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ABSTRACT

This paper is addressed to the student already familiar with basic economic terms and concepts. It analyzes some existing policy alternatives by which sociopolitical units can attempt to modify environmental behavior. The primary objective of the paper is to construct a theoretical model of probabilistic effects that an effluent charge has on an industry. Application of a portion of the model is given, along with an evaluation of the completed tasks by specifying additional assumptions, limitations, and aspects needing further study. References are given. (Author/MA)

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A CONCEPTUAL ANALYSIS OF THE ECONOMIC EFFECTS OF AN EFFLUENT CHARGE ON AN INDUSTRY

--an exemplary environmental problem-solving and policy development aid designed for instructional purposes

by

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PREFACE

> The resource policymaker or administrator must organize information about both the natural *and* the social systems, notwithstanding the complexity of each, into a form that permits reasoned decision among alternative actions. He must do this, moreover, at two levels: *first*, in the selection of alternatives to be examined, which is itself a decision process shaped by political, economic, and institutional constraints; and *second*, in the aggregation of data showing the implications of each option examined. *His unique competence is his ability to sift out the elements in each system that are important to a particular decision context, and to integrate them in such a way as to illuminate the implications of choice for values affected in both systems.* (Andrews, 1972, emphasis mine).

The following inquiry is an example of the kind of "sifting" and "integrating" (within an economic framework) called for by Professor Andrews. Addressed to the student already familiar with basic economic terms and concepts, this paper analyzes some existing policy alternatives by which socio-political units can attempt to modify environmental behavior.

CONTENTS

INTRODUCTION

Purpose

The primary objective of this inquiry is to construct a theoretical model of probablistic effects that an effluent charge has on an industry. Additional objectives are to make an exemplary application of a portion of the model and to evaluate the completed tasks by specifying additional assumptions, limitations, and aspects needing further study. Effluents into water courses will be used as our industrial example.

Significant questions might be posed, such as (a) How does an industry's behavior differ, in the long-run, after the imposition of an effluent charge when contrasted to before the imposition of the charge? (b) What economic functions and relationships within the industry are altered as a consequence of a charge? or (c) Does an industry's behavior vary according to differing water quality goals?

Delimitations

This analysis is delimited to embrace only those factors and variables normally associated with "ideal" market conditions. Also, because a water industry model was selected, and because water quality decisions are best made with long-ranged horizons (e.g., 20 years), only the long-ranged consequences on an industry are considered (Dorcey, 1970). The reader also must realize that an effluent charge is but one means of attaining levels of water quality. Other means are discussed by Kneese and Bower (1968). A further delimitation places the theoretical industry under the jurisdiction of an agency imposing equal effluent requirements on every member of that industry. Also, the method of implementation of the effluent charge is not considered but has been discussed by Dorcey (1970) and Johnson (1967). Monopolies are also omitted from this inquiry.

GUIDING PRINCIPLES

Beyond the usual economic principles operative in a market system, the following principles are applicable to this paper:

1. Externalities should be internalized.
2. Damages to water resources should be assessed in terms of marginal damages.
3. An effluent charge system should be couched within, and take advantage of, the conventional functions of price theory (Kneese and Bower, 1968).
4. Effluent charges should be calculated that reflect the incremental external costs that the discharge imposes upon the whole water resource system (Kneese and Bower, 1968).
5. The goal of an effluent charge should be to economically force a firm and its parent industry to behave in certain patterns.
6. Damages and costs should be quantified in incremental terms (Kneese and Bower, 1968).
7. An effluent standard should be considered in light of the overall goals of water quality for the stream to which the outfall contributes (Kneese and Bower, 1968).
8. Striving for a "standard" of water quality versus the "optimization" of water quality should be considered within the parameters of the water resource basin.
9. Effluent discharge should be specified in terms of quantities (lbs., tons, etc.) of pollutants rather than percentages of outfall (Kneese and Bower, 1968).
10. The level of water quality desired should be treated as the dependent variable.
11. Water quality values should be related to the adjacent land values.
12. For purposes of calculating effluent charges, a firm's production costs should be estimated in terms of the average of the marginal costs of the firms involved.
13. Attempts at improved water quality should be viewed as essentially shifts in property rights (Crocker and Rogers, 1971).

