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CONTRACTUAL CHOICE*

THOMAS D. CROCKER**

ON FREE LUNCHES AND FREE MARKETS

Even in its most general and sophisticated form, economic theory postulates the existence of markets in which claims to all place-marked and time-dated commodities, contingent and uncontingent, can be exchanged.¹ That is, markets exist for claims on all goods, in all futures, and at all places. It then follows that any economic agent given its initial endowments, will select one consumption, production, and exchange plan to which it will adhere under all states of nature, for all time, and at all places. Voluntarily chosen predestination from here to Kingdom Come is the fate to which every economic agent subscribes.

The logic of these conclusions is impeccable and is even intuitively reasonable if one assumes, except for unexpurgable randomness, all information is costlessly available to all economic agents, that no scarce resources are employed in identifying and acting upon exchange possibilities, and that once accepted, all obligations are scrupulously observed. In short, if markets are free, then, at least for living generations, there is no conceivable adjustment of exchange, production, or consumption possibilities that could make everybody feel they were better off or at least no worse off. Given a few weak additional assumptions, it can be shown that an economic system employing no more than market prices as allocation instruments will: (1) generate all the information necessary and sufficient for the coordination of all economic agents' production, consumption, and exchange plans; and (2) provide the incentives for each agent to behave in a manner consistent with maximization of the aggregate value of all agents' activities.

The net benefits of the analytical simplifications flowing from economists' revealed preference for the fiction of free markets have been substantial. A powerful analytical engine has been constructed that is capable of explaining a wide range of real phenomena. Nevertheless, a price has been paid. On the one hand, the assumption that the act of assigning resources to their highest valued uses is costless makes the economic decision problem appear economically

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1. See, e.g., K. Arrow and F. Hahn, *General Competitive Analysis* (1972).

trivial. More important perhaps, the assumption of free markets is too restrictive a mode of analysis for the study of institutions and their associated structures of obligations.

If resources can be allocated at no cost, perfect efficiency becomes identified with the equilibrium of a perfectly competitive market, a conclusion that can make it difficult to comprehend the economic basis for the pervasive voluntary adoption of nonmarket modes of allocation. Since with costless allocation the price system that is decentralized in terms of both information and authority can be shown to lead to a perfectly efficient allocation of resources, the existence of other institutions is logically viewed at best as redundant, or worse, inefficient.² If Pareto-relevant losses in welfare exist due to the presence of monopoly or externalities, they are instantaneously eliminated by voluntary agreement. Interference by government is unnecessary. The affected economic agents have an incentive to agree to maximize their joint returns, since it can be shown that the returns of each agent will be at least as great as prior to the agreement.³

Costless allocation and externalities and monopoly are apparently logical contradictions. If in arriving at policy judgments, one accepts the existence of all three, he is justified in concluding at his whim that the market "works" or does not "work." Any statement is consistent with a logical contradiction.

More frequently, the identification of the results of allocation under ubiquitous markets with perfect efficiency has led to a more subtle yet still questionable procedure. In particular, when making prescriptive statements economists have frequently used the results of the price structure that would occur with ubiquitous markets as the highest standard of efficiency against which to compare the results of all existing price structures. Thus, when drawing prescriptive conclusions about monopolistic or externality phenomena, they strive to bring about the results of the price structure associated with a world of ubiquitous markets.⁴ In effect, it is insisted that reality conform to a

2. No attempt will be made here to attach precise meanings to the intuitively obvious but technically vague concepts of decentralization of information and authority. For a thorough attempt to give precise meanings to the concepts, see Koopmans & Montias, *On the Description and Comparison of Economic Systems*, in *Comparison of Economic Systems* 27 (Eckstein, ed. 1971).

3. Whether intended by its authors or not, much of the literature of the 1960's on externalities has been interpreted in precisely this fashion. See, e. g., Whitcomb, *Externalities and Welfare* 14-15 (1972). For an interesting exchange on Buchanan & Stubblebine, *Externality*, 29 *Economica* 371 (1962), a major article whose analysis is frequently thought to coincide with this view, see Shibata, *Pareto-Optimality, Trade and the Pigovian Tax*, 39 *Economica* 190 (1972), and the reply from Buchanan & Stubblebine, *Pareto Optimality and Gains from Trade: A Comment*, 39 *Economica* 203 (1972).

