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EFFLUENT CHARGES AND POLITICAL REALITIES–A QUALIFICATION

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ABSTRACT

For some time now, economists concerned with the pollution problem have espoused the effluent charge as the "in principle" solution to environmental degradation. This paper examines the potential of the effluent charge ideas as a *practical, workable* policy. Specifically, the authors recognize that any potential environmental policy must pass certain political acceptability tests before it may be implemented and investigate the impact on the construction of an optimal effluent charge.

During the winter of 1972-73, New York City was faced with a low-sulfur residual fuel-oil shortage and employed a financial incentive scheme to encourage the use of environmentally desirable fuels. This paper examines the implications of this approach and demonstrates that the existence of a legally specified "principle of fairness" effectively *prohibited* the construction of an optimal effluent charge. Moreover, the authors show that an analytically identical "fairness" stipulation is a central feature of the Pure Air Tax Act of 1972 and extend the results of this broader policy issue.

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Introduction

For nearly a half-century, economists have argued that appropriately constructed tax penalties could serve effectively as a means of environmental protection. However, in both recent environmental policy literature and prominent public decision forums, there continues to exist considerable question as to the desirability of effluent charges in terms of their efficiency and impact on the economy. [1, 2] In view of the Pure Air Tax Act of 1972, which stipulates that a national sulfur tax-penalty approach is to be implemented on January 1, 1976, the urgency for a resolution of this issue is now intense. Fortunately, (given this eleventh hour position) our recent energy difficulties have provided us with a social experiment from which at least a partial assessment of the operational character of such a penalty approach can be made. Specifically, during the winter of 1972 New York City employed a financial incentive scheme to encourage the use of environmentally desirable fuels, and this paper will address an interesting political-economic qualification to the traditional arguments that surfaced from this experience.

Confronted with shortages of low-sulfur content residual fuel oil which conformed with the existing legally enforceable air-quality standards, the New York City authorities were forced to relax hard-won, air-quality standards during the winter of 1972. In order to minimize damage to ambient environment, yet avoid the potential welfare loss which would be derived from strict enforcement of the law (i.e., cold homes and brownouts), a general variance to the sulfur-content regulations was granted jointly with a financial surcharge. This paper will examine the implications of this approach and demonstrate that the existence of a legally specified "principle of fairness" effectively *prohibited* the construction of an optimal effluent charge. Moreover, it should be recognized that an analytically identical "fairness" stipulation is a central feature of the Pure Air Tax Act of 1972, and thus our results have profound insight on this broader policy issue.

The New York City Experience

Sulfur emissions in New York City were significantly reduced following compliance with a series of laws passed since 1967 that mandated the maximum allowable sulfur content of residual oil to be 0.3 per cent by weight. By 1972, the City's air quality conformed, in most instances, to the federal standards. During the winter of 1972, due to a general shortage on the world oil market of such fuels, various jobbers, suppliers, and terminal operators formally requested relaxation of the sulfur-content restrictions. The importance of these requests for variances or exceptions to existing air-pollution-control laws can only be appreciated when it is recognized that residual fuel oil represents about fifty percent of New York City's total annual energy consumption during the heating season; and, without question, the City is more heavily dependent on residual oil than any other metropolitan area of the country.

Fortunately, local laws concerning variances were vaguely worded and permitted a rather novel interpretation. Conditions were attached to the variances that required a surcharge be paid to the City in an amount equal to the total number of barrels of nonconforming oil multiplied by seventy-five cents for those barrels containing between 0.3 and one per cent sulfur, and multiplied by two dollars for those barrels containing between one and two per cent sulfur. In order to avoid legal challenge, the surcharge was intended to set the supply price of nonconforming oil at the same price as the relatively low-sulfur substitutes. In effect, this general variance coupled with a financial surcharge, opened the market for nonconforming oil while providing an incentive to supply more nearly conforming grades of residual fuel oil.

The variance strategy, however, due to both political and legal considerations was constrained by a fairness principle. Specifically, differential air shed management reflecting the diverse meteorological characteristics was not permitted. Thus all consumers of residual fuel oil faced the same effluent rate structure regardless of their location within the New York City air shed.[1]

Analysis

In this section we will analyze the economic character of an effluent charge system whose structure is politically-legally confined as in New York City. Specifically, we will demonstrate that such ethically satisfying restrictions effectively thwart the realization of the efficiency properties as generally conceived in the literature.

Although the affected parties in the New York City experience included a composite of households, hospitals, and schools as well as firms, for simplicity of exposition the model presented in this note is based on the theory of the firm. Moreover, in order to minimize notational complexity, we posit a competitive industry and focus on two firms located in two distant air sheds whose effluents impinge on each other's costs. Each firm is assumed to be engaged in the production of only one good, q. The cost function for the firms are: [3, 4]

$$C_1 = C_1(q_1, E_2) \text{ and } C_2 = C_2(q_2, E_1)$$

[1] It should be recognized that this restriction is not confined to New York City but well-founded in Western ethical principles. First, the most basic criterion for designing a tax structure in the U.S. is the principle of equity. Second, an unequal rate structure would tend to disrupt the current dispersion of industry and thus alter regional tax bases and employment opportunities. Finally, a rate structure violating the fairness condition would be political dynamite and, therefore, few elected representatives would espouse it.

