

On Internalization of Externalities

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Abstract

Externalities can be internalized through market mechanism, government regulation, or self-governing institutions or a mix of these institutions. We recommend the institutional route which minimizes total cost (sum of technology, management, and transaction costs) to the firm. These costs are influenced by the externality attributes (occurrence, polluter, spatial, time, and technology). Different institutions may be appropriate for different stages and social contexts of an externality.

Introduction

There is copious advice available on how to internalize externalities in order to marry growth with environmental sustainability. A framework to match institutional solutions to the (a) attributes and stage of an externality, and (b) historical and ecological context of the society in which externality has emerged, is not available. We submit that solutions to the externality issue hinge on how the problem is conceptualized. Externalities need to be analyzed in terms of their occurrence, impact, and other aspects. The solution may have to be stage (of the externality) and location specific. Along with the traditional command-control and market measures, feasibility of self-governing institutions should also be evaluated. We recommend 'minimization of the total cost' to the firm as the criterion for identifying the best solution to internalize an externality.

Part 1: Emergence of Externality:

Baumol & Oates (1988, 17-18) have identified two conditions for terming an event an externality.

Condition 1: An externality is present whenever any individual's (say 'A's) utility or production function includes real variable/s (non monetary)² whose value/ is chosen by others (say 'B') without particular attention to A's welfare.

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² We are not getting into the debate of pecuniary versus technological externalities because in both, 'the ultimate comparative static effects are likely to involve changes both in prices and in the values of the relevant real variables' (Baumol and Oates, 1988, 29-31)

Condition 1: 'A' does not compensate (receive compensation from) 'B' with an amount equal in value to the resultant benefit to (cost to) 'A'.

Meade (1973, 15-35) views an externality to arise when 'A' confers a benefit (incurs a cost) to 'B' without 'B' being a fully consenting party.³

Externalities⁴ cause divergence between private costs and social cost (Pigou, 1932). Though the individual entity (consumer or the firm) externalizes the cost, somebody else (other members of the society or the future generation) bears it (Kapp, 1963, 193-5). Hence to have a socially efficient allocation of resources, externalities need to be internalized.^{5, 6}

Externalities arise due to incomplete delineation of property rights over public resources⁷ e.g. 'A' burns coal resulting in emission of carbon-di-oxide. This

³ A person is a fully consenting party only when she chooses not to exercise the power of veto over the decision. Also it is assumed that consenting parties have 'sufficient' information (we have deliberately avoided the express 'full information') to equip themselves about the merits and demerits of the case.

This definition covers only human-human interaction; does not include human-non-human living being interaction.

Externalities arise when the communication system breaks down. "Externalities can be interpreted as a breakdown in the cybernetic function of the market system. A properly functioning market system provides communication and control among the participants through negative feedback systems (Ashby, 1964; Seckler, 1980). With negative feedback, the error in the system (the difference between the objective and the reality) is progressively reduced through successive iterations ... the problems of externalities is that negative feedback does not exist because the sources and the recipients of the costs and the benefits are out of communication and control" (Seckler, 1992, 14).

An interesting discussion on the apple-bee example used by Meade can be found in Johnson (1973) and Gould (1973).

⁴ In this paper we have discussed only negative externalities. However, for the sake of convenience, these shall be referred to as externalities.

⁵ This has also been referred to as 'full cost accounting' (Commoner, 1977, 135; Leighton, 1992). 'Cradle-to-Grave' approach, if defined to take into account social costs, would also be comparable to full cost accounting. However much of the journalistic writings (which have taken fancy to this evocative phrase with biblical connotations) may be we suspect, referring to private costs only.

We have discussed subsequently whether all externalities need to be internalized and in what circumstances this may happen.

⁶ For a detailed discussion on externalities see Viner (1931); Mishan (1971); Dahlman (1979); Dasgupta (1981, Ch.2); Dragun (1983); Corners & Sandler (1986, Ch.1); Baumol & Oates, 1988).