4. Thus, for example, when referring to benefit-cost analysis, Julius Margolis states:

The analyst tries to simulate a perfect and competitive market for the public

state that is economically infeasible in most conceivable circumstances. This seems a rather incautious practice when many of the processes governing voluntary choices among alternative allocation modes and institutional forms appear to be prominent elements of the economic behavior from which economic theory has typically abstracted. The practice has the potential and has in fact probably been used to justify a substantial amount of collective interference in voluntary choice among alternative forms of economic coordination.

To assert that a result is efficient because it is the outcome that would occur with omnipresent markets after having initially made a set of assumptions inexorably leading to the conclusion that a market is the only form of economic cooperation that leads to efficient outcomes is not very enlightening. If markets are in fact costly, this sort of reasoning does not provide any obvious conclusions about the efficiency of markets or any other institution as modes of allocation and economic cooperation. When allocation is costly rather than free, the ranking in efficiency terms of alternative modes in a particular setting may no longer make the market the preferred mode. That is, the market may not be the mode that would be voluntarily chosen. To suggest that an allocation mode represented by nothing other than a price established in a setting where information and authority is highly decentralized will allocate resources in a welfare maximizing manner even though private exchange terms in real allocation systems embody a wide variety of conditional and absolute contractual obligations is to neglect absolutely a wide variety of seemingly important economic phenomena. The efficiency of any institutional form depends not only on the manner in which it allocates its resources but also on the opportunity costs of the resources it consumes in carrying out this allocation. There exists more than one degree of freedom with respect to institutional choice. The purpose of this paper is to present a framework that is at least suggestive of one manner in which the problem of choice among alternative allocation modes might be introduced into economic analysis.⁵

output, estimate the price which would have resulted, and accept this as the shadow price.

See Margolis, *Shadow Prices for Incorrect or Nonexistent Market Values, The Analysis and Evaluation of Public Expenditures: The PPB System*, A Compendium of Papers submitted to the Subcom. on Economy in Government of the Joint Economic Com., Vol. I, 91st Cong., 1st Sess. 533 (1969). It should be noted that Margolis does not subscribe to the procedure of the analyst to whom he refers.

5. The problem of choice among alternative institutional forms has received increasing attention in economics since the early 1960's. *Decision and Organization*, (McGuire & Radner ed. 1972) is a good example of some of this work. However, from the middle 1930's to the early 1960's, R. H. Coase was apparently one of the few who thought the problem to be worthy of analytical attention. Within the general analytical framework of preference rankings, endowments, production possibilities, and exchange possibilities, he was one of the few who did not

THE COSTS OF COORDINATION

The reasons for the organization of economic activity by means other than the decentralization of authority and information are identical to the reasons why any economic activity is ever undertaken. There are expected gains that economic agents feel outweigh the expected costs.

Consider a collection of resource owners who are price takers in all relevant economic modes of cooperation. Assume that these owners are thinking about combining their resources to produce an output, the returns from which they will share in some as yet still to be decided fashion. For example, the owners may be perpetrators of and sufferers from air pollution who are considering ways of allocating the waste disposal abilities of the atmosphere. The method of allocation itself is presumed to be a matter of indifference to the owners; they evaluate alternative methods differently only because different methods are thought to yield different results.

Whether the owners choose to coordinate their activities by means of a multitude of bilateral exchanges or by means of a completely centralized authority that acts as a residual claimant,⁶ the owners will incur costs in their attempts to coordinate their activities with one another. No matter how skillful the owners are in coordinating their activities, some positive amount of some valuable resource must be expended on the coordination process itself.

Coordination costs represent the costs of making implementable and actually implementing the terms of a joint enterprise, whether that enterprise be a simple bilateral exchange or a corporation having a legal life of its own. For our purposes, these costs do not include the costs of information and search. It is assumed that the individual does not face a choice between the discovery of more information about enterprise possibilities and consequences and selection from among the set of possibilities and consequences already known. He deals only with the choice problem that exists given the a priori decision not to allocate additional resources to search. This assumption is made in part because, in the absence of knowledge about the consequences the resource owner desires, it is not at all apparent exactly what it is that

implicitly view exchange possibilities as invariant with respect to institutional arrangements. This is evident in Coase, *The Nature of the Firm*, 4 *Economica* 386 (1937) and Coase, *The Problem of Social Cost*, 3 *J. Law & Econ.* 1 (1960). One might justifiably argue—if one likes to argue about such questions—that Coase's major and lasting contribution is his analytical refurbishing of the economics of institutional design from the dustbin it had been relegated to by the professional disrepute the Institutionalist School fell victim to after World War II.

