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Taxing the Monopolistic Polluter: A Reconsideration

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Serie B - Nr. 14

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Taxing the Monopolistic Polluter: A Reconsideration

Alfred Endres

I. Introduction

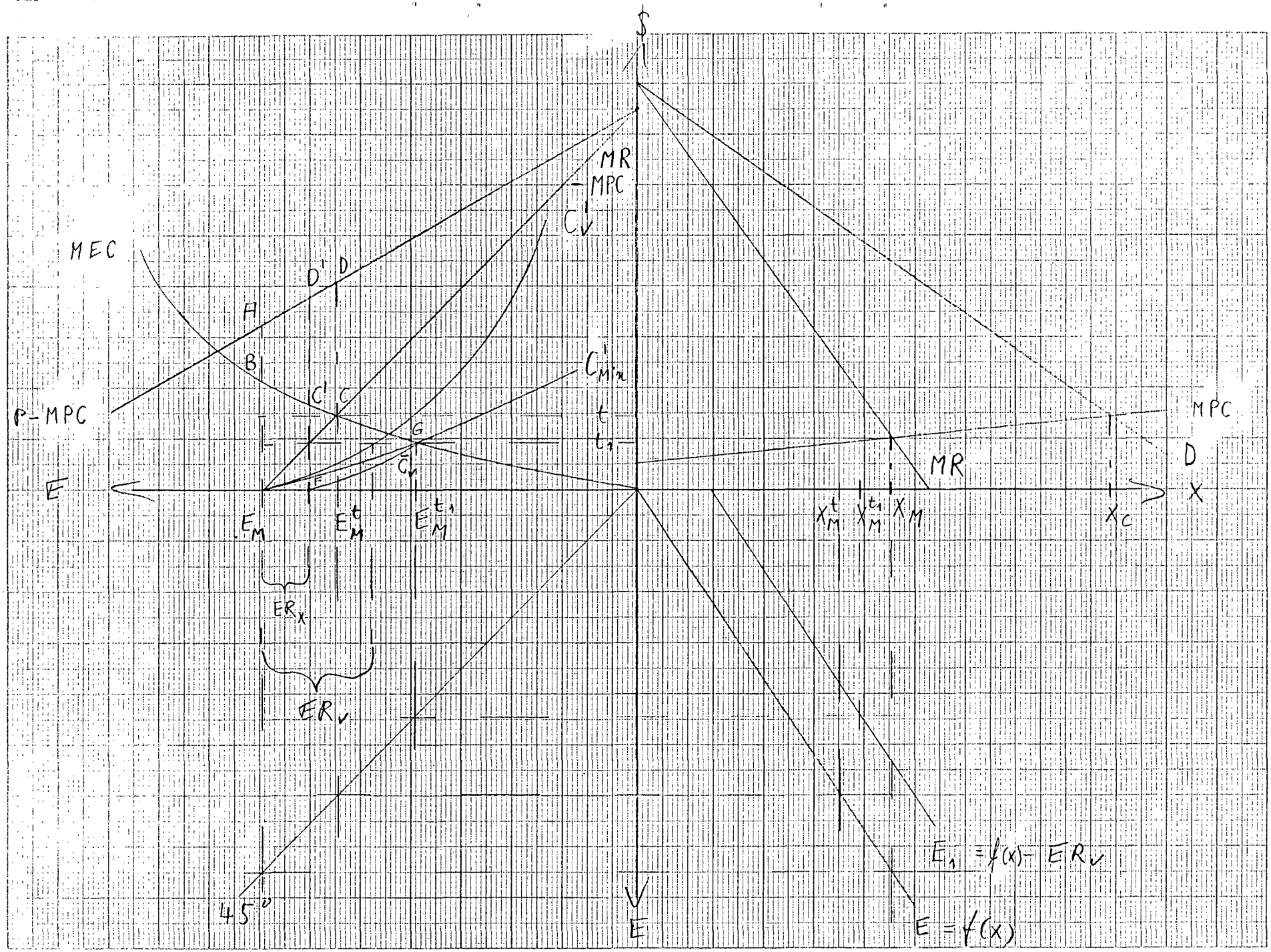
A profit maximizing monopolistic polluter causes two kinds of market failure. As a monopolist he underproduces, exploiting the divergency between price and marginal revenue. As a polluter he overproduces, ignoring parts of the cost caused by his activity.

In this paper, the response of a monopolistic polluter to the application of environmental policy is examined.[1] A constant per unit emission tax serves as the example of an environmental policy instrument. In paragraph II, it is assumed that output reduction is the only feasible way to reduce pollution. In paragraph III, the effects of additional means for pollution control are considered. Paragraphs IV and V provide conclusions and a summary.

