THE EFFECTS OF ECONOMIC INCENTIVES IN CONTROLLING POLLUTION IN THE SOUTH AFRICAN LEATHER INDUSTRY

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Pollution of the environment is becoming an increasingly serious problem. A large contributor to this is industry which generates effluent as a by-product of its production process. Two methods of controlling the pollution generated by industry are the so-called “command and control” techniques and economic incentives. In theory, economic incentives promise a more economically efficient and equitable means of pollution control. This paper sets out to ascertain whether this would hold in practice by applying environmental economic theory to the practical problem of controlling the effluent generated by one particular industry, viz the South African leather industry.

1. INTRODUCTION

The leather industry is important to both the South African economy as a whole and to the agricultural sector in particular by utilising a by-product of livestock farming namely the skins and hides of slaughtered animals. However, a potential problem facing the South African leather industry, and one that has already confronted similar industries in the developed regions of Europe and the United States, is the threat of forced closure due to the environmental damage caused by the effluent generated by the leather
industry’s production process. This has already lead to a number of firms having to close down in the above mentioned regions (Jackson-Moss, 1995; Rose, 1995).

Environmental economic theory claims that the most economically efficient and equitable means of reducing pollution to some predetermined level is through the use of economic incentives as opposed to the so-called “command and control” techniques (Seneca & Taussig, 1974; Baumol & Oates, 1988; Pearce & Turner, 1991). By equitable is meant that the cost of the externality caused by the production of a good be borne by the producers and consumers of the product.

The aim of the paper is to investigate the promise offered by environmental economic theory by applying the theory to a practical situation, viz controlling the effluent generated by the leather industry to some predetermined level. It must, however, be noted that this study looks at two hypothetical leather firms discharging effluent into a body of water. It does not, therefore, take into account the interaction, especially in terms of the trading of market permits, amongst all firms in all industries. It does, however, give a realistic look at the practical application of the theory by using real data on the actual cost and reduction in effluent strength.

2. ECONOMIC THEORY OF POLLUTION CONTROL

There are a number of ways of controlling pollution. These include moral suasion, education, environmental bonds, command and control techniques and economic incentives.

Controlling pollution by making use of command and control methods involves directives to individual decision makers prohibiting them from exceeding some specified level (Baumol & Oates, 1988). There are disadvantages in using command and control measures. Firstly, they are not an economically efficient means of pollution control because, if all firms, regardless of their individual cost of control, are required to limit pollution by the same amount, the pollution reduction will not be done at a minimum cost to society. Furthermore, polluters are not allowed the freedom to decide how best to control the pollution they cause. Secondly, they are not an equitable means of pollution control because the burden of research and development costs into new technology lies with the State rather than with the polluter.

An alternative to command and control techniques in controlling pollution is the use of economic incentives. “Economic incentives attach a cost which is
determined either by the authorities or the market, to polluting activities. This cost is related to damages suffered as a result of the externalities resulting from the acting parties’ activities” (Stauth & Baskind, 1992). There are a number of advantages in using economic incentives instead of command and control methods to protect the environment. Economic incentives can be shown to be more economically efficient. They do not interfere directly in the internal operations of entrepreneurs and greater flexibility is allowed in meeting environmental objectives. Most importantly, firms for whom the cost of limiting environmentally damaging activities is lowest will do so first or to a greater degree than those whose cost of controlling pollution is greater.

3. DATA DESCRIPTION

The most difficult aspect of this study proved to be that of obtaining data on the leather firms’ costs of treatment. Although data was sought from a number of firms it was found that all only had a vague idea of what their total costs of treatment are. This necessitated using treatment processes of two hypothetical firms cited in “A guide to wastewater management in the tanning and fellmongering industries” (WRC, 1987). The firms, a fellmongery and a chrome tannery, were chosen both because a detailed outline of the treatment process and the reduction of the effluent strength after each stage is provided. The treatment process above was broken down into its various components. Quotations on the cost of the mechanical components were obtained from a commercial supplier of plant items. The civil costs are based on estimates from a civil engineer. All other costs are based on estimates from the Leather Industries Research Institute (L.I.R.I.).

The costs of the two firms and the reduction of effluent strength after each stage of treatment can be summarised as follows:

Table 1: Total abatement costs and effluent strengths of firms 1 and 2.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Firm 1 (TAC) (R)</th>
<th>Firm 2 (TAC) (R)</th>
<th>Effluent Strength 1 COD (kg)</th>
<th>Effluent Strength 2 COD (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>103,84</td>
<td>120,96</td>
<td>4500</td>
<td>4800</td>
</tr>
<tr>
<td>1</td>
<td>183,43</td>
<td>233,05</td>
<td>3550</td>
<td>3376</td>
</tr>
<tr>
<td>2</td>
<td>402,29</td>
<td>545,82</td>
<td>2336</td>
<td>3220</td>
</tr>
<tr>
<td>3</td>
<td>837,83</td>
<td>1,144,20</td>
<td>630</td>
<td>960</td>
</tr>
</tbody>
</table>

4 See Mowat, 1996 for full details of the derivation of these costs
The above data may then be used to derive the Total and Marginal Abatement Cost curves for the respective firms.

