MICROECONOMIC CONSEQUENCES OF INSTALLING ELECTROSTATIC PRECIPITATORS ON A SULPHURIC ACID PLANT TO REDUCE EMISSIONS OF SO_2 AND SO_3

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OPSOMMING:

Volgens tradisionele ekonomiese teorie is daar regverdiging vir die owerhede om in die vryemarkekonomie in te meng deur lugbesoedelingstandaarde neer te lê en toe te sien dat hulle uitgevoer en gehandhaaf word. In die algemeen aanvaar 'n nywerheid wat hoë besoedelvlakke veroorsaak dat stappe gedoen moet word om die hoeveelheid besoedeling te verminder, maar maatskappye kan ernstige finansiële probleme ondervind om aan die standaarde wat deur die owerheid neergelê word, te voldoen. Hierdie probleme kan versag word deur die owerhede, deur die betrokke firmas toe te laat om die totale waardevermindering van die besoedelingverminderingtoerusting in die eerste bedryfsjaar in te reken. Daar is sterk ekonomiese argumente ter ondersteuning van die begrip dat nie-produktiewe besoedelingverminderingstoerusting anders behandel word as produksietoerusting ten opsigte van die waardeverminderingstempo.

SYNOPSIS:

According to traditional economic theory, there is full justification for government authorities to interfere in the free market economy by setting down air pollution standards and seeing that they are implemented and maintained.

In the main, an industry that causes high levels of pollution accepts that steps must be taken to reduce the amount of pollution, but individual companies in the industry can suffer serious financial problems in complying with government imposed standards. These problems can be alleviated by the authorities by allowing the companies concerned to depreciate the abatement equipment *fully* in the first year of operation.

There are cogent economic arguments in support of the concept that non-productive pollution abatement equipment be treated differently to production equipment as regards the rate of depreciation.

INTRODUCTION

This Paper will show that the Receiver of Revenue's present allowance for the depreciation of air pollution abatement equipment is unjust because there is no distinction made between production plant and non-productive abatement plant (for depreciation purposes).

A number of recommendations are made which should relieve the burden of the chemical industry, which, although not wanting to shirk its responsibility for reducing effluent levels, finds the financial burden of installing and maintaining air pollution abatement equipment a heavy one.

1. *ECONOMIC JUSTIFICATION FOR GOVERNMENT INTERVENTION IN SETTING AND APPLYING AIR POLLUTION STANDARDS*

The Free Enterprise System can be described as a computer that co-ordinates the self-interest of individuals, inducing them to produce a diverse menu of products to satisfy man's unlimited wants. It also allocates the scarce and dwindling resources necessary for producing the goods.[1] The pricing system of this Market Economy assumes equilibrium in each industry, and the market price paid by each of the consumers is equal to the full costs of production.[2] Competition is the great regulator that harmonises the interests of resource suppliers, producers, and consumers.[3]

The market Economy breaks down when the price paid by the consumers does not reflect all the costs of production, as is the case with all kinds of pollution associated with any production process. Pollution abatement regulations have been implemented by governments at all levels in order to reduce the substantial rising costs society has been bearing as a result of pollution. These costs are reflected to varying degrees, sometimes subtly, sometimes directly, in such factors as increased demands for medical services, property devaluations, lost man-hours of productive work, lower crop yields, shorter useful lives of man-made structures, animal losses, and in such subjective considerations as the reduction in the quality of life.[4] The environmental *regulations,* as opposed to effluent payments or effluent fees, force the producers to install pollution abatement equipment and "internalise" the social costs, and this is reflected in a rise in the market price.[5,6,7]

The net social costs of any particular form of pollution are difficult to estimate, and for this reason the levying and enforcement of effluent/pollution taxes in order to equalise the selling price with the "full" costs of production is not considered an equitable method. The laying down of minimum emission standards, or maximum pollutant reduction, is a fairer method of allowing the free market mechanism to regulate itself and equalise costs with the market price. The method of applying the regulations in the developed countries differs, but that which is found in South Africa

is considered very fair: The Chief Air Pollution Control Officer in consultation with industry has laid down certain minimum emission standards, and should it be found that a factory is exceeding these limits, the Chief Officer will insist on abatement equipment being installed. The onus is on the polluter to investigate the "best means available" to reduce the amount of air pollution to within acceptable limits, and then to install the appropriate equipment.

