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Rationale for Government Intervention for Environmental Regulation

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Abstract

Controlling pollution is not costless and there is a trade-off between economic development and environmental quality. So, how much pollution society can bear and how much to control, is important. Depending on Marginal Damage Cost (MDC) and Marginal Control Cost (MCC), we obtain social optimal level of pollution. Now target is to keep the pollution/waste only up to that level and not more than that. But the problem is that private producer doesn't take into account external cost (pollution) of production. Hence due to presence of externality (pollution) there is market failure and efficiency condition are violated. As a result, over production of some and under production of some other goods takes place. To correct market failure and to ensure efficiency, intervention of government is essential. In case of environment, pollution is negative externality which creates market failure and role of government becomes essential as regulator. Similar, is the case where environmental quality is public good.

Keywords: Marginal Damage Cost (MDC) and Marginal Control Cost (MCC), willingness to pay (WTP), Marginal Private Cost (MPC), Marginal External Cost (MEC), Public Goods, Externalities or Spillovers, Imperfect Information, Imperfect Competition, Property Rights, Non-Rivalness, Non-Excludability, External Cost.

Introduction

The paper is divided into five sections. **Section I** describes Efficiency Rules and Causes of Market Failure; **Section II** is devoted to Understanding Market Failure in Public Goods Market; **Section III** describes, Pollution Externality and Market Failure; and **Section IV** is devoted to Government Intervention and Social Optimal Level of Pollution and **Section V** describes Conclusion.

Objective of the Study

1. To provide theoretical economic background for justification of government instrument for environmental regulation;
2. To establish the maximum acceptable level of pollution which is social optimal and which can provide a benchmark for government regulatory policies.

Methodology of the Study

The present study is theoretical in nature. It is based upon background of Standard Economic Theories. Various concepts of macro and micro economics have been used to provide building blocks of present paper of environmental economics.

Section I

Efficiency Rules and Causes of Market Failure

Pareto efficiency is defined as a situation in which everyone is so well off that it is impossible to make anybody better- off without simultaneously making at least one person worse-off. There are three conditions that must be satisfied for the allocation to be Pareto optimal or Pareto efficient. They are:

1. Efficiency of Distribution of Commodities among Consumers
2. Efficiency of Allocation of Factors among Producers
3. Efficiency in the Composition of Output (Product Mix)

Efficiency of Distribution of Commodities among Consumers

The marginal condition for a Pareto-optimal or efficient distribution of commodities among consumers requires that the MRS between two goods be equal for all consumers i.e. $\mathrm{MRS}_{XY}^{A} = \mathrm{MRS}_{XY}^{B}$

Efficiency of Allocation of Factors among Producers

The marginal condition for a Pareto-optimal allocation of factors (inputs) requires that the MRTS between labour and capital be equal for all commodities produced by different firms i.e. $\mathrm{MRTS}_{L,K}^{X} = \mathrm{MRTS}_{L,K}^{Y}$

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Efficiency in the Composition of Output (Product Mix)

The marginal condition for a Pareto-optimal or Efficient Composition of Output requires that the $MRPT_{XY}$ between any two commodities be equal to MRS between the same two goods i.e. $MRPT = MRS_{X,YA} = MRS_{X,YB}$

When all three conditions are satisfied it is Pareto optimum state for economy which is the best situation known as First best solution. We establish then that a Pareto optimum price is equal to the marginal cost everywhere. Under perfect competition, long run equilibrium ensures that MC = P. Hence, Perfect competition secures a Pareto optimum. Thus the three rules for efficiency can be summed up in one fundamental theorem. "Every competitive equilibrium is a Pareto Optimum. And every Pareto Optimum is a competitive equilibrium". When efficiency conditions are violated it creates market failures.

In the presence of some factors, efficiency conditions are violated and we don't get first best. It results in market failure. The main factors which are responsible for violation of efficiency are:

1. Public Goods
2. Externalities or Spillovers
3. Imperfect Information
4. Imperfect Competition
5. Absence of Property Rights
6. Co-ordination Problems

Economists model environmental problems as market failures using either the theory of public goods or the theory of externalities. Each is distinguished by how the market is defined.

1. If the market is defined as "environmental quality", then the source of the market failure is that environmental quality is a public good.
2. If the market is defined as the good whose production or consumption generates environmental damage, then the market failure is due to an externality.

