MARKETS BASED POLICY - POLLUTION CHARGES AND ENVIRONMENTAL SUBSIDIES, DEPOSIT REFUND SYSTEM, POLLUTION PERMIT TRADING SYSTEMS.

INTRODUCTION

Dear friends, in this module we examine the market based policy to get quality environment. By using economic modeling and criteria of allocative efficiency and cost-effectiveness, we shall evaluate the implications of using these different regulatory strategies to solve the complex problem of environmental pollution.

We know that market can fail but the incentives that define the market process can enable us to tackle environmental problems. The important element in market is that it we can internalize the environmental degradation and leave us with allocative efficiency. The market approach uses prices or other economic variables to provide incentives for polluters to reduce harmful emissions.

Economists are strong proponents of the market approach for it can achieve a cost-effective solution to environmental problems by designing policy initiatives that allow polluters to respond according to their own self interests. Market instruments are aimed at bringing the external costs of environmental damage back in to decision making of firms and consumers. Market approach attempts to restore economic incentives by assigning a value to environmental quality or equivalently, by pricing pollution.

The primary tool of our analysis will be economic modeling, using the criteria of a allocative efficiency and cost- effectiveness to make policy assessment.

In order to provide a framework for our investigation, we begin with a brief overview of the major categories of market-based instruments such as pollution charges, subsidies, deposit refund system, and pollution permit trading systems. By this we shall structure our economic analysis. Taking each category successively, we develop models of specific instruments, assess the results, and give examples of how each is used in practice.

DESCRIPTIVE OVERVIEW

The fundamental difference between market-based approach and command and control approach is that the former has efficiency base while the latter is based on standard objectives, set of a socially desirable level. Market approach is an incentive-based policy that encourages conservation practices of pollution-reduction strategies.

Types of Market - Instruments

The market instruments are basically, pollution charges, subsidies, deposit/refund systems and pollution permit trading systems.

The market based approach is used by many countries of the world. The nations in Organization for Economic Co-operation and Development (OECD) are approximately using 375 different environmental taxes as well as 250 environmentally based fees and charges. The market approach is important for it gives the range of available solutions to environmental problems. The given table here in gives brief descriptions of market instruments.

Categories of Market-Based Instruments

Market Instrument	Description

Pollution charge	A fee charged to the polluter that varies with the quantity of pollution released.
Subsidy	A payment or tax Concession that provides financial assistance for pollution reductions or plans to abate in future.
Deposit/refund	A system the imposes an up-from charge to pay for potential pollution damages that is returned for positive action, such as returning a produces for proper disposal or recycling.
Pollution permit	The establishment of a market for rights to pollute, using either credits or trading system allowances.

<u>POLLUTION CHARGES</u>

Theoretically speaking a pollution charge is to internalize (means to take under market fold) The cost of environmental damages by pricing the pollution generating activity. By definition, a pollution charge is a fee that varies with the quantity of pollutants raised. It can be implemental as a product charge or as an effluent or emission charge. The motivation follows what's known as the "polluter-pays principle" a position rooted in the belief that the polluter should bear the costs of control measures to maintain an acceptable level of environmental quality.

<u>Modeling a product charge as a per-unit Tax</u>

Let us assume that there is a good in a competitive market whose production generals a negative environmental externality in the sense that the producers base their decisions only on the marginal private cost (MPC) of production, they ignore the marginal external cost (MEC) of the environmental damage, hence they allocate too many resources to production. Let us try to understand this with the help of diagram. It is generally known as Pigovian Tax for it was presented by economist Pigou.

Graph....

This model illustrates how Pigou tax achieves efficiency in the market for some pollution generating product (Q). By setting the unit tax equal to MEC at QE shown as distance a b, the MPC curve shifts up to MPC, Equilibriums output is then determined by the interaction of MPC_t and MSB, which is efficient production level Q_E

<u>Product charge:</u> The motivation of *product* charge is to induce firms to internalize the externality by taking account of the MEC in their production decision. Product charge is a one kind of fee added to the price of a pollution generating product based on its quantity or some attribute responsible for pollution. By imposing a unit tax on the pollution generating product equal to the MEC at the efficient level of output (Q_E).