6. The view of the central manager as a residual claimant originates with Knight. See *Risb, Uncertainty and Profit* 280 (1965).

constitutes "more" information.⁷ The distinction between search costs and coordination costs can be further justified by recognizing the difference between the completeness and the accuracy of flows of information and the incentive to provide undistorted and unfiltered information flows. Information accuracy and completeness can vary independently of incentives if the costs of communication and search are sensitive to different combinations and technologies of information inputs. Nevertheless, there is no particular reason to expect one mode of coordination to have a comparative technological advantage relative to another in the provision of information. However, alternative modes of coordination can have an advantage in providing joint enterprise participants with the incentive to supply the valuable resource of accurate and complete information. Establishing and maintaining these incentives is a problem of coordination, not of search.

Coordination costs are composed of the costs of arriving at an agreement to undertake a joint enterprise and realizing the terms of the agreement. They thus include the costs of higgling and haggling about terms as well as the costs of monitoring the contributions of resource owners and the rewards they receive. Coordination costs are the costs of determining how rewards and costs will be assigned to those resource owners responsible for changes in output in addition to the costs of attempting to ensure that they are assigned in the agreed upon manner.

As Alchian and Demsetz have argued, these costs of coordination appear to take on their greatest significance when there are substantial interactive or nonseparable effects among resource owners.⁸ That is, each resource owner's contribution to enterprise output is not independent of the contributions of other resource owners. Thus a change in the resource contributions of any one owner can affect the output that all other owners are responsible for even when their resource contributions are unchanged. Exact assignment of rewards according to the responsibility for enterprise output requires that rewards be recalculated each time the contribution of one owner changes. Unless a monitor is aware of the strategic decision rules of

7. See J. Marschak & R. Radner, *Economic Theory of Teams* 53-62 (1972) for development of this point. It should also be noted that dismissal of the search problem avoids the severe analytical difficulties caused by the introduction of nonconvexities, a feature of the world that economists approach with some trepidation. The acquisition of information frequently involves a fixed outlay that appears to be more or less independent of the scale of the enterprise in which the information is to be employed.

8. Alchian & Demsetz, *Production, Information Costs, and Economic Organization* 777 Am. Econ. Rev. 62 (1972).

the resource owners, a requirement that this exact assignment be fulfilled would impose severe demands upon enterprise coordination. Under these circumstances, some other indicator of owner output responsibility involving measures of resource contributions under specified conditions is likely to be adopted.

In spite of the difficulties that nonseparability introduces, it is not the sole circumstance in which coordination costs can occur. Coordination costs are frequently high when the monitoring of the input contributions in a production process or the good traded in an exchange process is difficult. Many inputs are simply hard to count in a manner that meets with the approval of all interested resource owners. On the one hand, the informational content of the same measure may differ among owners. Concentrations of an atmospheric pollutant in the parts per billion may be highly meaningful to an epidemiologist but nearly empty of substance to the lay person. The extent to which the latter's vision is obscured is for him likely to be more suggestive. Unless one can show each individual exactly how vision and ambient concentrations are related, a common measure cannot be defined independently of the things that each individual values. The two measures are noncomparable. Even when a particular measure has the identical informational content across all resource owners, coordination costs may still be introduced because some owners derive particular advantage from one measure rather than another measure of the same phenomenon. Consider, for example, the recent tensions between American automobile manufacturers and the U.S. Environmental Protection Agency about emissions sampling for automobiles. Since automobile engines typically generate more pollutants when they are cold, the time interval after ignition over which emissions are averaged clearly makes a difference in calculated average emissions. It is to the advantage of the automobile manufacturers to find reasons for making this time interval as long as possible. Establishment of a sampling time interval that is mutually acceptable to EPA and to the manufacturers requires that both parties expend resources.

As a means of coordination, prices alone appear to perform well enough when resource contributions are easily ascertained and reciprocated by rewards. For example, the spot exchange of two currencies requires no statement of terms other than the exchange ratio. When cardinally measurable, perfectly homogenous commodities such as currencies are exchanged, the parties to the enterprise need only count the quantities exchanged to establish what they have obtained. However, in the case of an enterprise like air pollution control, for example, there can be harsh impediments to initially

tracing the parties responsible for the air pollution, unraveling a measure of what it is that is being called air pollution,⁹ and finally monitoring the contributions of each polluter. In these conditions rules of evidence and procedure are likely to be established for all participants in a joint enterprise. Contingencies will be specified and appropriate responses will be stipulated. In short, a mode of coordination other than the decentralized market in which observed price is the sole coordinating device is likely to be adopted. Objective, easily measured standards of performance will be embraced that may not always be consistent with maximization of the value of output of the joint enterprise under conditions where the coupling of output responsibility and rewards poses only trivial measurement problems. Thus an air pollution control agency might make rules about the type of inputs a polluter can use or a university might employ numbers of publications as the major indicator of faculty performance in both research and teaching.