Characteristics of Public Goods

Non-Rivalness

Non-Rivalness refers to the notion that the benefits associated with consumption are indivisible; meaning that when the good is consumed by one individual, other person is not preempted from consuming it at the same time. Put another way, the marginal cost of other individual sharing in the consumption of good is zero. Contrast this with what happens when a private good, such as personal computer, is consumed. Once, someone is using the computer, that consumption prohibits another person from using it at the same time.

Non-Excludability

Non-Excludability means that preventing others from sharing in the benefits of a good's consumption is not possible (or prohibitively costly in a less strict sense). In contrast, consider the inherent excludability of a conventional private good, such as hotel lodging. Exclusive rationing of a hotel services to the consumer paying for them is easily accomplished, and the associated benefits accrue solely to that single consumer.

Although non-rivalness and non-excludability may seen similar, but they are not similar. A good way to distinguished them is as follows. Non-rivalness means that rationing of the good is not desirable, where as non-excludability means rationing of the good is not feasible.

Two classic examples of public goods are a light house and national defense. Contemplate the services provided by these goods to see that the benefits of each are both non-rival and non-excludable. A more contemporary and, from our perspective, more relevant example of a public good is environmental quality. Just like the light house, cleaner air, for example is both non-excludable and non-indivisible.

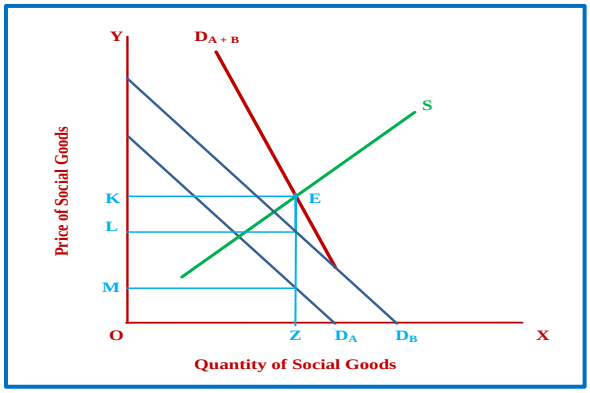

Fig I: Demand Curve for Social Good

For social good, we assume that consumers are willing to reveal their marginal evaluations of the social good- say. Weather forecasting installation is being understood that daily reports will be available free of charges. As before D_A and D_B are A's and B's respective demand curves, subject to the same conditions of given income and prices for other goods.

Since, it is unrealistic to assume that consumers volunteer their preferences; such curves have been referred to as "pseudo-demand curves". But suppose for arguments take that consumer preferences are revealed. In case of social goods, the market demand curve D_{A+B} is obtained by vertical summation of D_A & D_B, with D_{A+B} showing the sum of prices which A and B are willing to pay for any given amount. SS is again the supply schedule, showing marginal cost (chargeable to A and B combined) for various output of social goods. The combined price paid by A is OM where as that paid by B is OL, where OM +OL = OK.

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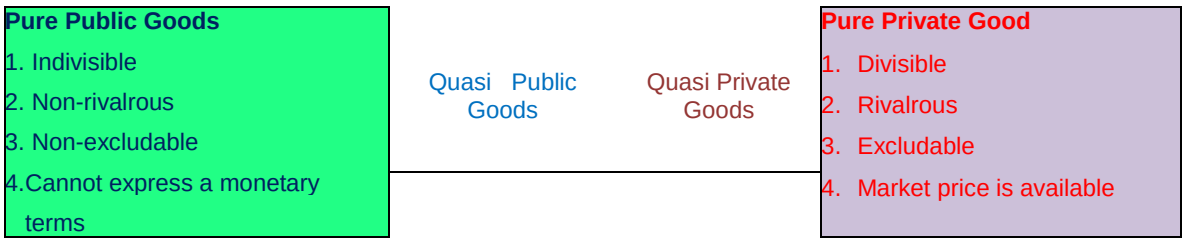

Fig II: A Spectrum of Economic Goods

Section II

Understanding Market Failure in Public Goods Market

The achievement of an allocatively efficient outcome in a public good market depends on the well-defined demand and supply functions. Although, we develop both functions for our hypothetical market for air quality, market demand was identified only because we implicitly made one critical assumption that consumers would reveal their willingness to pay (WTP) for SO_2 abatement. However, without third party intervention, the non-excludability of this or any public good makes it difficult, if not impossible, to ascertain such information. If consumers WTP responses are unknown, market demand cannot identify, and an efficient outcome cannot be obtained. It is precisely the inability of free markets to capture the WTP for a public good that causes the market failure.