Pigouvian tax is good theoretically to detect pollution, but there are two difficulties is in this measure: (1) If is difficult to identify the dollar value of MEC at QE and hence, the level of the tax, (2) The problem is that the model implicitly allows only for an output reduction to abate pollution - an unrealist restriction. Having these difficulties with Pigou's tax approach, we can think of some alternate measure to restrict environmental damages. This alternate measure is emission or effluent charge.

Modeling an Emission charge : Single polluter case :

Emission or effluent charge is a fee imposed directly on the actual discharge of pollution. An emission or effluent charge assigns a price to a pollution, typically through a tax. This comes under the price mechanism which a polluter can no longer ignore the effect of its environmental damages on sourly. A polluter will pay the charge and consider it part of his cost of production. Taking this in to account the polluting firm can either, continue polluting at the same level and pay the charge or invest in abatement technology to reduce its pollutant releases and lower its tax burden. The firm will go for the alternative that gives minimum cost. This model allows the polluters to make cost minimizing decisions. We assume that government sets an abatement-standard at some "acceptable level' A_{st}. Now we consider a policy that presents the polluter with following options to the taken singularly or in combination.

(1) The polluter must pay a constant per unit tax (E) on the difference between its existing abatement level (A_0) and the standard (A_{ST}) such that Total Tax = $t(A_{ST}-A_0)$; and/or (2) The polluter incurs the cost of abating.

The Emission charge for a single polluter can be explained with the help of diagram.

Graph

In a diagram per-unit tax is constant at t, the marginal tax (MT) is horizontal at that tax level. The cost of abating at the margin is shown by the marginal abatement cost (MAC) curve. At each unit of A. the cost minimizing from will compare MAC to T and choose whichever is lower.

In our model the firm will abate up to A_o because up to that point MAC is below MT. Assuming no fixed costs, total abatement costs (TAC) are represented by the area under the MAC curve up to A_o, or area O_aA_o.

Notice that these costs are lower than what the taxes would be up to A_0, shown as area Ota A_o. Beyond A_0 and up to A_{ST}, the firm will opt to pay the tax, because MT is lower than MAC in that range. The firms total tax payment for not abating between A_0 and A_{ST} represented by area $A_{0ab}A_{ST}$, which is smaller than the costs to the polluter of complying with this policy are $O_{ab}A_{ST}$. Which comprising the following two elements.

(1) Area O_aA_0, the total cost of abating A_o units of pollution

(2) Area $A_{0ab}A_{ST}$, the tax on pollution not abated up to AST

In brief the firm will abate up to A_0, because up to that point MAC < MT, beyond A_0 and up to standard A_{ST}, the firm will pay the taxes because MT < MAC.

Assessing the model

AT any point in time, *Static* incentives motivate the firms to choose among the available options, given its existing technology. Seeking to satisfy its own self-interest to maximize profit, the polluter makes a least-cost decision between paying the tax and abating. The result is that externality is internalized, using the least amount of resources.

There are also dynamic incentives which encourage the firm to advance its abatement technology. More efficient abatement techniques would allow the firm to reduce pollution more cheaply and enjoy the associated cost savings. Furthermore, the lower abatement costs might even allow the firm to avoid paying any emission charge. This can be represented by the diagram.

Diagram :

A technological advance causes the MAC curve to shift downward to MAC. As a result if the firm is faced with the option of abating or paying the unit tax at each abatement level up to AST, it would be better off abating up to A_{ST}. In this case, the technological change helped the firm avoid paying emission charges.

Most of the European countries U.S.A. and Japan are using this measure to control environmental pollution.

If we extend this multiple-polluter case than as for our analysis the two or many followers would abate at the point where $MAC_1 = MAC_2$, which indicates the least-cost abatement allocation across the two firms.