2. *GENERAL MACRO- AND MICRO-ECONOMIC CONSEQUENCES OF INSTALLING AIR POLLUTION ABATEMENT EQUIPMENT*

The study on the macroeconomic consequences of applying the pollution standards which was commissioned by the Department of Commerce, the Council on Environmental Quality and the Environmental Protection Agency of the U.S. government, found that "the additional costs incurred by implementing existing laws for pollution control standards will indeed have a significant effect on the U.S. economy. In particular, it is very difficult to escape the conclusion that either prices must rise by an additional 0,25% per year throughout the decade (1970–1980), or the rate of unemployment must be as much as 0,25% higher during the decade."[8] Other macroeconomic consequences of compliance with pollution standards are a reduction in the amount of capital available for increases in productive capacity and a drop in productivity. This last aspect is highlighted in the following extract from a Time discussion on the American drop in productivity growth: "Companies have had to pour more and more money into costly anti-pollution equipment . . . . rather than buying productive machinery and figuring out more efficient operating methods. Though lives have been saved and the air and water cleansed, the price has been high. The CEA estimates that regulation may be cutting annual non-farm productivity growth by four-tenths of a percentage point."[9]

For an individual industry, and a company within that industry, the consequences of compliance with effluent emission standards are considered microeconomic. In the case of sulphuric acid manufacture, the introduction of emission limits on SO_2 and SO_3, did not result in all producers having to install abatement equipment, but only those exceeding the limits. The market price for sulphuric acid comes about at the point of intersection of the Market Demand Curve, and the Market Supply Curve, which is the summation of the supply curves of the individual producers of sulphuric acid. This is shown in Graph (1) of Figure 1; and in Graph (2) the position of an individual producer who has had to install abatement equipment is shown. The consequences of compliance for this polluter (and others) will be to cause the Individual Supply Curve to rise from S_1' to S_2', while the Market Supply Curve (Graph (1)) rises from S_1 to S_2.

The consequence of these events is that the market *and* the individual producer prices rise from P_1 to P_2; the total

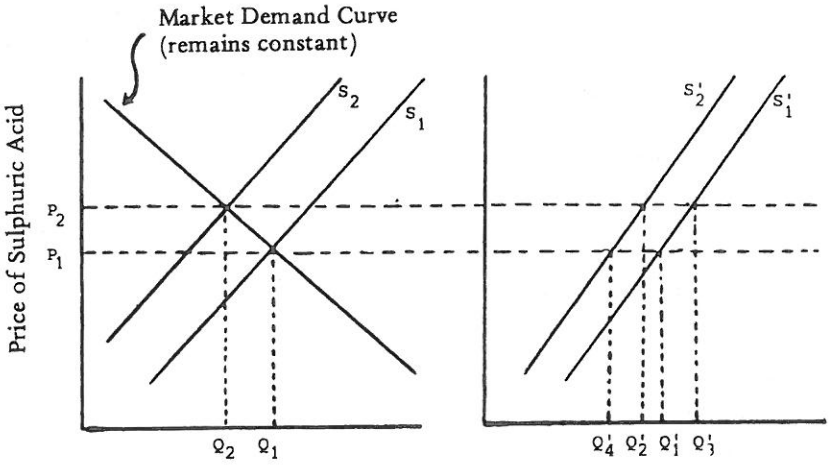

FIG 1 *Effects in the market place and for an individual sulphuric acid producer, of installing air pollution abatement equipment.*

tonnage of sulphuric traded drops by an amount of Q_1Q_2, and the tonnage sold by the individual "polluting" producer drops by an amount of $Q_1^1Q_2^1$. However, had the individual not been a polluter in the first place, there would have been no change in his Individual Supply Curve (S_1^1), but instead *increase* of $Q_1^1Q_3^1$ in the tonnage of sulphuric acid sold by the "non-polluter".

It should be pointed out that there is usually a considerable time lag between the installation of air pollution abatement equipment by the individual "polluting" sulphuric acid producers and the rise in the Market Supply Curve S_1 to S_2. The result of this is that the producers of sulphuric acid who have installed abatement equipment have an immediate rise in their Individual Supply Curve from S_1^1 to S_2^1, but because the market price remains at P_1, the drop in tonnage of sulphuric acid sold is $Q_1^1Q_4^1$, a quantity greater than is the case when the market adjusts to the higher Market Supply Curve and consequential higher market price of P_2.

In general, the microeconomic consequences to an industry of individuals complying with air pollution standards by installing abatement equipment are minimal; the industry is not seriously impacted, or threatened. However, profits of individual firms will decline, and in certain cases, the cost increases cannot be passed on to the consumer in either the short- or long-term. Accordingly, there will be curtailment of production in certain instances, and plants will have to be closed down.[10] Certain of the closures will most probably be marginal operations, (e.g. smaller, older, or less efficient), and the investment in abatement equipment reduces profitability to a level which cannot allow justification for continued operation.

