended, become "ruling theories."[36]

Maternalism leads investigators to ignore facts that are inconsistent with ruling theory, and when challenged, can lead them to actively repress facts that threaten their favored theories. When such repression becomes apparent, improvement is sought in the method of the working hypothesis. The purpose of a working hypothesis has been to challenge favored ideas

35. Chamberlin, *The Method of Multiple Working Hypotheses*, 5 J. Geology 837 (1897).

36. Such affective attachment to a theory should not be confused with Thomas Kuhn's "paradigm." To Kuhn, a paradigm is an overarching set of assumptions about cause and effect relationships; "normal science" (successive experiments or tests) elaborates detailed behavior of phenomena encompassed by a paradigm, for example, in the history of Newtonian mechanics. Unlike those who cling to ruling theories, such scientists may challenge favored hypotheses contained within a paradigm. What remains unchallenged are the, often unrecognized, assumptions about cause and effect relationships (the possibility that Newtonian mechanics fails to account for many physical processes). T. Kuhn, The Structure of Scientific Revolutions (2d ed. 1970).

with facts. Facts are assembled and their relations examined to challenge the hypothesis and to shape an evolving theory. Yet there also is a danger that the working hypothesis may become an intellectual child to which investigators cling, even to the point of defending it with maternalistic passion.

To guard against this tendency, researchers have adopted the method of multiple working hypotheses. It is at this stage that researchers practice strong inference. Multiple working hypotheses divide the maternal affections among several competing hypotheses. Parentage of a family of competing hypotheses promotes impartiality in the investigation of facts. Within a given theory, crucial experiments involving competing hypotheses facilitate progressive exclusion of branches. Although true experiments are seldom possible in natural resource policy analysis, quasi-experimentation, simulation, and other approximations of experimentation provide opportunities to practice the method of multiple working hypotheses.

The land use example presented in the previous section provides an oportunity for testing multiple working hypotheses from within rational choice theory. The first step in conducting a rational choice analysis of the conversion problem is to identify landowners' objectives in holding undeveloped or wild land. One plausible objective is to maximize net returns from an investment. A second objective might be to maximize the utility derived from ownership of wild land, subject to a cost constraint. Either of these objectives would be consistent with rational choice theory.

One could use the theory to deduce testable implications related to each landowner objective.[37] If landowners are motivated by the first objective, then reduced tax assessments should have little effect on conversion rates. This will be especially so when land values are high and owners can realize large profits from development. However, if landowners hold wild land to derive extra-monetary benefits and if costs are a constraint, then tax policy may be an important lever for manipulating conversion rates. Thus rational choice theory can be used to generate contradictory implications regarding the use of tax assessments to control development in urbanizing areas.

In order to test these implications, one would have to specify hypotheses

37. Like economics, rational choice theory uses deductive reasoning to reach particular conclusions. Hypotheses are deduced from general principles that are assumed to be true. The assumption of individual rationality is the cornerstone of rational choice theory. Logical deduction permits the extension of this assumption from market behavior to other aspects of decisionmaking. N. Frohlich & J. Oppenheimer, *supra* note 25, at 3.

38. Attempting to prove a proposition true exemplifies the logical fallacy of affirming the consequent. *See* M. Blaug, The Methodology of Economics 13-14 (1980).

more precisely, define decision rules for hypothesis rejection, develop valid and reliable measures of variables, and select an appropriate set of observations. If an empirical test were conducted and the results indicated that a reduction in assessed valuations was associated with reduced rates of land use conversion, one could conclude that the observed landowners were not motivated by the objective of profit maximization. These results would lend support to the proposition that owners of undeveloped land hold their land to satisfy extra-monetary desires and are subject to a cost constraint. Of course this proposition can never be proven true;[38] but if it survives repeated tests against competing hypotheses, our confidence in it will grow. The results of the initial empirical test would offer decision-makers a tool with which to evaluate tax assessments as a policy instrument. Subsequent tests against competing hypotheses from within rational choice theory would suggest the most promising directions for development of the theory. Such studies might reveal patterns regarding the contexts in which particular kinds of objectives guide behavior. Tests against hypotheses derived from other theories would offer a basis for evaluating competing theories of individual decisionmaking.

The use of strong inference is neither a simple nor an unambiguous process. Many practical problems make hypothesis testing and evaluation of results difficult. Often critics of a particular test will argue that research results reflect inappropriate test conditions (measurement theory, simplifying assumptions, selection of observations) rather than the truth-value of the test hypotheses. Even the most rigorously conducted research will be subjected to such criticisms.[39] But as a body of evidence emerges, the accuracy of the theory will become apparent.