II. Output Reduction as the Sole Means for Pollution Control

It has been shown that if in the monopolistic equilibrium, unmodified by environmental policy, the market failure caused by market power is stronger than the one caused by the externality--i.e. if the difference between price (P) and marginal private cost (MPC) is bigger than marginal external cost (MEC)--the imposition of an emission tax reduces social welfare.[2] This can be illustrated in Figure 1. In Figure 1, x_M is the monopolistic equilibrium quantity. The emission function $E = f(x)$ indicates that the level of emissions produced in this situation is E_M.[3]

The monopolist's marginal costs to reduce emissions (by output reduction) are defined by the difference between marginal revenue (MR) and marginal private cost.[4] Consider any emission tax, t.[5] If t is levied, the monopolist will react by reducing pollution to an amount E_M^t, defined by the equality of the tax rate and the marginal cost of pollution control. The level of output produced in this new equilibrium is x_M^t.



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Given no income effects and second best problems, the welfare effects of the emission tax can be easily assessed.[6] The essence of the matter is a comparison between the consumers' evaluation of the quantity $(x_M - x_M^t)$ of goods, no longer produced, the private cost saved due to this cut in output and the external damage avoided by the emission reduction associated to the output reduction. In terms of Figure 1, these effects are illustrated by the difference between the area under the (P-MPC)-curve and the area under the MEC-curve within the limits of the pre-tax equilibrium emission level E_M and the post-tax level E_M^t. Thus, the net effect of taxing the monopolistic polluter turns out to be a social loss illustrated by the area ABCD in Figure 1.

This result has been interpreted as dismantling the Pigouvian tradition by limiting its applicability to the competitive case. If the Pigouvian tradition is dismantled, however, so is any other tradition. Whether an emission level E_M^t is achieved by levying a tax t, a Coasian bargain (with MR-MPC as the "supply curve" and MEC as the "demand curve" for pollution reduction) or by governmental regulation, the welfare implications are the same.

III. Additional Means for Pollution Control

Before drawing policy conclusions, however, the more realistic case of the polluter having means of pollution control other than output reduction should be examined.

Assume, the polluter may install some additional device, e.g. a filter, with marginal operating cost c_v'.[7] Again the monopolistic polluter will respond to a given tax rate by abating pollution wherever this is cheaper than paying the tax. Moreover, the monopolist will apply the cost minimal mix of his two abatement methods, filter application and output reduction. It follows that the two methods will be used to an extent such that their marginal costs are equal to each other and to the tax rate. This situation is illustrated in

Figure 1.

C'_{Min} is the marginal minimum pollution abatement cost curve, generated by horizontally aggregating the cost curves for the two abatement methods, MR-MPC and C'_v. Again, the emission tax under consideration is chosen to be defined by the equality of marginal abatement cost and marginal external cost. The monopolistic polluter will react to the imposition of this tax, t_1, by reducing the emissions from E_M to E_M^t. This total amount of emission reduction is brought about by reducing an amount of ER_x by output reduction and an amount of ER_v by applying the additional method. The latter of course changes the relationship between output and emissions defined by the emission function, from $E = f(x)$ to $E_1 = f(x) - ER_v$. Thus, the quantity of output produced, when emissions of E_M^{t1} are generated is $X_M^{t_1}$ in Figure 1.

Now, consider the welfare implications of this adjustment behavior.

The loss in consumers' evaluation due to the output reduction, net of the private resources saved can be illustrated by the area under the (P-MPC)-curve within the limits of E_M and E_M-ER_x. Net of the external damage avoided, this leads to a social loss of output reduction ABC'D' in Figure 1. This loss has to be compared with the impact of the additional abatement method on social welfare. The benefits of the additional device are illustrated by the area under the MEC-curve within the limits(E_M-ER_x) and $E_M^{t_1}$, the costs by the area under the C'_v curve within the limits E_M and E_M-ER_v. The net benefit of the additional pollution abatement device is shown as C'EF in Figure 1.[8]

The desirability of taxing the monopolistic polluter depends on whether the benefits of applying the additional device compensate for the losses of output reduction, i.e. in Figure 1, whether ABC'D' $\gtrless$ C'EF. Of course, the magnitude of the two effects cannot be assessed in this qualitative analysis. Obviously, the result depends on the relative costs of the available abatement

means. The relatively cheaper the mean other than output reduction is, the better are the chances to improve social welfare by applying environmental policy, even in the case of a monopolistic polluter with P-MPC > MEC in the first place.