As Samuelson has shown, the sum of owner incomes in joint enterprises where nonseparability is present will be maximized in a world of costless coordination if and only if the marginal effect of an activity upon an owner's income is equal to the marginal effect of that same activity upon the sum of incomes of all other owners.¹⁰ That is, for total owner incomes to be maximized, the increase in the income of an owner from an activity must not be less than the reduction in the incomes of all other owners. In less obtuse language, this is simply the familiar refrain requiring marginal private gain to be equal to marginal private cost. The problem is the old one of making the private optimum compatible with the collective optimum. In the presence of nonseparability, a set of prices alone is not sufficient to assure compatibility between private and collective optima.¹¹ As for the separability case when, as we have earlier noted, there is no consensus on standards for measuring the flow of resources among owners, prices by themselves will again be insufficient.

In circumstances where there exist coordination costs, the economic problem can be viewed as one of finding a set of rules for owner behavior such that the resource owner's costs and rewards are made less dependent on his joint relation with the other resources

9. Comparisons of ambient air pollutant concentrations over time and space are utterly fruitless unless the sampling procedures and conditions are fully specified. For an interesting review of the many pitfalls, see Schneider, *Sampling Problems in Air Pollution Analysis*, 3 *Environmental Research* 452 (1970).

10. Samuelson, *The Pure Theory of Public Expenditure*, 36 *Rev. of Econ. and Stat.*, 387 (1954).

11. For formal proof, see Baumol & Fabian, *Decomposition, Pricing for Decentralization, and External Economics*, 11 *Management Sci.* 1 (1964).

owners in the enterprise. The partial suppression of the price mechanism reduces the incentive and the opportunity for participants in the enterprise to maximize their rewards at the expense of their fellows. The rewards of the resource owner from the production of the enterprise are made at least in part independent of those of his feasible activities that can impose costs upon his fellows. Separability and common standards of measure are established. If each owner tries to maximize his rewards subject to the constraints imposed by his obligations, the expected value of the enterprise output is maximized, given the owners' stock of information about the state of nature and their utility functions. These obligations serve to make a group of owners behave as if they were a team, i.e., as if they had common objectives. Whether or not these obligations reduce uncertainty about the state of nature, they do introduce regularity and coherence and thus predictability about the behavior of all owners with respect to each other. They define the limits within which owners and their appointed custodians may operate without fear of retribution and they permit owners to exercise greater control over future events. By defining the activities owners may undertake with respect to property objects, they also specify how owners must behave with respect to each other. Contract obligations amount to specifications of acceptability conditions that serve to narrow down the range of possible outcomes. In effect, the owners specify the conditions for a satisfactory outcome and mutually accept any realized outcome that meets these conditions.

When confronted by a decentralized allocation mode in which there are substantial coordination costs, the response of many observers is to "internalize the externalities" by formation of a central authority in whom effective property rights to the jointly used resource would be vested. In addition to its possible alliterative appeal, there is implicit in this response the recognition that the central authority, whether it be a firm or a government bureau, and the market are alternative institutions for the coordination of a collection of resource owners. Within the market, each of the owners acts autonomously, maximizing the value of his objective function subject to the observed market prices that serve more or less imperfectly to coordinate his actions with other resource owners. Within the voluntarily joined firm, each of the owner's actions is directed by central fiat, this authority being established by the mutual agreement of the resource owners in order to maximize the values of their individual objective functions. The authority strives to arrive at agreements with resource owners that will serve to increase the expected rewards of all owners who voluntarily submit to the

direction of the authority. Since the authority is a residual claimant, those entrepreneurs who hold the greatest promise in reducing coordination costs by fostering owner collaboration will attain competitive success.¹² Resource owners may on occasion voluntarily relinquish at least part of their discretion about their use of their own resources in order to reduce coordination costs and thus increase their expected incomes above what they would be if the owners were to act in an autarkic fashion. The market of economic theory texts and the central authority constitute polar forms of voluntary coordination. The choice between one form of coordination and another is determined by which form yields the least inefficient set of activities for the given set of resource owners.¹³

CHOICE AMONG FORMS OF COORDINATION

A framework suitable for representing the owner's choice among alternative forms of coordination is presented in this section. It has long been recognized that the attachment of various obligations to the use of a good affects its observed market price. However, no one seems to have presented a framework that explicitly introduces a variety of obligations into a choice problem.