McDavid refers to the approach outlined above as piecemeal crucial testing.[40] The short run objective is to select the best theory in a specific context. In this way, empirical results provide information for policy makers. Accumulation of results from such tests eventually leads to rejection of theories or to development of higher level generalizations that integrate competing theories. In this way policy analysis serves its second objective, the development of social science.

39. This is an important reason that single studies are seldom sufficient to demonstrate that a theory is inadequate. Any empirical test requires a set of auxiliary assumptions or hypotheses regarding test conditions. An important task of research design is to minimize the extent to which questions regarding auxiliary hypotheses interfere with the interpretation of results. For further discussion of the role of auxiliary hypotheses in falsification, see Lakatos, *Falsification and the Methodology of Scientific Research Programmes*, in Criticism and the Growth of Knowledge 91-195 (I. Lakatos & A. Musgrave eds. 1970). For a discussion of these issues related to social science, see M. Blaug *supra* note 38; McDavid, *Crucial Testing for the Study of Complex Institutions*, in Problems of Theory in Policy Analysis (P. Gregg ed. 1976).

40. McDavid, *supra* note 39.

C. Methodological Development of the New Resource Economics

During the first years of the development of the new resource economics, proponents of the paradigm asserted their model, extended it to explain diverse phenomena, and advocated policies consistent with it. For example, in 1975, Baden and Stroup drew on economic theory to argue that privatization of the national forests would contribute to equitable and efficient forest management.[41] During the early 1980s subsequent papers by these and other authors strengthened the argument by integrating elements of property rights economics and public choice theory.[42] They also expanded the substantive range of concerns to include water, wildlife, wilderness, and air as well as other resources.[43] Their papers often used historical data to criticize government management of natural resources and thus to demonstrate the plausibility of their argument against the public sector. These data were used to support an argument rather than to test (and potentially falsify) propositions derived from the new resource economics. Thus early work in this school employed the method of ruling theory.[44]

More recent efforts by the new resource economists have involved hypothesis testing.[45] With few exceptions,[46] these papers have examined only one hypothesis, one derived from the new resource economics, usually asserting that public agencies maximize budgets or that public agencies misallocate resources. Rules for hypothesis rejection are seldom defined and evidence that would disconfirm the working hypothesis is not sought. Thus the current status of research in the new resource eco-

41. Baden & Stroup, *Private Rights, Public Choices, and the Management of National Forests*, 2 W. Wildlands 5 (1975).

42. R. Stroup & J. Baden, *supra* note 26; see also papers in J. Baden & R. Stroup, *supra* note 27.

43. *See supra* note 2. *See also* Cuzan, *A Critique of Collectivist Water Resoureces Planning*, 32 W. Pol. Q. (1979); Johnson, *Energy Resources*, and Baden, *Privatizing Wilderness Lands: The Political Economy of Harmony and Good Will*, both in Private Rights and Public Lands (P. Truluck ed. 1983).

44. Early research conducted by the new resource economists illustrates how ruling theories differ from Kuhn's conception of a "paradigm." (*See supra* note 36.) New resource economists have worked within the paradigm established by neoclassical economists, but seldom sought to falsify hypotheses deduced from this paradigm.

45. Gardner, *Water Pricing and Rent Seeking in California Agriculture*, and Smith, *The Economic Determinants and Consequences of Private and Public Ownership of Local Irrigation Facilities*, both in Water Rights: Scarce Resource Allocation, Bureaucracy, and the Environment (T. Anderson ed. 1983); Johnson, *U.S. Forest Service Policy and Its Budget*, and Libecap, *Regulatory Constraints on Oil and Gas Production on Forest Service and BLM Lands*, both in Forestlands: Public and Private (R. Deacon & M. Johnson eds. 1985).

46. Gisser and Johnson provide an exception; they compare three explanations of the behavior of a regional water district. The authors find that the district's behavior is best explained by viewing it as an entity that "seeks to survive and expand," *Institutional Restrictions on the Transfer of Water Rights and the Survival of an Agency*, in Water Rights 158 (T. Anderson ed. 1983).

nomics is between the stage of ruling theory and the working hypothesis.

The new resource economists have developed a forceful argument in favor of privatizing a spectrum of publicly-owned resources. In doing so they have performed a service by expanding the range of policy options that may be considered. Analysts and decisionmakers now regularly examine policy alternatives that involve market provision of services and market-like arrangements in the public sector. The new resource economists have demonstrated the plausibility of their argument in some contexts. It remains for them to systematically evaluate implications of their model by formulating and testing families of competing hypotheses.