$(MAC_1 = MAC_2 = ... = MAC_n$

ENVIRONMENTAL SUBSIDIES

The alternative market approach to reduce environmental degradation is to introduce the subsidies. In this measure government is giving subsidy to the polluter for not to pollute. This is known as environment subsidy. There are two major types of subsidies - *abatement equipment subsidies and pollution reduction subsidies*. We can discuss each of them in turn.

Modeling an Abatement Equipment Subsidy:

Abatement equipment subsidy is a payment aimed at lowering the cost of abatement technology. In fact, subsidies are "negative taxes", they have a similar incentive mechanism to pollution charges expect they are payments for not making pollution. To be more precise in case of pollution charge and you "pay tax for pollution" and in case of subsidy you get reward for not polluting. In practice, abatement equipment subsidies are implemental through grants, low-miters or investment tax credits all of which give polluters an economic incentive to invest in abatement technology.

Theoretically speaking subsidies are used to internalize the positive externality associated with the consumption of abatement activities. If a subsidy were offered for installing specific abatement equipment, such as scrubbers, quantity demanded would increase because the effective price would be lower. To achieve an efficient equilibrium, the subsidy would have to equal the marginal external benefit (MEB) of scrubber consumption measured at the efficient level. This is analogous to a Pigouvian tax, and in fact, this type of subsidy is known as a Pigouvian subsidy. It is a per unit payment on a good whose consumption generates a positive externality such that the payment equal the MEB at Q_E shown in the diagram.

A model of a hypothetical competitive market for scrubbers is as follows.

$$MSC = 70.0 + 0.5\,Q, \qquad MPB = 350.0 - 0.9Q$$

$$+$$

$$\underline{MEB = 56.0 - 0.2\,Q}$$

$$MSB = 406.0 - 1.1Q$$

Where Q is the number of scrubber system produced in a year, and MSC, MPB and MEB are denominated in millions of dollars (for simplicity it is assumed that there are no marginal external costs (MEC), so that MPC = MSC). This can be explained with the corresponding diagram

Diagram :

The competitive equilibrium arises where MPB = MSC, or at Q_C = 200 and P_C = \$170 million. However, the efficient equilibrium occurs where MSB = MSC, or at Q_E - 210 and P_E = \$175 million. If a subsidy (s) equal to the MEB at the efficient output level were provided to demanders (i.e, polluters), it is as if MPB shifts up to MPBs, and more scrubbers would be traded. In this case, the Pigouvian subsidy would equal MEB = 56.0 - 0.2 (210) = \$ 14 million as distance KL shown in the figure. The effective price to polluters would be the efficient market price less the subsidy, or (P_E-s) which in this case would be (\$175 million -

\$ 14 million), or \$ 161 million.

However there are some limitations of Pigouvian subsidy approach to arrest environmental damages.

Firstly, how to measure MEB such as intangible variable like betterment of health and more stable ecosystem, secondly, there is no assurance that subsidized abatement equipment will give us allocative efficiency. Moreover such measure can create bias in polluters decision about how best to abate and subsidies affect-relative prices, making other alternative less attractive from financial perspective. Since subsidies are financial by taxes and public borrowing, they redistribute income from society to polluters which is not acceptable from social welfare point of view.

Environmental subsidies practices are seen in European countries and U.S.A. especially with regard to the extent and type of use of energy sources.

<u>DEPOSIT/ REFUND SYSTEM</u>

In some contact, however, pollution charges can be costly to administer because of associated expense of monitoring and enforcement. Moreover one of the drawbacks of pollution charges is that they may encourage illegal disposal of contaminants. Hence due to this reason a Deposit/Refund System is adopted.

Deposit/Refund system is a market instrument that imposes an upfront charge to pay for potential damages and refunds it for returning a product for proper disposal of recycling. This market instrument combines the incentive element of a pollution charge with a built in mechanism for controlling monitoring costs. Its intent is to capture the difference between the private and social costs of improper waste disposal, with its most common targets being beverage containers and lead-acid batteries.