Any allocation mode or set of obligations is viewed as a specification of who has to obtain whose permission in order for the use of a valuable entity to occur, the form the act of permission must assume, and stipulations as to time, place, and conditions of use, exclusion, and alienation. Given an individual's initial portfolio of obligations, he must decide, given his opportunities, whether a voluntary change in this portfolio will increase its value. The individual can voluntarily commit himself to a wide variety of obligations ranging from complete lifetime servitude to spot contracts that stipulate only the state of the physical good to be exchanged. If exchange is costly and if, in accordance with Lancaster,¹⁴ every good that is exchanged involves physical characteristics and legal obligations, every activity then produces joint outputs. Furthermore, some of the same characteristics and obligations may be attached to more than one good.

An equilibrium means of coordination or institutional structure is one in which a knowledge of the internal observable exchange price for a valuable entity by the members of the institution is sufficient to

12. Knight, *Some Fallacies in the Interpretation of Social Cost*, 38 Q. J. Econ. 582 (1924), and Alchian & Demsetz, *supra* note 8.

13. The view that obligations fostering coordination are voluntarily adopted by initially atomistic, uncollectivized owners in order to exploit potential economic gains is certainly not original. See, e.g., D. Hume, *A Treatise of Human Nature*, 436-59 (1961).

14. Lancaster, *A New Approach to Consumer Theory*, 74 J. Pol. Econ. 132 (1966).

ensure that each individual member's optimum is compatible with the collective optimum. That is, there is no desire by any one owner who has committed his resources to the institution to alter the terms of his contract. An adequate analysis of economic transformation requires an explanation of individual owner choice among alternative combinations of obligations. It requires a framework capable of explaining the complete "deal" that the owner will ask for and provide. As economic theory has always recognized, if owner activities can be costlessly coordinated, then this choice problem is uninteresting in that the equilibrium combination of obligations must always exist. We thus confine our attention to the case where coordination is costly.

Given that the sovereign sees fit to establish and enforce some positive degree obligations that apply to all individuals, voluntary agreements among individuals about their mutual obligations can be viewed as the establishment of a special set of property rights that apply only to the parties to the agreement.¹⁵ A sovereign initially designates the universally applicable property rights.¹⁶ Subsets of individuals are permitted, however, to establish any kind of obligations within the framework of these universal obligations. Thus, even if the universal framework is consistent with a structure that achieves and polices cooperation by means of a multitude of bilateral sales, a wide variety of alternative modes of cooperation is now permitted.

We limit our attention to the choice problem of the owner who must decide upon the obligations he will be willing to ask for and provide in order to join a given institution. That is, the owner must decide which part of his portfolio of obligations to delegate to an institution and which parts to retain for himself. If an owner values self-discretion positively, he bears a cost whenever he foregoes discretion about the use of a resource on which he has obligations.¹⁷ An equilibrium means of coordination is one in which the gains from further owner discretion and further institutional discretion are equal.

15. "A contract between two parties, in proper form and for a legitimate object, constitutes, as it were, a miniature statute." See L. Fuller, *Anatomy of the Law* 71 (1968).

16. Discussion of the collective decision rules employed to determine the nature and domain of the universal obligations will be avoided in this paper. The 10th Amendment to the United States Constitution makes clear the limits of our interest. "The powers not delegated to the United States by the Constitution nor prohibited by it to the States are reserved to the States respectively, or to the people." Our attention is devoted to that residual left "to the people." As the history of U. S. constitutional law demonstrates, the scope of this residual can at any one time have rather fuzzy and vague boundaries.

17. "Discretion" is used to refer to the owner's opportunity to specify the set of alternatives he is willing to consider as well as his opportunity to choose from among a given set of alternatives. Both of these uses of the term encompass the notion that the owner has final authority to make a decision. He cannot be reviewed and reversed by any other individual.

"Mutual coercion mutually agreed upon"¹⁸ will occur if and only if the stipulations of the contract between the owner and the institution do not reduce the present value of the income of either party.