Clearly, this is no refutation of Buchanan's results, because allowing for additional means for pollution control, the assumptions used here are different from his and after all, the result given above is an ambiguous one. Nevertheless, some important conclusions can be drawn from this simple analysis.

IV. Conclusions

1. If the efficient way to reduce pollution is to mix different abatement methods, the idea of two kinds of market failure compensating each other in the case of a monopolistic polluter looses much of its appeal: Even if the two market failures would be exactly equal in the first place (P-MPC = MEC), the allocation would not be efficient because the monopolist would, without environmental policy applied, have no incentive to use any resources in abatement methods other than output reduction.[9]

2. One might argue that the analysis given suggests a selective approach towards polluters with market power: Effluent charges or other policies could be advocated if, in the particular case, sufficiently cheap additional devices for pollution control seem to be feasible and policy abstinence could be favoured if this is not so. That, however, could be a dangerous approach. Whether a firm is flexible with respect to pollution abatement techniques depends upon whether it invested in resources to find such means in the past. Without being confronted with internalization instruments, there is no incentive for a firm to make any such investment. Levying a tax, on the other hand, gives an incentive for the firms to develop and apply new abatement techniques.[10] Thus, imposing a tax induces a process which increases the chance that the conditions for positive welfare effects of taxation are met.

3. The analysis suggests that it is in the interest not only of the polluters but as well of the society not to introduce environmental policy instruments as a shock, but as a measure firms can anticipate and have time to adjust to, technologically. Only then, they can meet environmental requirements without relying too much on output reduction as the immediately feasible pollution control method.

4. These conclusions suggest that improving social welfare by environmental policy in the case of a monopolistic polluter whose market power is stronger than his externality generation is not a priori impossible, as widely believed in the literature.

Opposed to the view of environmental policy as an instrument to increase social welfare, underlying the analysis given above, environmental policy is interpreted by some authors as an instrument of achieving a predetermined level of environmental quality at minimum cost.[11] The analysis given above suggests that from this point of view emission taxes are less promising than believed in the literature:

It is generally accepted that emission taxes--even though missing pareto optimality when market power is involved--are able to achieve a given target level of emissions at minimum cost, whatsoever the market structure in the polluting industries may be.[12]

Indeed, it was shown above, that the monopolist, confronted with an emission tax minimizes abatement costs. This is true however, only in a sense different from the interpretation in the literature.

The cost calculated by the monopolist determining the best mix of all abatement methods is different from society's cost. Even if we assume that the monopolist has no market power as a demander[13] in the market for the additional abatement devices, things are different for output reduction as a means for pollution control. The monopolist is defined by the fact that

his valuation of output is different from society's. If he reduces output marginally, the cost of this pollution control activity is MR-MPC to him but P-MPC to society. Thus, the cost minimizing mix of pollution abatement methods means different things to the monopolist and the society.

This can be illustrated at the example of reducing pollution from E_M to $E_M^{t_1}$ in Figure 1.[14] As we have established above, the monopolist would achieve this level of pollution by applying the two abatement methods at levels ER_x and ER_v. The society, however, taking c_v' and P-MPC as the relevant costs would find it cost minimal to achieve $E_M^{t_1}$, starting with E_M, by applying the additional device exclusively. Because, in the example of Figure 1 (P-MPC) > c_v' holds for all levels of E between E_M and $E_M^{t_1}$, society would want no output reduction to be applied at all.

Thus, by reducing the externality by output reduction the monopolist gives rise to a second externality, in addition to pollution. He does not take into account all the costs of this method and therefore overapplies it from the society's point of view.[15] Taking this view of the issue, the borderline between externality and market power as two different causes of market failure does not seem to be as clear as it used to be.[16]

From the result given above, it follows immediately that a related property of effluent charges, generally taken for granted, does not persist if there are polluters with market power:

In the competitive case, an emission tax manages to split up a given reduction of total pollution among several polluters such that the abatement costs summed over all polluters are minimized. This is due to the fact that the adjustments of all firms lead to the result of all the individual marginal abatement costs of the firms being equal to each other and to the tax rate. Since, in the competitive case, all firms calculate the true (society's)

marginal abatement cost, this leads to an overall cost minimum.

This is not the case, when some of the polluters have market power. Here, the emission tax will lead to a split up of the total emission reduction among the individual firms, in which the marginal abatement costs calculated by the firms are equal to each other and the tax rate. But this is not a condition for social cost minimization since the costs calculated are not identical to the true costs for firms with market power.