IV. RATIONAL CHOICE THEORY AND NATURAL RESOURCE POLICY ANALYSIS

Rational choice theory lends itself to empirical testing. Its deductive structure facilitates derivation of refutable implications and empirically-based evaluation of the theory.[47] While the new resource economists have not fully exploited this feature, they have used elements of rational choice theory to analyze numerous natural resource problems. In this section, we argue that natural resource analysis will be most productive when it reflects the social constitution of resources and suggest a research strategy for exploiting the analytical insights generated by rational choice theory.

A. Natural Resources

Characteristic concerns of resource policy analysis derive from the social constitution of natural resources. Analysts are accustomed to categorizing resources in a variety of forms. They are fugitive and stationary, renewable and depletable. Some are easily subject to capture by an individual, others not. But, most importantly, analysts have adopted *natural resources* as a social science concept. The idea that natural resource is a dynamic social science concept yields analytical power unavailable to those who see resources as tangible, static substances.

The conventional use of the term *resource* is a prime example of what Whitehead referred to as the "fallacy of misplaced concreteness"—the reification of an abstraction. People often refer to forage, timber, and scenery *as if* these resources were tangible things. Zimmerman was one of the first natural resource policy analysts to reject this common sense view. He suggested the following definition:

> The word "resource" *does not refer to a thing or substance but to a function which a thing or substance may perform or to an operation in which it may take part,* namely, the function or operation

47. *See supra* note 37.

> of attaining a given end such as satisfying a want . . . the word "resource" is an abstraction reflecting human appraisal and relating to a function or operation.[48](emphasis in original)

The false impression that resources are things continues to be one of the greatest obstacles to the advancement of research on natural resources. Unlike tangible objects such as trees, resources such as timber change in response to changes in societal tastes and values or changes in knowledge and technology. New resources emerge and old resources are transformed or disappear with societal changes such as the invention of new wood processing technologies or the emergence of substitutes for raw materials in certain end uses.

Hence, natural resource policy analysis focuses on the functions performed by natural objects or processes. Attributes of natural resources constrain the forms of use and management that are possible; thus consideration of such attributes must be part of policy analysis. The manner in which people use natural resources is also guided by social institutions, especially property arrangements; thus the nature of social institutions is a second focus of natural resource policy analysis.

Theories that address these concerns—attributes of resources and social institutions (especially property arrangements)—are potentially valuable tools for natural resource policy analysis. While the nature of social institutions is a central element of most social theories, the attributes of resources are not. Thus a theory that explicitly addresses such attributes holds the promise of generating unique insights regarding natural resources.

B. Exploiting Rational Choice Theory

The substantive focuses of rational choice theory (collective action, characteristics of goods, institutions) indicate that it may be a useful tool for natural resource analysis. Indeed rational choice theory provides means to address numerous issues that are central to natural resource policy. How are changes in the relative value of various water resources related to changes in water law and in the agencies that administer law and manage water development? How do different tenure rules affect energy development? Rational choice theory provides an analytical framework with which to address questions that relate the nature of resources, institutional arrangements, and resource allocation. To date, this framework has been exploited only minimally.

The new resource economists have been the primary source of applications of rational choice theory to natural resource problems.Their con-

48. E. Zimmerman, World Resources and Industries: A Functional Appraisal of Agriculture and Industrial Materials 7 (1951).

tribution has been limited by their methodological approach. Because their work has not included derivation and testing of multiple working hypotheses, they have presented a narrow perspective on rational choice theory. The theory permits other interpretations. For example, one element of rational choice theory is that individuals are the appropriate unit of analysis. Property rights economists demonstrated the importance of focusing on individuals rather than organizations. Yet much of the new resource economics uses the government bureau as the unit of analysis and asserts that bureaus maximize budgets because bureaucrats are self-interested. Johnson presented some empirical evidence to argue that the Forest Service behaves as a budget maximizing bureau.[49] Johnson followed Niskanen in asserting that utility maximizing bureaucrats will always maximize budgets.[50] Johnson, like Niskanen, offered little empirical or logical support for this assertion. We know that the assertion that managers of private firms maximize personal wealth does not always imply that firms maximize profits. Perhaps bureaus composed of utility and wealth maximizing bureaucrats maximize something other than budgets. Thus there is an opportunity to test competing hypotheses from within the theory. Considerable recent work in rational choice theory has sought to model bureaucracies in the context of different behavioral assumptions.[51] While the budget maximization claim may be true for some bureaus, there is no reason that it need be true of all.