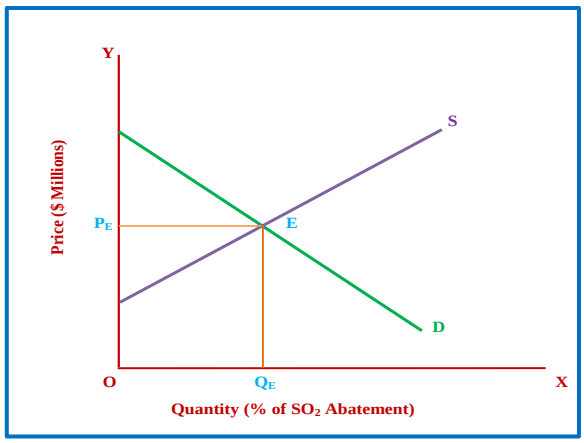

Fig III: Market Supply and Market Demand for Air Quality

In Fig III, Q_E represents the optimal level of abatement measure from left to right and implicitly the optimal level of pollution measured from right to left. As the model suggests, this optimal level of pollution is not necessarily zero.

From a general perspective, abating at the 100 percent level to reduce pollution to zero involves prohibitive opportunity cost. These include the forgone production and consumption of any good generating even the smallest amount of pollution. Given our present technology, a zero-pollution world would be one without electricity, advanced transportation systems, and virtually all manufactured products. Thus, it makes little sense to argue for the elimination of all pollution in our environment.

In the case of a public good that is non-excludable, the consumer can share in its consumption even when it is purchased by someone else. Thus, there is no incentive for a rational consumer to volunteer a WTP for something he or she can consume without having to pay for it.

Formally, this problem is known as non-revelation of preferences which in turn are due to the more basic dilemma of free-ridership. The rational consumer recognizes that the benefits of a public good are accessible simply by allowing someone else to purchase it. The consumer becomes a free-rider. Individual preferences about the public good remain undisclosed, and thus market demand is undefined. When the public good is environmental quality, the consequence can be serious ecological damage.

Section III

Presence of Externality (Pollution) and Market Failure

The concept of externality can be traced back to Alfred Marshall's ideas on external economies. Marshall introduced the concept of external economies, which by no aggregation contains the key to the economic analysis of production. Marshall defined external economies to include only the benefits enjoyed by producers, without the additional cost caused by factors outside the market. In 1920, A.C. Pigou pointed out the externalities involved both benefits and costs. He explained negative externalities through his classic illustration of 'woodlands damaged by sparks from railway engines' thus leading the discussions that considered pollution as an externality. In 1950 K.W. Kapp presented the first substantial discussion of externalities and social costs in his book "The Social Cost of Private Enterprise". In which, he analyses all external costs arising from production processes in the form of air and water pollution.

In the presence of an externality, we expect to observe a clear divergence between social and private benefits and social and private costs. Under these conditions, resource allocation through a market mechanism i.e. one that is based solely on consideration of private costs and benefits- would be inefficient when viewed from the perspective of society at large. This constitutes a clear case of market failure because the market, if left alone, lacks any mechanism by which to account for external costs and/or benefits.

The presence of such externalities in economic theory is an instance of market failure. While the market system appears to be highly efficient at using priced resources like land, labour, raw materials etc., it fails to guide firms towards the

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efficient use of un-priced resources. This market failure arises because, firms take into account, exactly the market price of the resources it uses for its decision making. The assimilative capacity of the environment that the firm uses when it discharges emissions into air or effluents into the water is an un-priced environmental service which the firm does not incorporate into its decision making analysis. Because of such external effects, markets fail to allocate resources efficiently. Negative externalities in the form of air and water pollution are pervasive and inevitable is the modern industrial economics. In such cases, efficiency conditions need to be modified to account for externalities. Even a competitive market economy cannot allocate resources efficiently by allocating price ratio to marginal private cost ratio, if production and consumption activities generate external costs. In such an economy if we are to have output and price levels that are socially efficient, we must include in our calculations both private cost and external cost, i.e. the cost that is relevant for "efficient" outcomes is marginal social cost and not marginal private cost and Marginal Social Cost= Marginal Private Cost + Marginal External Cost

i.e. MSC = MPC+ MEC

In the absence of externalities, socially optimal level of output is reached when P = MPC, where MPC = Marginal Private Cost. In the presence of externalities, marginal external cost should be added to marginal private cost.