V. Summary

1. Given output reduction as the sole means for pollution control, any emission charge on a profit maximizing monopolistic polluter leads to welfare losses in the case of the difference between price and marginal private costs exceeding the marginal external costs in the firm's unregulated equilibrium.

2. If additional pollution abatement methods are feasible, however, the welfare effects of taxing the monopolistic polluter depend on the relative costs of the various methods. Dynamic considerations should be taken into account, when a decision on environmental policy application is made.

3. Emission taxes, designed to achieve a predetermined "acceptable" level of pollution do not induce a monopolistic polluter to use the mix of abatement methods which minimizes social abatement cost. Accordingly, they do in general not achieve the socially cost minimizing distribution of pollution reduction among several polluters either, when market power is present.

Notes

1) Monopolistic polluters with objectives other than profit maximization are analyzed by A.R. Shepherd [9].

2) See J.M. Buchanan [5], whose analysis has been widely accepted in the literature.

3) In E_M, (P-MPC) > MEC holds true.

4) In Figure 1, MR-MPC and the other variables in the second quadrant are shown as functions of E rather than X. Since the emission function is monotonously increasing, this does not cause any problems.

5) In Figure 1, t is chosen to be defined by the equality of marginal external cost and marginal abatement cost.

6) The procedure applied here is analogous to the one given by J.M. Buchanan, [5], p. 176.

7) The additional device is assumed to generate no pollution of its own.

8) For convenience of exposition in Figure 1, to show the net benefit of filter application, its cost curve C_v' is shifted to the right by ER_x to $\bar{C}_v'$, unifying the relevant integration limits of the MEC and C_v' curves.

9) See A. Endres [6].

10) See L. Orr [7].

11) See e.g. W.J. Baumol, W.E. Oates [2]. P.H. Aranson, T.A. Ferrar, and P.G. Sassone [1], p. 12, somewhat overstating the case, call the first view the "economic approach" and the second one the "political approach".

12) See e.g. W.J. Baumol, W.E. Oates, [3], p. 71-75.

13) Monopsony power is examined by A.R. Shepherd [9].

14) $E_M^{t_1}$ is chosen to be the target level of pollution for convenience of exposition, only.

15) Subsidies, "tax forgiveness", etc. on output may help to correct this failure (See A.R. Shepherd [9], p. 35/36).

16) Approaches unifying the theories of different causes of market failure are suggested by S.P. Schatz [8] and H. Bonus [3].

References

[1] P.H. Aranson, T.A. Ferrar, P.G. Sassone, Pigouvian Policies in Closed Behavioral Systems, Public Choice, Vol. 33 (December 1978), pp. 1-26

[2] W.J. Baumol, W.E. Oates, The Use of Standards and Prices for Protection of the Environment, Swedish Journal of Economics, Vol. 73 (March 1971), pp. 42-54

[3] W.J. Baumol, W.E. Oates, The Theory of Environmental Policy, Englewood Cliffs, 1975.

[4] H. Bonus, Offentliche Guter und der Offentlichkeitsgrad von Gutern, Zeitschrift fur die gesamte Staatswissenschaft, Vol. 136 (March 1980), forthcoming.

[5] J.M. Buchanan, External Diseconomies, Corrective Taxes and Market Structure, American Economic Review, Vol. 59 (March 1969) pp. 174-177.

[6] A. Endres, Monopoly Power as a Means for Pollution Control? Journal of Industrial Economics, Vol. 27 (December 1978), pp. 185-187.

[7] L. Orr, Incentive for Innovation as the Basis for Effluent Charge Strategy, American Economic Review, Vol. 66 (May 1976), pp. 441-447.

[8] S.P. Schatz, Externalities, Divergencies, and the Profitability Criterion, Quarterly Review of Economics and Business, Vol. 13 (Winter 1973), pp. 19-26

[9] A.R. Shepherd, Corrective Taxes Under Monopoly, The Quarterly Review of Economics and Business, Vol. 12 (Summer 1972), pp. 33-38

Abstract

A. Endres, Taxing the Monopolistic Polluter: A Reconsideration

The response of a monopolistic polluter to the imposition of an emission tax and its welfare implications are examined. The cases of output reduction as the sole means for pollution control and of additional means being feasible are considered. It turns out that in the second case the tax may increase social welfare even in the case of a firm whose market power is more distorting than its externality generation. The tax, however, is unable to achieve a predetermined target level of pollution at minimum social cost in the case of a monopolistic polluter.