4. PRACTICAL APPLICATION OF ECONOMIC THEORY TO POLLUTION CONTROL

Before applying the data to the environmental economic theory, a number of assumptions need to be made, viz:

1. the two firms make up the leather industry;

2. the strength of the effluent is measured by its chemical oxygen demand (COD). There may be other pollutants present in the effluent but they are not taken into account;

3. the predetermined maximum level of effluent that can be discharged each day is 5 850 kilograms of COD; and if the cost of the treatment is the same as a charge or the price of a permit, firms will prefer to treat. (The need for this assumption is to avoid the problem of an indeterminate equilibrium which arises from the “stepped” nature of the marginal abatement cost (MAC) curves).

Where a standard for compliance is initiated, the regulating authority informs the firms of the appropriate reduction in pollution to meet the standard. If all firms are required to limit pollution by the same amount, the pollution reduction will not be done at a minimum cost to society. Assume, (derived from the data presented in table 1), that the regulator states that the overall strength of the effluent must be reduced to 5 850 kg of COD and therefore commands each firm to cut their effluent strength to 2 925 kg. The cost of the economy as a whole would be the cost to firm 1 plus the cost to firm 2 of cutting their respective effluent strengths to the stipulated levels. Firm 1 would have to undertake stages 1 and 2 of its treatment process and firm 2 would need to do all three stages of treatment. The overall cost of using standards to achieve the predetermined level of effluent strength would be R1 546; R402 for firm 1 and R1 144 for firm 2.

The imposition of taxes or the payment of subsidies to reduce the levels of pollution leads to the same outcome. The use of taxes or subsidies is a lower cost solution to the abatement problem than the use of standards. If the regulating authority wants to obtain the same overall optimal level of effluent as under a system of standards and assuming they have perfect knowledge of the relevant cost functions, the authority sets a charge (or offers a subsidy) of
18.03 cents per kilogram of COD discharged (or not discharged). Both firms should treat until the MAC of treatment equal the charge or subsidy. Therefore firm 1 will respond by undertaking stages 1 and 2 and thereby reducing the strength of its effluent by 2 164 kg to 2 336 kg. Firm 2 would only undertake stage 1 and reduce the strength by 1 424 kg to 3 376 kg. The overall strength is therefore 5 712 kg which is within the desired level of effluent strength. The cost of achieving the standard under a system of charges or subsidies has been firm 1’s treatment cost of R402 plus firm 2’s cost of R233 for a total cost of R635.

Theory maintains that the use of marketable permits will lead to the same least cost solution to controlling pollution as charges or subsidies. It should be noted that the assumption that the regulating authorities have perfect knowledge of the firms relative cost functions is highly unlikely to hold in practice. The consequence of this would be that the charge would have to be set on a trial and error basis. This process is not costless. Marketable permits, however, have the advantage of reducing the uncertainty and adjustment costs found in setting charges and subsidies.

The regulating authority can directly restrict the strength of the effluent by the number of permits it issues. To reduce the effluent to the same optimal strength it would therefore issue 5 850 permits (each permit would allow the holder to discharge 1 kg of COD per day) Given that the sum of the MAC curves is the industry demand curve for permits and that the authorities supply 5 850 permits, the price per permit would be 18.03 cents. At this price the firms would act in the same manner as they would under a system of charges or subsidies. Polluters with high abatement costs (firm 2) will prefer to buy permits while low abatement cost firms (firm 1) will prefer to sell permits in favour of abatement.

While it can be seen that the actual cost of reducing pollution to a predetermined level is the same for charges, subsidies and marketable permits, it could be argued that the latter are the most economically efficient. The reason for this is because they do not include the costs of trying to set a charge or subsidy on a trial and error basis. This method of setting a charge would be even more costly than the theory envisages, given the ‘stepped’ nature of the MAC curves. Furthermore, marketable permits also take into account economic growth and inflation, automatically adjust to new entrants and allow standards to be varied with comparative ease.
5. CONCLUSIONS

While this study is narrow in scope, it is encouraging in so much as it would seem, in this particular application, to confirm the theoretical promise that economic incentives are the least cost solution to the abatement problem, when compared to a system of standards. Furthermore, it suggests that market permits, because of their lack of search costs, are the most economically efficient of the economic incentives looked at. It would nonetheless be necessary to do more research in this field as the theory is not tailor made for all practical situations. Further evidence of the viability of economic incentives could, however, encourage wider use by policy makers.

REFERENCES