MEC may be defined as the additional cost imposed on third parties from the production of an additional unit of output. Optimal output, when externalities are present is determined by equality of price to MSC. The presence of externalities leads to over production of a good relative to the socially optimal level.

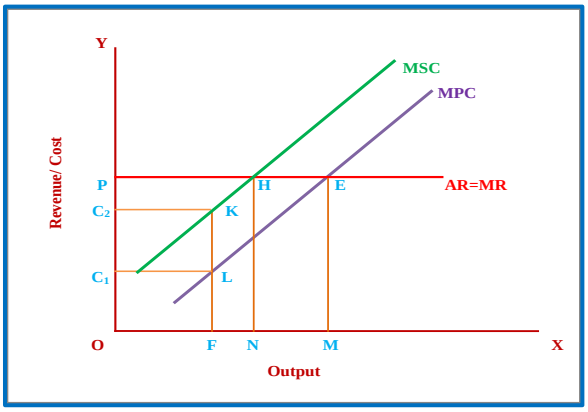

Figure IV: Effects of External Cost on Firm's Output

Fig IV has been drawn on a crucial assumption namely marginal external cost is constant per unit of output. The vertical distance between MPC and MSC, is MEC and it is the same throughout implying that MEC per unit of output is constant. In reality, with increase in the level of output, there will be a proportional increase in external cost also. The MPC a curves represents Marginal Private Cost. It has all incremental cost to the firm, of labour, material and capital. The AR = MR line shows the price level the determined by demand and supply of the product and passed on to the firm. In figure, socially optimal output is OM because price equal to marginal cost. The firms incur an external cost of C_1C_2 (KL) per unit of output shown by the vertical distance between MPC and MSC. From the society's point of view, for social optimum to exist, the firm should account for this external cost also. Hence, ideally the price marginal cost equality should occur at H, at which P = MSC. The output corresponding to this equilibrium H is ON. Thus, there is a difference between socially optimal output level and private optimally output level given by MN. This means that the society would be better-off with ON units of this output but by not accounting for external cost it produces OM, (MN more than requirement). The resources used to produce MN units of output have greater valve in other employments. There is an over production of this good equal to MN units which means that some other good or goods is being under produced or not produced at all. Thus externalities distort efficient and optimal allocation of resources.

Modeling Environmental Damage as a Negative Externality

We develop a formal model of negative environmental externality. We elect to model a production externality (environmental pollution). In this case we define the market as refined petroleum products. This is a fitting choice, because refined petroleum plants are major water polluters. Among the associated external costs are serious health risks for people using the rivers and streams? Here, two concepts are important:

MSC = MPC + MEC

i.e. Marginal Social Cost = Marginal Private Cost + Marginal External Cost

MSB = MPB + MEB

i.e. Marginal Social Benefit = Marginal Private Benefit + Marginal External Benefit

At, Competitive Equilibrium: **MPB = MPC**

MPB − MPC = 0

Mπ = 0

At, Efficient Equilibrium (After Internalizing Externality)

MSB = MSC

MPB+MEB = MPC + MEC

MPB−MPC = MEC (Since MEB = 0)

Mπ = MEC

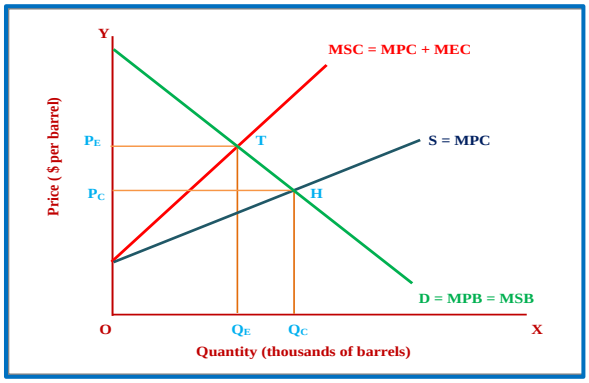

Figure V:Competitive and Efficient Equilibrium in the Presence of a Negative Externality

The intersection of MSC and MSB identifies the efficient equilibrium at P_E and Q_E. At Q_C, MSB is below MSC, which means that society is giving up more in scare resources to produce petroleum then it

gains in benefits from consuming it. The Q_E is less than Q_C.