⁷ Externalities arise when the right to contract is absent. "In the absence of exclusive rights to the use of the fishing ground, the right to contract so as to stipulate its use does not exist.. The alleged "externalities" in fisheries are thus attributable to the absence of the right to contract" (Cheung, 1970, 50).

Cheung infact questions the very concept of an externality. "The concept of externality is therefore vague because every action has effects" (pp.70). In his opinion, the problem of social cost arises either

causes respiratory problems to `B`. If property rights over air to which `A` emitted smoke were well defined, `externality` would not have arisen as `A` would have known consequences of her action. Assume `B` to have property rights over air, then `A` would have had to fully compensate `B` for the injury. Alternatively if `A` were to have property rights, `B` would have had to bribe/persuade `A` for not emitting smoke⁸.

Part II : Attribute of an Externality

Once we have identified an externality, its various attributes need to be specified. This will enable complete description of the externality (Gupta & Prakash, 1992, 12-13, 16)⁹. We have grouped ten attributes under five categories viz: occurrence, polluter, spatial, time and technological. This shall be useful for the policy maker to devise appropriate policies for internalizing externalities.

a: Occurrence¹⁰

1. Occurrence of an externality may be certain (emission of smoke on burning of coal) or uncertain (nuclear leak in a reactor). Certainty/uncertainty can be over space (will it occur in a particular area), time (will it occur at/during a particular time), and beings (will it affect a particular set of human and other living beings).

For an uncertain externality, we may/ may not be able to quantify its extent, given a varying probability distribution of its occurrence¹¹.

due to absence of the right to contract, or the inability to draw a contract due to high transaction costs (pp.66)

However it is not clear whether the absence of the right to contract is due to conceptual reasons (how does one divide ownership of a public goods) or due to operational problems (conceptually it is possible but it is difficult to operationalize).

⁸ See Coase (1960), Demsetz (1964) for a full discussion on this aspect.

Opschoor (1961, 6) has observed that interests of the party, on whom the costs have been shifted, do not adequately get reflected, if the party does not have the means to exert `countervailing power` (Galbraith) through the political process.

⁹ We thank R T Krishnan, Kajoli B Krishnan; P D Jose, S Pande, K R Maitreyi, Manjula R S, and other participants of "Workshop on Externalities" (march 1993, Indian Institute of Management, Ahmedabad) for their comments.

¹⁰ We thank A R Pastakia for useful comments on this issue.

¹¹ Measurability of occurrence is not the same as (a) measurability of the extent of occurrence, (b) measurability of impact, and (c) measurability of the extent of impact.

Whether smoke was emitted or not (occurrence) from a power utility is an ordinal (yes/not) variable. This needs to be distinguished from how much smoke was emitted (extent of occurrence-cardinal variable), whether it had any impact or not (ordinal variable), and if there was an impact, how much was the impact (cardinal) on different beings.

When we cannot measure the impact on different beings, we are essentially acting as `trustees of uncertain interactions`.

Now a word of caution. Measurability of an externality depends on the availability of technology and on institutional factors. Are there institutions to undertake such measurements ? If yes, then the socio-political factors (ruling coalition defines the scale of measurement) will decide the space (in which areas) and the time (for how long) over which this measurement scale would operate¹².

b. Polluter

2. Identifiable / Non Identifiable

Can the source/s of pollution be identified (thermal plant in the hinterland causing air pollution) or not identified (undifferentiated and large number of emitters of a pollutant) ?

3. Single/Multiple Source¹³

If the source/s of pollution can be identified, how many are they ?

c. Spatial

4. Localized/Non Localized¹⁴

Is the effect of the externality limited to a specified geographical area or not ? The definition of `local' would depend on the perspective of the decision maker e.g. a national externality becomes local in a global perspective.