THEORETICAL MODELS

The purpose of this section is to model three important functional relationships and principles as they express the consequences of effluent charges. The first two models contrast the differences between (a) applying an effluent charge to all levels of water quality and (b) applying the charge only to undesirable discharges above certain imposed standards. The third model (c) traces the effects of discharge cost through a total industry, given the delimitations mentioned earlier. Figures 1, 2, and 3 should be referred to, respectively.

Water Quality Optimization Model

A predictive model for water quality "optimization" is shown in Figure 1. Regardless of the method of implementation, discussed by Dorcey (1970) or Johnson (1967), an efficient condition of water quality is expressed as the satisfaction of marginal conditions; that is, from a theory of welfare economics point of view, water quality should be enhanced to the point where the marginal cost of affecting water quality levels has also risen. Figure 1, therefore, expresses the optimal level of waste abatement as OX (Dorcey, 1970).

INSERT FIGURE 1 HERE

However, as Dorcey states, it is almost impossible to calculate at this time the damage and costs as functions of units of wastes withheld from water resources. Determination of relevant marginal conditions therefore cannot be attained. A solution lies in the establishment of water quality standards.

Water Quality Standard Model

The establishment of water quality standards simplifies the attainment of certain effluent levels. As shown in Figure 2, the damage function is completely inelastic. This represents the applied standard and may be used in marginal analysis. As Dorcey (1970) indicates, this assumption means that infinite benefits accrue from improving water quality up to the standard, after which the benefits become zero. The quantity of waste that must be withheld is represented by OX in Figure 2. Effluent charges are such that they begin above this inelastic curve. Any firm operating above the standard will be charged accordingly. It should be understood, moreover, that the setting of a standard implies that a stream of benefits are extant (Dorcey, 1970). Any firm discharging excessive effluent into a stream will have added costs, and the assumption is made that firms in our hypothetical industry are subject to effluent charges.