In a mature developed economy like that in the United States, the closure of a number of plants will not have any serious effect on the problems of unemployment, reduced growth, inflation and investment. The economy is large enough to absorb and accommodate the problems. The situation in a smaller, less developed economy like that of South Africa, is such that it is further from the ideal of a "perfect economy", and the negative consequences of compliance with air pollution standards are more difficult to absorb and accommodate. For this reason, individual firms that have to install abatement equipment should be given assistance to tide them over the problems that arise in the short-term, e.g. when there is investment in non-productive plant, the environmental problems of all forms of pollution are so serious that the reduction in emission standards, or a delay in implementation should not be considerded, but rather the assistance proposed and motivated in section 3.2: FINANCIAL IMPLICATIONS OF INSTALLING AIR POLLUTION ABATEMENT EQUIPMENT should be given.

3. *EFFECT OF INSTALLING AIR POLLUTION ABATEMENT EQUIPMENT ON A PYRITE-BURNING SULPHURIC ACID PLANT*

3.1 *INTRODUCTION*

Sulphuric acid is considerd the most widely used, and hence the most important, industrial chemical of any economy.[11,12,13,14] Internationally, it is most commonly made from burning crude sulphur, and until the early 1960's, this was the preferred method of production in South Africa, using imported sulphur – there are no indigenous resources of elemental sulphur in this country. The Witwatersrand mineral complex has large quantities of iron pyrite which is obtained when gold-bearing ores are treated. At present, the roasting of iron pyrite to obtain the sulphur dioxide necessary for making sulphuric acid accounts for the greater proportion of South Africa's production of sulphuric acid.[15] The development of other base minerals in the Northern Cape is having an effect on sulphuric acid production, since several of the minerals are in the sulphide form; and in the smelting process, the sulphur dioxide waste gases are having to be converted into sulphuric acid. It is accepted that the capital costs of a pyrite-burning sulphuric acid plant are as much as three times higher than that of an equivalent capacity sulphur-burning plant. In addition, a pyrite-burning plant has a large amount of dust and other impurities in the primary gas stream, and these need to be removed.[16]

From the point of view of economics, the characteristics of manufacture and sale of sulphuric acid make it one of the few chemicals made in South Africa that could be seen as approaching that of a perfectly competitive situation. This is because there are many buyers and sellers of the product: no producer has more than 12% of the country's productive capacity; no single producer could affect the market price; and the price is set by the Chamber of Mines, and not by market forces.

3.2 *FINANCIAL IMPLICATIONS OF INSTALLING AIR POLLUTION ABATEMENT EQUIPMENT*

When abatement equipment is installed on an existing sulphuric acid plant, there are a number of serious consequences. The first is the adverse effect on the cash flows during the year of installation, since the equipment has to be purchased; and production will drop during the installation period. The total costs of products will rise marginally once the abatement equipment has been commissioned due to increased running (variable) costs, maintenance costs, and higher allocation of central overheads.

One method of alleviating the cash flow problem is by "writing off" to tax, the additional investment during the year of installation. This will reduce the tax commitment for the year, and so decrease the negative cash flow during the year. This will have no effect on the actual costs of production, but only on the net cash flow – the main factor that determines profitability.

Should the financing of abatement equipment be through a loan or lease finance, the fixed costs of production will rise substantially, thus also reducing the net cash flow.

The present method of depreciation for all production equipment is that in the first year of operation, there is an investment allowance of 30 per cent of the total outlay. In addition, an initial depreciation allowance of 25 per cent of the total outlay is granted in the first year and a pro-rata first year depreciation of 20 per cent on the remaining 75 per cent of the total capital spent. The plant is then depreciated at 20 per cent of the book value for the rest of its operating life.

The method of depreciation proposed in this Paper is that the pollution abatement portion of the investment, together with the investment allowance, be written of during the first year of operation. The tabulation in the appendix gives hypothetical data for investment in a sulphuric acid plant (R8 million and a capacity of 350 000 tons sulphuric acid per year) and a mist precipitator (R2 million). The Internal Rate of Revenue* for the two methods of depreciation are 11,57 and 11,70 per cent respectively. The higher rate applies to the method of depreciation proposed in this paper.

An estimate of the Internal Rate of Return without the mist precipitator, and maintaining the same production costs, is considerably higher at 14,3 per cent.

The additional capital expenditure on the mist precipitator (R2 million) has had a significant effect on the profitability of the operation. The proposed method of depreciation for the air pollution abatement equipment has made only a marginal improvement to the Internal rate of return in the particular example analysed in the Appendix. Improvements of as much as 2 per cent can be expected where the proportion of capital in the abatement equipment is higher than 20 per cent, and where taxation commences after only a few years after commissioning the plant.