where C_1 is the total cost incurred by firm i at output q_i and when subjected to effluent E_j from firm j. Also, we posit that $\partial C_i/\partial q_i > 0$ and $\partial C_i/\partial E_j > 0$, for $i = 1,2; i \neq j$; and $j = 1,2$. The effluent will be viewed as a by-product of the production process, [5] that is, $E_i = E_i(q_i)$; where $\partial E_i/\partial q_i > 0$, $i = 1,2$. P denotes the competitive market price of q, and we assume there are no externalities in the consumption of q. By assumption, firm i attempts to choose a $\hat{q}_i$ which maximizes

$$\Pi_i = Pq_i - C_i(q_i,E_j),$$

which requires that $\hat{q}_i$ satisfy

$$P = \partial C_i/\partial q_i, \; i = 1,2 \tag{1}$$

i.e., the firm should set price equal to marginal cost.[2]

Employing the standard result that in a competitive setting the social optimum is attained by maximizing the net value of the production effort, society's objective can be written as:

$$\text{MAX } S = P(q_i + q_2) - C^1(q_1,E_2) - C^2(q_2,E_1),$$

hence, the socially optimal outputs, $q_1{}^*$ and $q_2{}^*$ must satisfy

$$P = \frac{\partial C_1}{\partial q_1} + \frac{\partial C_2}{\partial E_1}\frac{\partial E_1}{\partial q_1}, \text{ and}$$

$$P = \frac{\partial C_2}{\partial q_2} + \frac{\partial C_1}{\partial E_2}\frac{\partial E_2}{\partial q_2} \tag{2}$$

where

$\dfrac{\partial C_j}{\partial E_i}$ is the marginal damage measure

As usual, we may observe from comparison of (1) and (2), that in the presence of cost effective externalities the competitive market is socially inefficient; that is,

$$q_1 \neq q_1{}^* \text{ and } q_2 \neq q_2{}^*. \tag{3}$$

Inequalities (3) are the *raison d'etre* of the classical tax-subsidy approach, and the reasoning behind this approach is well accepted. Equation (1) must now be adjusted so they yield the same solutions as equation (2). To this end, define z_i as a per-unit-of-effluent tax on firm i, and the firm's maximum is thus altered to

[2] The second order sufficient condition is that $\frac{\partial}{\partial q_i}\frac{\partial C_i}{\partial q_i} > 0$, i.e., the marginal cost curve must be rising at its point of intersection with the horizontal price line. Here, and elsewhere in the paper, we shall simply assume the second order conditions are satisfied. This amounts to assuming the various functions are traditionally shaped.

$$\text{MAX } \Pi_i = Pq_i - C_i(q_i,E_j) - z_i E_i$$

or $i = 1,2; j = 1,2; i \neq j$. The resultant optimizing outputs, call them $\bar{q}_i$, satisfy

$$P = \frac{\partial C_i}{\partial q_i} + z_i \frac{\partial E_i}{\partial q_i}, i = 1,2 \tag{4}$$

Therefore, by setting $z_i = \partial C_2/\partial E_i$, the equality of $\bar{q}_i$ and q_i^* is assured.

Let us now impose the fairness criterion as developed above via the following definitions:

DEFINITION 1

Assuming the physical character of the effluents are identical, our *fairness criterion* can be imposed symbolically by requiring that $z_i = z_j$. That is, if the emissions are identical so must the tax penalties (i.e., it is only the characteristics of your discharge that matters, not whether your name is i or j).

DEFINITION 2

An externality is *symmetrically reciprocal* if

$$\frac{\partial C_i}{\partial E_j} = \frac{\partial C_j}{\partial E_i}$$

The sense of this definition is that the effluents inflict damages reciprocally and identically.

THEOREM (Necessary Condition for Fairness)

A necessary condition for our fairness criterion to be satisfied by a socially optimal effluent charge system is that the external linkage be symmetrically reciprocal.

PROOF

A socially optimal effluent charge was characterized above by

$$z_i = \frac{\partial C_j}{\partial E_i}$$

Our fairness criterion requires that $z_i = z_j$, therefore,

$$\frac{\partial C_j}{\partial E_i} = \frac{\partial C_i}{\partial E_j}$$

Hence, our external linkages must be symmetrically reciprocal by Definition 2.

This demonstrates that our seemingly innocuous fairness requirement is a severe restriction on the efficiency of effluent charges. Indeed, the theorem argues that, in general, effluent charges which satisfy this condition will never be efficient since uni-directional external linkages are prohibited. The fact that there exist established meteorological patterns precludes this constrained effluent tax from efficiently guiding production in the Pigouvian tradition.

The objection might be raised that these firms produce physically distinct effluents. Certainly, in a pure sense this renders inapplicable the preceding arguments. However, even when the effluents differ in physical character there will tend to be an overriding fairness consideration in the effluent rate setting process, and the potency of this influence will determine how closely the implications of the above theorem will be approximated. Moreover, one must recognize that for reasons of proximity to markets and raw resources, climatic and geographic considerations, firms of the same industry often locate in the same area. Thus, if symmetric reciprocity does not prevail, an effluent charge policy cannot yield an optimal resource allocation when subject to our fairness criterion.

Conclusions

We have argued that the real meaning of "political economy" when applied to effluent charge schemes, seriously affects this well-accepted economic paradigm. Since the marginal damage function depends on a variety of meteorological, topological, demographic, and other socio-economic factors, the optimum user charge must vary within a given environmental management region in order to achieve the efficiency characteristics normally flaunted in the literature. However, the restrictions mandated by the political-legal setting in New York City and the cited Federal legislation refuse to recognize these differences and hence prohibit the realization of an optimal resource allocation pattern.

It must be emphasized, however, that our results do *not* suggest that a user-charge policy should not be implemented. We've simply demonstrated that the optimality normally accredited to such an approach to resource management is rather fragile with respect to politically constrained operation.

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