Consider an owner faced with an array of institutions, each of which offers him certain income expectations but requires he accept certain obligations that involve giving up some self-discretion. Let the owner's objective function be

$$(1) \quad \Pi = \sum_i y_i (p_i - r_i - T_i), \quad i = 1, \dots, m$$

where Π is the present value of the owner's expected income and y_i is a resource composed of a unique combination of *physical* characteristics to which the owner is able to attach some realizable, albeit possibly minute, obligations or claims. p_i is the observable selling price of the unique combination of objective physical characteristics that defines the good *and* the obligations that are attached. The r_i are the costs of the inputs necessary to produce a unit of y_i and the T_i are the costs of coordination, i.e., all costs borne by the owner net of the costs of producing the unique combination of physical characteristics represented by y_i . It is assumed that the p_i and the T_i are determined independently of the r_i .

In implicit form, T_i is defined as

$$(2) \quad T_i (z_{1i}, z_{2i}, \dots, z_{ni} ; y_i) = 0, \quad j = 1, \dots, n$$

where the y_i is introduced to account for the possibility that unit coordination costs may differ according to the number of units of the resource involved in the coordination effort. The z 's are realizable obligations that compose the owner's claim on the i^{th} resource. They specify—not necessarily exhaustively—what the owner can do with the resource and what will happen to him if he fails to fulfill his obligations. Thus, for example, if the means of transformation is the air resource in a particular area and the owner is an emitter of air pollutants, the z 's might be obligations in agreements the emitter has arrived at with other parties specifying the timing and character of his emissions. We assume that each obligation can be described by a unique index and that $\partial T_i / \partial z_{ij} \geq 0$. Thus an obligation that brings a deadline for installing pollution control equipment close to the present can be treated as an increase in the obligation and measured as the inverse of the time interval still available for meeting the deadline.

18. Hardin, *The Tragedy of the Commons*, 162 Science 1246 (1968).

Let there exist a relation

$$(3) \quad P_i = f_i(z_{ij}, y_i),$$

where $\partial p_i / \partial z_{ij} \geq 0$. Unlike the standard analysis, these observable p_i need not be constant in a competitive market. Only the market value of the combination of the p_i and the contract obligations must be constant.

A particular value of z_{ij} is arrived at in negotiations and ultimately realized in reality by the application of a set of coordination inputs that we will denote by x_{ijv} , where $v = 1, \dots, q$. Examples of coordination inputs are accounting systems and staffs, jails, office managers, telephones, time studies experts, monitoring equipment, and all of what might be termed the transactions industry. The following implicit function is used to describe the transformation of the q coordination inputs into a realizable obligation attached to a particular resource.

$$(4) \quad g_i(x_{ijv}, z_{ij}, y_i) = 0.$$

This is the production function that underlies (3). Henceforth it will simply be denoted by g_i . In effect, the owner is viewed as combining coordination inputs and traditional inputs to produce a joint output of realizable obligations and a resource having objective physical characteristics.

Let the price of the v^{th} coordination input be denoted by t_v . The owner's costs are then

$$(5) \quad k_i = y_i r_i + y_i T_i,$$

where

$$(6) \quad y_i T_i = \sum_v t_v x_{ijv}.$$

$$(7) \quad \Pi = \sum_i y_i (p_i - r_i) - \sum_v t_v x_{ijv} + \lambda_i g_i.$$

Assuming that r_i is invariant and that $\partial \pi / \partial y_i = 0$, the first-order conditions for maximizing (7) are

$$(8) \quad \frac{\partial \pi}{\partial x_{ijv}} = -t_v + \frac{\lambda_i \partial g_i}{\partial x_{ijv}} = 0, \quad \forall v;$$

$$(9) \quad \frac{\partial \pi}{\partial z_{ij}} = y_i \frac{\partial p_i}{\partial z_{ij}} + \lambda_i \frac{\partial g_i}{\partial z_{ij}} = 0 \quad \forall j;$$

$$(10) \quad \frac{\partial \pi}{\partial y_i} = p_i - r_i + \lambda_i \frac{\partial g_i}{\partial y_i} = 0 \quad \forall i$$

$$(11) \quad \frac{\partial \pi}{\partial \lambda} = g_i = 0.$$

Consider two coordination inputs, a and c , an abacus and a computer. From the set of equations the general form of which is (8), we obtain

$$(12) \quad \frac{t_a}{t_c} = \frac{\partial g_i / \partial x_{ija}}{\partial g_i / \partial x_{ijc}} = - \frac{\partial x_{ijc}}{\partial x_{ija}}.$$

This is similar to the standard decision rule regarding input prices and marginal rates of input substitution. However, in this case, the $\partial g_i / \partial x_{ijv}$ involve more than the change in objective output quantity with respect to a change in the (coordination) inputs. The changes in the obligations the owner is prepared to assume are included as well.