INSERT FIGURE 2 HERE

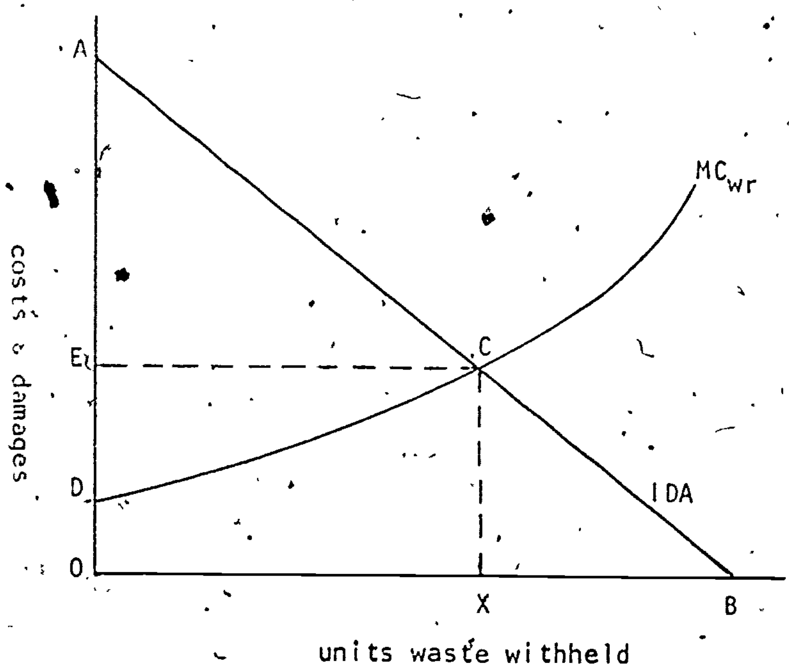

Figure 1: Water Quality Optimization Model

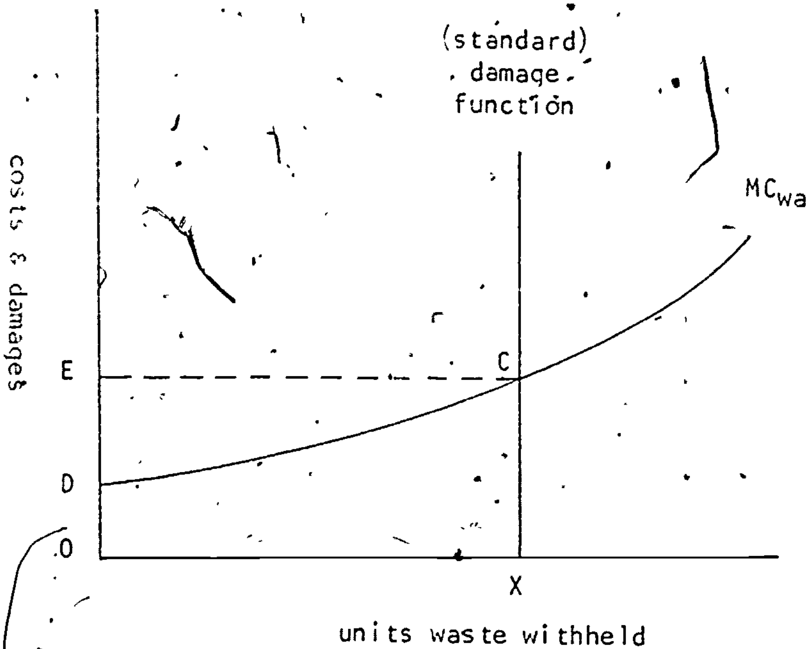

Figure 2: Water Quality Standard Model

Effects on a Competitive Industry

An effluent charge implies that incremental benefits accrue from waste reduction. When wastes are not reduced then the appropriate firms are charged for their use of public resources. These costs have no corresponding direct benefit to the firms. Collectively they change the nature of the entire industry, especially if they continue over long periods of time which we have assumed to be the case. What is a probablistic reaction of an industry to these additional costs?

Figure 3 illustrates a theoretical industry model. The assumption is made that there is a proportional increase between quantity of production output and the amount of discharged pollutants. Also, since effluent charges are tax deductible operating expenses, then the firms of the industry will only consider the net charge as a cost influencing their behavior (Dorcey, 1970). Furthermore, firms are going to equate the marginal costs between the cost of cleaning up wastes and the costs of polluting (the effluent charges). They will not clean up when it is cheaper to pay to pollute. It must be understood that the purpose of an effluent charge at the outset is to induce a certain level of water quality; therefore, to induce the needed level the charges must have sufficient clout to change behavior. In other words, in response to the fee which is based on marginal damages, the outfall effluent is decreased by the perpetrator until the cost of additional reduction equals the effluent charge. Theoretically, the polluter must assume a cost equal to the water damage he has created.

INSERT FIGURE 3 HERE

On the firm level, the effluent charge will mean an increased marginal cost and average cost since each unit will cost more to produce. The effluent charge is assumed to be directly related to the quantity of output. Each unit will therefore have an increase and, in turn, increase the average cost. Since firms are subject to the market price (P_1 in Figure 3), an increase in firm costs will imply a drop in production because of the rule of producing where marginal cost equals marginal revenue.

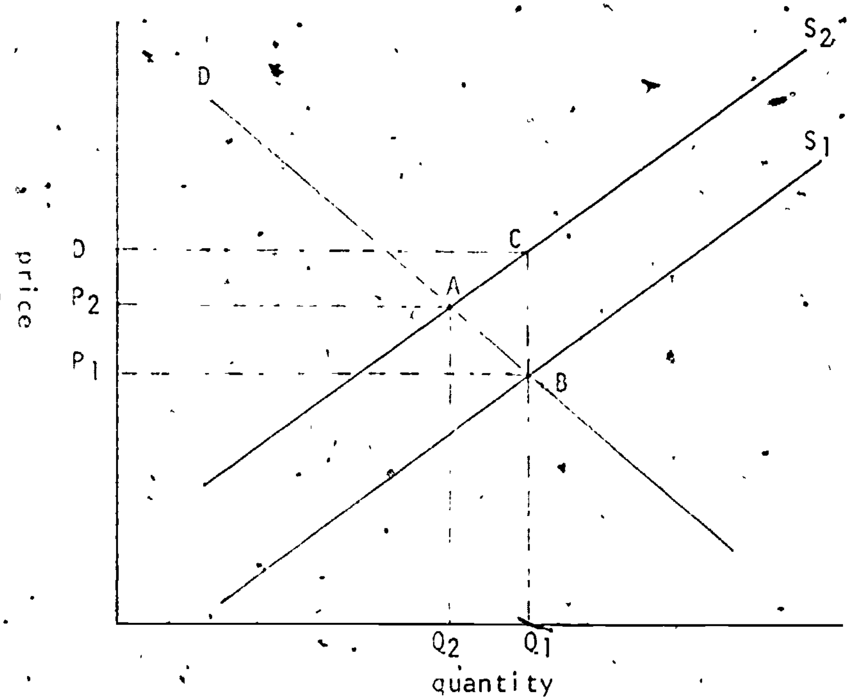

Figure 3: Competitive Industry Model

A reduction in output for the firms will have the cumulative effect of shifting the supply curve of the industry from S_1 to S_2 (Figure 3). This upward and to the left shift reflects the reduced production (hence supply) and will therefore tend to increase price toward a new equilibrium (A).