ECONOMICS OF DEPOSIT/REFUND SYSTEMS

The negative externality caused by improper and illegal disposal of waste. It generates external cost in terms of diseases spread and health hazards. In the system of deposit/refund systems cover both the marginal private cost (MPC) and marginal external cost (MEC). This enforced design restricts the environmental damages.

As the pollution charge, the deposit is intended to capture the MEC of improper waste disposal. The deposit force the polluter to internalize the cost of any damage it may cause by making it absorb this cost in advance. The unique feature of this system is the refund component that gives an incentive to properly dispose of wastes and hence prevent environmental damage from taking place at all. This system targets the potential polluter instead of penalizing the actual polluter, using the refund to reward appropriate behaviors.

Modeling a Deposit/Refund System

A model of deposit/refund system can be explained diagrammatically. In the given diagram the *improper* waste disposal (IW) is measured on horizontal axis while the cost is measured on vertical axis in terms of MSC_{IW} shows the marginal social cost of improper waste disposal while MPC_{IW} shows the marginal private cost of improper waste disposal MPC_{IW} + Deposit, dotted curve shows the marginal private cost of improper waste with deposit and the MSB_{IW} and the MPB_{IW} are shown by negatively sloping curve.

Diagram :

In the figure from left to right, the horizontal axis measures improper waste disposal (IW) as a percentage of all waste disposal activity. Implicitly, then the percentage of proper waste is measured right to left. Thus if 25 percentage of all waste is improperly disposal of, then by default, 75 percent is disposed of appropriately and safely.

The MPC_{IW} includes expenses for collecting and illegally dumping wastes plus the costs of improperly disposing, recycling wastes, such as expense of trash receptacles, collection fees paid to refuse companies, and the opportunity costs of foregone revenue associated with recycling. The MSC_{IW} includes the MPC_{IW} plus the MEP_{IW}, represented implicitly as the vertical distance between MSC_{IW} and MPC_{IW}. The MPB_{IW} is the demand for improper wastes, disposal. It is motivated by the avoidance of time and recourses to collect waste, bring non recyclables to a land bill and haul recyclables to a collection center (The MPB_{IW} measured left to right is equivalent to the MPC_{PW} measured right to left) MPC_{PW} shows the marginal private proper waste. Because we assume no external benefits in this case, MPC_{IW} = MSB_{IW}.

In the absence of environmental controls, equilibrium is determined by the intersection of MSBW and MPC_{IW}, or Q_{IW}. The efficient equilibrium occurs where MSC_{IW} equals MSB_{IW} or at Q_E, which is smaller than QIW. Predictably, we observe that in the presence of a negative externality, for much improper waste disposal is produced because market participants do not consider the full impact of their actions.

To correct the negative externality, assume that a deposit/refund system is instituted whereby the deposit equals the MEC_{IW} at Q_E. This is labeled as distance ab in the diagram. Once the imposed, the deposit effectively elevates MPC_{IW} by distance ab, forcing the market participants to a new equilibrium at QE. In so doing, a percentage of waste disposal is converted from improper methods to appropriate ones, measured by distance (Q_{IB}-Q_E). Notice that the deposit serves the same function as a pollution charge. The critical difference is that the refund helps to deter improper waste disposal. The potential polluter has an explicit incentive to properly dispose of waste, because doing so allows it to reclaim the deposit. should disposers choose instead to illegally discard waste, at least they will have paid for external costs in advance. Authorities also have the flexibility to adjust the deposit or refund amounts to enhance the built in incentives.

Assessing the model

The positive aspect of this model is that it encourages environmental responsible behavior adding to governments monitoring and compliance cost and it requires supervision.

It also enables to encourage more efficient use of raw materials. The refund encourages proper disposal or recycling of raw material waste at the end of the production phase.

Deposit/ Refund systems in practice

These systems have been used by U.S.A. in different states and other countries like Hungary, Netherland and Canada where The performance of the system is satisfactory an impressive Denmark, Mexico and Poland also have set such systems as an environmental safe guard.