Moving to the set of equations (9), we have

$$(13) \quad y_i \frac{\partial p_i}{\partial z_{ij}} = - \lambda_i \frac{\partial g_{ij}}{\partial z_{ij}}$$

or

$$(14) \quad \frac{\partial p_i}{\partial z_{ij}} = \frac{-\lambda_i \partial g_{ij}}{y_i \partial z_{ij}}.$$

It can be shown that¹⁹

$$(15) \quad \frac{\partial p_i}{\partial z_{ij}} = \frac{\partial T_i}{\partial z_{ij}}.$$

19. Substituting (3) into (1), we have

$$\Pi = \sum_i y_i [f_i(z_{ij}, y_i) - r_i - T_i].$$

One of the first-order conditions for maximizing this expression is

$$\frac{\partial \Pi}{\partial z_{ij}} = \sum_i y_i \left[\frac{\partial p_i}{\partial z_{ij}} - \frac{\partial T_i}{\partial z_{ij}} \right] = 0$$

or

$$\frac{\partial p_i}{\partial z_{ij}} = \frac{\partial T_i}{\partial z_{ij}}.$$

Another first-order condition is

$$\frac{\partial \Pi}{\partial y_i} = \sum_i y_i \left[\frac{\partial p_i}{\partial y_i} - \frac{\partial r_i}{\partial y_i} - \frac{\partial T_i}{\partial y_i} \right] + p_i - r_i - T_i = 0$$

that, upon the assumption that the marginal revenues and costs of producing the objective physical output are constant, reduces to

$$p_i = r_i - T_i + \frac{y_i \partial T_i}{\partial y_i}.$$

If marginal coordination costs are high and further attempts at coordination contribute little or nothing to market price, some obligations will not be adopted. That is, nonexhaustive stipulation of obligations for all contingencies is possible.

Performing the obvious substitution, (9) becomes

$$(16) \quad \frac{\partial T_i}{\partial z_{ij}} = \frac{-\lambda_i \partial g_i}{y_i \partial z_{ij}}$$

Thus for two obligations, r and s , we can obtain the decision

$$(17) \quad \frac{-\partial z_{ir}}{\partial z_{is}} = \frac{\partial p_i / \partial z_{is}}{\partial p_i / \partial z_{ir}} = \frac{\partial T_i / \partial z_{is}}{\partial T_i / \partial z_{ir}} = \frac{-\partial z_{ir}}{\partial z_{is}} .$$

That is, the marginal rate of transformation between the obligations must be equal to their marginal rate of substitution, or, in pecuniary terms, the ratio of marginal revenues from changes in obligations must be equal to the ratio of marginal coordination costs.

Finally, from (10), we obtain

$$(18) \quad p_i - r_i = \frac{-\lambda_i \partial g_i}{\partial y_i}$$

which can be written as²⁰

$$(19) \quad p_i - r_i = T_i + \frac{y_i \partial T_i}{\partial y_i} = \frac{-\lambda_i \partial g_i}{\partial y_i} .$$

This, given that contractual stipulations are held constant, is the familiar marginal revenue equals marginal cost condition. However, in this case it is the effect of changed provision of the objective resource upon coordination costs and revenues that is of interest.

Assuming that each coordination input exhibits a diminishing marginal product in realizable obligations and that the obligations and the objective resource have decreasing returns to scale in the net income maximizing combination of coordination inputs, the usual second-order conditions will be fulfilled.

SOME IMPLICATIONS

At least some of the possibilities for extending the analysis of the previous section are fairly obvious. For example, the introduction for several owners of demand and supply relations for resources and obligations would permit the simultaneous mutual determination of observable price, combinations of obligations, and resource quantities.

20. *Id.*

One can hold the number of resource owners fixed or permit entry and one can analyze the comparative static effects of exogenously induced changes in combinations of obligations. Some interesting propositions might fall from these and other extensions. Nevertheless, the heart of the analysis would remain the explanation of choice among alternative modes of voluntary coordination as this choice is expressed through owner decisions on combinations of obligations and their relation to observable price. The remarks in this section will be limited to some of the more obvious implications of the analysis of the previous section and its plausible extensions.

Perhaps the most obvious implication that could be generated by a modest extension of the previous analysis is that there is no such thing as a universally preferable mode of economic coordination. Given that coordination inputs are costly and that these costs differ among resource owners and settings, a variety of efficient modes of coordination can exist simultaneously. The set of obligations that is voluntarily chosen by an individual is dependent on the relative costs of producing each realizable obligation. Equilibrium sets of obligations are not exogenously given but are instead arrived at as an integral part of the voluntary exchange process. To the extent then that an exchange involves obligations, the observed exchange price of the good is not an adequate indicator of the true exchange value.²¹ This point is as valid for objective physical inputs as for outputs. The equation of observed price with marginal value product or marginal cost is not even a necessary condition for efficiency.