The empirical task is to specify conditions under which it would be true. This effort will be facilitated by attention to a second element of rational choice theory, the presumption that institutional arrangements matter. Not all private firms are the same and not all government bureaus are the same. Rational choice theory tells us that the structural and contextual differences among them are important. Thus analyses ought to examine the rules and procedures that characterize individual bureaus. They create different kinds of incentives. Organizational structures and environments create alternative paths for the maximizing bureaucrat.[52] There is a wealth of scholarship that analyzes resource bureaus.[53] This

49. Johnson, *supra* note 43.

50. W. Niskanen, Jr., Bureaucracy and Representative Government (1971).

51. *See* Bendor and Moe, *An Adaptive Model of Bureaucratic Politics*, 79 Am. Pol. Sci. Rev. (1985); Moe, *The New Economics of Organization*, 28 Am. J. Pol. Sci. (1984); Wood, *Principals, Bureaucrats, and Responsiveness in Clean Air Enforcements*, 82 Am. Pol. Sci. Rev. (1988).

52. J. Wilson, The Politics of Regulation 372 (1980).A. Downs, Inside Bureaucracy (1966). Wilson argued that self-interested bureaucrats may pursue at least three kinds of objectives, career advancement within an agency, political power, and professional stature. Similarly, Downs, arguing from a rational choice perspective, contended that bureaucrats have complex sets of goals and that different goals generate different kinds of behavior. The structure of a particular bureaucracy affects the chances for success and thus the prevalence of each type of bureaucrat.

53. *See, e.g.*, J. Ferejohn, Pork Barrel Politics (1974); H. Kaufman, The Forest Ranger (1960); P. Selznick, TVA and the Grass Roots (1949).

scholarship should be integral to any rational choice analysis of agency behavior.

Another source of competing hypotheses from within rational choice theory is the focus on the nature of goods. The theory offers concepts with which to trace changes in natural resources. What attributes of streams become important when the source of irrigation water gains value as an element of wildlife habitat? How has the resource changed? Are some institutional arrangements appropriate for management of an irrigation system but not of wildlife habitat? Concepts such as costliness of exclusion and jointness of consumption can be used to generate hypotheses that are relevant to these questions.

If policy analysts are to make optimum use of rational choice theory, it will be necessary to clearly define empirical claims and to systematically test them. These tests ought to pit competing branches of rational choice theory against one another, while also challenging basic assumptions by pitting hypotheses derived from rival theories against those of rational choice theory.[54] The tests may employ historical data, quasi-experimental methods, or econometric techniques. But these studies need to clearly define criteria for rejecting hypotheses and then to accept the consequences of the confrontation of data with theoretical claims.

If we are to get the most out of rational choice theory we need to repeatedly challenge basic assumptions when extending the theory to new policy problems or institutional contexts. Rational choice theory readily permits development and testing of multiple working hypotheses. The theory's contribution to policy analysis will increase as we move toward this stage of methodological development.

V. CONCLUSIONS

Our purpose in this paper has been to assess the value of rational choice theory as a tool for resource policy analysis. We have argued that strong inference—the derivation and testing of competing hypotheses—is an appropriate methodological strategy for policy analysis and that rational choice theory can be used in conjunction with this strategy. Furthermore, the parallel concerns of natural resource analysis (attributes of resources,

54. Sproule-Jones, *supra* note 14, has offered an explication of rational choice theory as it relates to natural resources. We agree with him regarding the potential value of rational choice for natural resource analysis. We disagree with Sproule-Jones regarding the appropriate methodology for realizing that potential. Sproule-Jones' primary concern is with making rational choice "impregnable to assaults of rival theories," *id.* at 801. Thus, for Sproule-Jones, testing of multiple working hypotheses generated from within rational choice theory would be an appropriate strategy. His argument implies that empirical tests of contradictory hypotheses derived from rival theories would be inappropriate. In contrast, our objectives relate to useful policy analysis and the development of social science rather than the defense of a single theory. We have argued that these ends are best served by a broadly conceived strategy of strong inference.

social institutions) and of rational choice theory (characteristics of goods, social institutions) offer the possibility of generating important insights.

To date, the bulk of rational choice analyses of natural resource issues has been presented by the new resource economists. These analyses have focused on advocating a set of public policies rather than on testing theoretical claims using strong inference. Two consequences of this method have been the development of policy prescriptions with weak empirical foundations and a narrow interpretation of rational choice theory.

Rational choice theory can be most productively employed through strong inference. By conducting empirical tests of competing hypotheses we build an evidentiary base. We have no illusions that such evidence will resolve arguments about which policies are best. But it will move political science a small step toward consensus on which empirical claims are clearly false. It will also provide information to decisionmakers about what kinds of policies are possible and what their consequences will be.

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