POLLUTION PERMIT TRADING SYSTEMS

We have seen that market instruments can be used to set prices per polluting and abatement activities. In this respect through price government restrict the environmental degradation or through price it attains socially desirable environmental condition or put limit to environmental degradation. Here in government adjust the quantity of desirable and appropriate environment by price quantity relation in opposite direction that adjusting price by quality quantity of environment. The problem with the price to quantity adjustment is that the government cannot know the price in advance and it becomes difficult for the government to adjust the quantity to the changing price.

It could be more appropriate and efficient to use policy instrument that operate from the known variable, i.e. the socially desirable quantity of pollution or abatement and let the market establish the price. This is the underlying premise of a *pollution permit trading system*, which can be implemented through the use of credits or allowance. Under a system of *pollution credits*, a polluter earns marketable credit only if it emits below an established standard. While in case of trading system uses *pollution allowances*, each permit gives the bearer the right to release some amount of pollution. These too are marketable, so that polluters can buy and sell allowances are needed, based on their access to abatement - technologies and their costs.

Precisely: *Pollution credits* means tradable permits issued for emitting below an established standard and,

Pollution allowances means tradable permits that indicate the maximum level of pollution that may be released.

The structure of a pollution trading system

A system of marketable pollution permits has two key components

(1) The issuance of some *fixed number of permits* in a region.

(2) A provision for trading there permits among polluting sources within that region

The fixed number of permits issued by whatever pollution level is mandated by law, capping, emissions to meet that regulated level. For example if the level were set at 200 units of emissions, a maximum of 200 one unit permits could be issued. Any polluters releasing emissions not authorized by permit would be in violation of the law. Once the limited permits are distributed, polluters may trade them with one another hence the common description of such a program me as a *cap-and-trade system.*

A barging process should develop, which gives rise to a *market for pollution* rights. Following their own self-interest, polluters either purchase their rights to pollute or they abate, whichever is cheaper alternative. High-cost abutters have an incentive to bid for available permits, whereas low-cost abates have an inventive to abate and sell their permits on the open market. The result is a cost-effective abatement allocation. But note that trading is critical to the cost-effective outcome. For example if the permits were allocated equally across all polluters and no trading were allowed, the result would be no different than a command and control system of uniform standards.

The tradable permit system accommodates environmental objectives at aggregate level. It covers all the regions of the country where environmental problems persist and such system makes adjustment through market between the high and low pollution areas. This system capitalizes on difference in polluter's abatement technologies and opportunities. The one that can abate efficiently is given incentive to do so in the sense that he can sell his unused permit to his less efficient counterpart.

Assessing the model

In this approach of controlling environmental damages, there is a search of price that well bring about the required amount of abatement. Secondly this system is more flexible. However unlike other system it does not tax, but price. There are two difficulties in this system, namely (1) it creates pollution hot spot and (2) it incurs cost for keeping record traders and the emission of buyers and sellers of permits.

Pollution Permit Trading System in Practice

This system is seen in U.S.A. introduced in 1993 with regard to clean air, covering state and region both on global scale, world-wide, it has received considerable attention with regard to greenhouse gases (GHG_S) after Kyoto Protocol, European union has also adopted this system owing to this multinational trading program effectively limits aggregate carbon dioxide (CO_2) emissions.

Conclusion

In this module concerning the solution of environmental problems, we have examined different market approaches to overcome environmental problem namely; pollution charges, environmental subsidies deposit/refund and pollution permit-trading systems. In reality environmental policy instrument is perfect, each one in general whether it is a market or non-market approach, have their own limitation. However, the market based solutions are 'incentive based' and as a principle of economics, incentives work, though there are flaws in each of them but they are more effective than other measures. Market-based instruments efficiently assign a price to environmental goods such clean air and clean water. Market-signaling forces the polluters to internalize the costs of pollution damage and adjust their decision as per the market signal. It must be noted that not all market-based instruments suit to all environmental problems. It all depends on the nature of the problem and market contact. We generally seek for perfection which is impossible, we should compromise with less than perfect.