3.3 *DISCUSSION OF THE PROPOSAL*

Perhaps the main reason why air pollution abatement equipment should be given special tax concessions is because this step would be an acknowledgement by the authorities that unproductive pollution control equipment is essential, but deserves special consideration.

In general, abatement for air, water or solid waste pollution decreases the capital/output ratio of the economy as a whole. This results in a lower productivity for the capital, and can reduce both actual growth and growth potential of the manufacturing sector.

During the current times of high inflation and stagnant productivity the importance of capital investment to improve overall productivity is acknowledged. The channelling of funds into non-productive abatement equipment will exacerbate the present problems.

4. *CONCLUDING REMARKS*

It is generally accepted that those industries which cause air pollution in any of their production processes, should be required to install equipment that will reduce the level of the pollutants to an acceptable level. The main result of installing the equipment is that in the long run the price of the products made on the polluting plant will rise.

The financial burden on the producer of having to invest in the unproductive capital equipment is a heavy one. The proposed method of relieving this burden on the individual companies as well as reducing the capital drain on the economy, is to allow the abatement equipment to be depreciated in its first year of operation.

* The Internal Rate of Return (also known as the Yield or Discounted Rate of Return) is the interest rate that equates the present value of a set of cash flows with the initial investment.

FINANCIAL TABULATION (IN INCREMENTAL CASH FLOW TERMS) FOR INVESTMENT IN A SULPHURIC ACID PLANT COUPLED WITH AIR POLLUTION ABATEMENT EQUIPMENT WITH TWO METHODS OF DEPRECIATION (DATA HYPOTHETICAL)

YEAR		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CAPITAL:																
Fixed: Main Plant	(Rm)	8,00														
Mist Prec.	(Rm)	2,00														
Working: Incremental			0,15	0,14	0,13	0,12	0,11	0,10	0,09	0,08	0,07	0,06	0,05	0,04	0,02	
Total (Rm)		10,00	0,15	0,14	0,13	0,12	0,11	0,10	0,09	0,08	0,07	0,06	0,05	0,04	0,02	(1,00)
REVENUE:																
Sales (tons x 10^3)			180	310	330	350	350	350	350	350	350	350	350	350	350	
Price (R/t)			27,00	29,00	31,00	34,00	36,00	39,00	41,00	42,00	45,00	47,00	49,00	52,00	55,00	
Revenue (Rm)			5,04	8,99	10,23	11,90	12,60	13,65	14,35	14,70	15,75	16,45	17,15	18,20	19,25	

FINANCIAL TABULATION (IN INCREMENTAL CASH FLOW TERMS) FOR INVESTMENT IN A SULPHURIC ACID PLANT COUPLED WITH AIR POLLUTION ABATEMENT EQUIPMENT WITH TWO METHODS OF DEPRECIATION (DATA HYPOTHETICAL)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
COSTS:															
Variable[2]: Unit (R/t)		20,00	20,00	20,00	21,00	22,00	23,00	25,00	27,00	28,00	30,00	33,00	36,00	36,00	
Total (Rm)		3,60	6,20	6,60	7,35	7,70	8,05	8,75	9,45	9,80	10,50	11,55	12,60	12,60	
Fixed[3] (Rm)		1,50	1,65	1,80	2,00	2,20	2,44	2,70	2,95	3,20	3,40	3,70	3,90	4,20	
Total (Rm)		5,10	7,85	8,40	9,35	9,90	10,45	11,45	12,50	13,00	13,90	15,25	16,50	16,80	
CASH INFLOW:		(0,06)	1,14	1,83	2,55	2,70	3,20	2,90	2,20	2,75	2,55	1,90	1,70	2,45	
TAX ALLOWANCE:															
Method 1		7,00	1,18	0,88	0,76	0,60	0,48	0,39	0,31	0,25	0,20	0,16	0,13	0,10	
Method 2		8,00	1,00	0,80	0,64	0,51	0,41	0,33	0,26	0,21	0,17	0,13	0,11	0,09	
TAX (43%):															
Method 1								1,08	0,81	1,08	1,01	0,75	0,68	1,01	
Method 2								1,11	0,83	1,09	1,02	0,76	0,69	1,01	
NET CASH INFLOW:															
Method 1	(10,00)	(0,21)	1,00	1,70	2,43	2,59	2,90	1,73	1,31	1,60	1,48	1,10	0,98	1,42	1,00
Method 2	(10,00)	(0,21)	1,00	1,70	2,43	2,59	3,10	1,70	1,29	1,59	1,47	1,09	0,09	1,42	1,00

Explanatory Notes:
1 Net amount realised from sale of plant
2 Includes power, water, pyrite, transport
3 Includes salaries, overheads, maintenance, interest

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