The above propositions are relevant to the continuing discussion about the economic propriety of alternative means of inhibiting environmental degradation. Rather strong advocacy positions have been taken up. The debate has concentrated upon the desirability of market like effluent charges versus direct regulation where various combinations of effluent standards, input controls, etc., are to be employed. At least among economists, the effluent charge position has been rather widely accepted, primarily because it is thought to provide the greatest number of degrees of freedom for the effluent perpetrator to choose a cost minimizing abatement procedure. For example, Kneese and Bower state that "despite some shortcomings and problems, the effluent charge approach is the one most likely to result in efficient arrangements."²² Freeman and Haveman assert, "At an abstract level the logic of the argument in favor of residuals

21. For empirical support of this statement, see Jesse & Johnson, *An Analysis of Vegetable Contracts*, 52 Am. J. Agric. Econ. 545 (1970).

22. Kneese & Bower, *Managing Water Quality: Economics, Technology, Institutions*, 173 (1968).

charges is impeccable. Even at the practical level of policy implementation, the case for such a strategy is strong indeed."²³

It may very well be true in a wide variety of circumstances that "the other alternative of reproducing the effects of a private market by charging a price or fee to those who would use the common property resource"²⁴ is in fact the economic mode of coordination. It is an empirical question whether a charge or a fee will be by itself the economic mode. The question cannot be settled by appealing to the deduced attributes of economic outcomes in a world of costless coordination. Furthermore, one is unaccustomed hearing economists who usually think and prescribe in terms of a little bit less or a little bit more make policy suggestions deduced from an imaginary world that contains only two choices. One choice involves only market like fees and (presumably) a fee simple absolute set of property obligations. The other posits a world in which there are only property obligations and zero observed money prices. The debate about effluent charges versus direct regulation has treated differences in degree as if they were differences in kind. An effort to discover a decision rule that is capable of pointing to the efficient combination of contract or property right obligations and associated observable money price in any given circumstance is perhaps more likely to yield useful results. If coordination inputs are in fact costly and if these costs differ among individuals, circumstances, and places, an insistence that the mode of coordination to be employed in environmental quality situations always be the same is fundamentally no different than insisting that all institutions in all situations be identically organized.

In the absence of a decision rule capable of pointing to the efficient combination of obligations and observable money price in any given circumstance, economists might consider searching for those alterations in obligations that appear likely to lead to reductions in the costs of coordination. However, if the alternative alterations are to be evaluated by means of traditional benefit-cost analysis, the concerns of this paper appear to raise some complications. The fundamental point of the paper is that the value of an owner's claim to a valuable entity is a function of the owner's realizable obligations. So-called externality problems can thus be viewed as deciding whether or not to alter the domain of an owner's obligations about the use of a resource. As earlier noted, most such alteration proposals also suggest the introduction of a central authority in whom the obligations removed from the

23. Freeman & Haveman, *Residuals Charges for Pollution Control: A Policy Evaluation*, 177 *Science* 322 (1972).

24. *Id.* at 323.

previous owners would be vested. Even if this central authority is benevolent and is aware that a price structure corresponding to a world of ubiquitous markets may not be efficient, it may still err if it attempts to make its choices employing the price structure corresponding to a world where owner coordination costs are minimized. This is because the set of obligations faced by the central authority will usually differ substantially from the obligations faced by the other owners if only because the authority is usually a government agency that is not permitted directly to appropriate any pecuniary benefits. Thus the costs of one activity relative to another will differ between the authority and the other owners. Therefore if the authority is to act as the embodiment of the other owners by choosing the set of activities maximizing the combined value of the entity to these owners, it must itself face a price structure given its own obligations that will cause it to choose this set of activities. Use of the price structure relevant to the other owners may cause it to choose an inefficient set of activities.

Benefit-cost analysis as usually practiced cannot be expected to tell the policy maker what to do. It cannot be treated as a means of optimization. At best, it can do no more than provide the policy maker some clarifying information on the consequences of his choices for those whose price structure is represented in the analysis. Any optimization must be performed by the policy maker with reference to his own obligations. If an economic efficiency criterion is to be employed in public policy making, "politics" cannot be separated from economics.