It is important to note that there has been an increase in price from P_1 to P_2 which reflects the result of the effluent charge. The total shift in costs, however, is greater than the costs passed on with an increase in price. Therefore, the producer and consumer will each bear its part of the cost of the effluent charge.

In essence, the consumer is now paying for benefits gained from clean water, and the producer is paying to use the water resource. The producer, with his increase in production costs, must now produce less at a higher price in order to compensate. Hence, the market mechanism begins to equilibriate (Figure 3). The only theoretical way in which all effluent charge costs could be passed on to the customer would be if the industry's demand curve were totally inelastic, which it was not.

If industry could pass on all effluent charge costs to the customers, then it would not particularly care about paying the imposed fees. However, an increased price does effect business by reducing product consumption.

DISCUSSION

Additional Assumptions

In the determination and use of effluent charges, other assumptions should be brought forth for careful review. It was a rather strong assumption that regulatory agencies have sufficient scope to internalize the major external effluent damages and costs (Kneese and Bower, 1968). Also, not all taxing agencies desire to obtain maximum net benefits from their jurisdictions, for they are often purely political bodies paying little attention to efficiency matters (Kneese and Bower, 1968). The assumption was also made that the damaged parties and the damagers could not reconcile their differences through direct negotiation. Hence, the public agency reflected the claims of individuals who might have been inconvenienced by a firm (Kneese and Bower, 1968).

Given the desirability of the goal of minimization of the cost of water quality management, the application of the effluent charge requires less information than other known methods. The effluent charge [illegible] assumes a linear function and nearly additive relationships among specific waste substances. In combination the unique substances may be synergistic and therefore place serious limitations on the additive-type increase of the typical effluent charge (Kneese and Bower, 1968; Crocker and Rogers, 1971).

In order for effluent charges to have predictable effects on an industry, managerial decisions must be made in conventional styles. Because of increased public pressure, management is sometimes forced to move in directions which apparently cannot be easily converted into pecuniary values. The cost of a public image is often difficult to calculate, but nevertheless may show up in the long-run if the company fails to abate pollution.

Limitations

The key limitation to the theoretical approach and hypothetical solution to the goals of water quality via the effluent charge is that the problem has been viewed principally from an "efficiency" viewpoint. The problems of "equity" must also be broached. The omission of equity considerations was an important limitation of this brief exemplary analysis.

The goal of the effluent charge is to attain certain levels of water quality. Many firms because of their unusual costs structures may be unable to abate pollution and might therefore have to continue to pay charges. A great many firms paying charges produces revenue which may or may not be aimed at cleaner water. Effluent charges, therefore, may never entirely lead us to the goal for which they were intended.

Many of the benefits from water are derived from recreation and esthetic values and therefore only accrue to those who "consume" these benefits. The equibility of such benefit allocation may be questioned (Kneese and Bower, 1968).

Further Research

The economic state of an industry before the application of a charge, versus the state after a charge has been imposed over a specified period of time, could be cast into a research model. This model could be the base for not only theoretical models but also empirical models. Additional research needs are to review actual case studies to further examine the consistency between theory and actual behavior. Both theory and overt behavior are important (Johnson, 1967), especially in environmental problem-solving and policy development.

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APPENDIX

AN EXAMPLARY PROJECT PROPOSAL

The purposes of this proposal brief are to (a) state the policy area under analysis, (b) outline how I intend to approach the area, and (c) list a few key bibliographical sources related to the area.

The policy area: The Economic Effects of an Effluent Tax on an Industry.

The approach:

(1) to peruse the literature listed below with the intention of conceptualizing the policy area by specifying the variables and principles (relationships) operative,

(2) to construct a working model of the alternative sequential events initiated by an effluent tax on an industry,

(3) to attempt to make an exemplary application of a portion of the model to a hypothetical industry,

(4) to evaluate the above tasks (1-3) by specifying additional assumptions, limitations, and problems needing further investigation.

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