Why Private Firms do not internalize External Cost?

It is important to understand the lack of incentives in the natural market process to explicitly account for external costs. Petroleum refineries are motivated by private gain, not by social gain. Although these firms may be aware of the environmental damage associated with their production, there is no incentive – in fact, there is a disincentive – for them to absorb these costs. Doing so would negatively affect profits. It would be as though firm offered to pay for the external costs on society's behalf. However, there is no market incentive for rational firms to incur higher costs than it has to, even if it is for the good of society. As a result, in absence of regulation, private firms have incentive to pollute and the cost is thrown upon third party (society) which leads to market failures.

Section IV

Government Intervention and Social Optimal Level of Pollution

Suppose a Paper Mill and Fish Hatchery both use a common lake for discharge of waste and fish production respectively. Both paper and fish are needed by society. If not regulated, paper mill will discharge all its waste into river without hesitation and produce paper as much as it wishes. On the other hand, due to increasing pollution of lake, day by day fish production will reduce. As a result, the impact of negative externality (pollution) will be that society will get more than desired quality of paper (over production) and less than desired quality of fish (under production), a clear case of market failure.

One way of obtaining socially optimal level of pollution is through total waste disposal cost where this cost is found minimum.

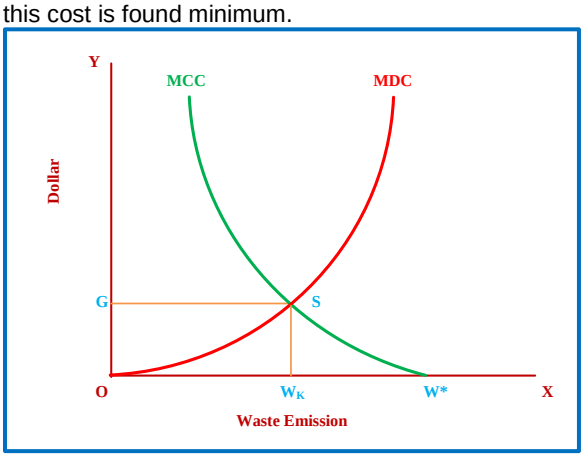

Figure VI: The Optimal Level of Pollution

In figure VI, OW_K is the waste emission (polluter) which is social optimum level of pollution i.e. society is ready to accept OW_K because society needs economic goods and whose production will generate pollution. For government, policy implication to make regulatory policy for polluters is to control pollution from W* to W_K.

The question, then, is what can be done to correct the misallocation of resources caused by environmental externalities? Does it require a minor or a major modification of the market system? In responding to these questions, the key issue at hand is to find the most effective ways of internalizing the externality. Some argue that, there are no technical solutions to environmental externalities. In other words, externality cannot be effectively internalized through voluntary private negotiation among the parties involved. Thus according to this view, the only way to resolve environmental externalities effectively is through coercive method. So, it is only government of a country which can correct market failure through regulatory measures and compel polluters to internalize external cost (through tax) or can provide incentive to invest in better technology (through subsidy) to prevent externality.

From view point of Sustainable Development government has to decide that up to what level pollution/externality should be controlled? Because zero pollution is neither possible nor feasible (it means zero production and consumption and no economic activity). Since, society needs economic goods for utility but has to bear pollution/ waste also. Moreover, control of pollution (provision of environmental quality) involves funds; hence provision of economic goods and provision of environmental quality has trade-off. So, the balanced way is that government should regulate pollution only up to that level which is not desired by society. So, up to the level W_K, pollution is socially acceptable. It provides the target or levels beyond which pollution should be controlled by government through regulatory instruments. Therefore, this social optimum level of pollution is the basis of policy of pollution control. Government permits pollution up to this level and uses different regulatory measures to compel polluters to control beyond that level.

Section V

Conclusion

Whenever efficiency conditions are violated, the first best is not achieved and a result there is misallocation of resources. In this situation to correct distortions in the economy and to restore efficiency intervention of government is must. Pollution is negative externality and environmental quality as public good is the two reasons of violation of efficiency condition in the case of environment. It results in market failure and misallocation of resources and production. Therefore, to correct market failure and restore efficiency in the case of environment justification of intervention of government comes into picture. Government as a regulator regulates environmental pollution through Command and Control (C&C) and Market Based Instruments (MBIs) on the basis of social optimal level of pollution which is the basis of regulatory policies.

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