Associated with this attribute is the aggregation dimension of victims i.e. are the number of victims large ? are they scattered or are they localized?

d. Time

5. Regular/Sporadic

Is the pattern of occurrence regular (effluents discharged by a chemical factory at a fixed time every day) or is it sporadic (radiation leaks in a nuclear plant). If it is sporadic, then is it catastrophic (Bhopal disaster)¹⁵ or is it within the `tolerable/

¹² Veblen (1919,3) has observed that “it is evident that these principles and standards of what is right, good, true, and beautiful, will vary from one age to another and from one people to another”.

¹³ This has also been referred to as `point and non point' externalities (for example, see Bruggink, 1992, 2). We however, believe that single/multiple source is a better description of this phenomenon.

¹⁴ Sterner (1992, 122) has suggested classification of “externalities not only by their severity (e.g. ecological impact) but also by the distance (in time or space) the polluter and those affected”.

¹⁵ The institutions may respond to such catastrophic externalities through generation of redundancy. It is important to note that, “too much of redundancy can create inertia and too little can cripple” (Gupta 1985). Redundancy in the safety systems, rules of monitoring and processes of preparedness for emergencies have costs. Societal norms often define the maximum and minimum limits of these costs.

permissible' range (unexpected seepage from the water treatment tank of a fertilizer factory).¹⁶

e. *Technological*

2. Preventable/ Non Preventable

Externality can/cannot be prevented partially/ totally from occurring by modifying input mix, machine design, or process¹⁷ e.g. treating sewage prior to release in a water body can substantially reduce its ill effect on aquatic life.

To prevent an externality at a certain stage, we may transfer it to another stage, area, or constituent¹⁸ e.g. we may 'wash' coal (a very polluting process), and reduce its ash content. This coal is then used by power utilities, and there is a decrease in carbon di oxide emission compared to non washing coal. In this case there is a transfer of externality from power utilities to washeries. The alleged relocation of 'dirty' industries from developed to developing countries is an example of transferring externalities to another area.

3. Unidirectional/Reciprocal

Unidirectional externality arises when the agent of externality imposes an externality on others e.g. Prof. Coase's confectioner generating noise with his mortars and pestles and disturbing the doctor. When each agent imposes externality on all others, reciprocal externality arises (Dasgupta, 1982, 31) e.g. several fishing trawlers polluting same water body and decreasing catch for each other.

4. Insulable/ Non Insulable.

Polluter may/ may not be able to insulate herself from the externality e.g. workers of a nuclear power plant may completely insulate themselves from radiation leaks by using special radiation proof clothing.

¹⁶ Peezy (1988,193) has mentioned a few of the attributes discussed above "firms discharge effluents at a constant rate which causes non cumulative, reversible damage to the environment". We have taken these aspects as separate attributes because different combinations of these attributes may require different institutional solutions. This has been discussed subsequently in the paper.

¹⁷ The same technology may work differently in mitigating a given externality under different institutional settings. In the subsequent part of this paper, we have discussed the need for compatibility between technology and institutions.

In cases where the technology for preventing certain kinds of externalities is costly to develop, inter-mediation by a non-market body for subsidization of access to technology becomes imperative.

¹⁸ Dragun (1987, 865) observes, "Where secondary markets can be put in place... it appears that some transferability may be possible".

5. Immediate/Delayed manifestation

Does the externality manifest immediately on occurrence, only after some lag, or when it has accumulated to reach a threshold e.g. low intensity radiation exposure may show up after a lag in the form of diseases or genetic changes; Ozone layer got punctured only after accumulation of a threshold level of CFCs.

6. Reversible/Irreversible

Can the externality be reversed partially or fully ? Reversibility can further be evaluated along following lines:

- Reversibility over what time period? Plastic wastes may be degradable over such a long horizon (hundreds of years) that they constitute a de facto irreversible externality.
- Reversible through the process of nature (forests acting as a sink for carbon-di-oxide and restoring the composition of air) or through human intervention (Ganga Action Plan to clean up the river Gange)¹⁹. In fact to enable nature to correct damage, human forbearance (fencing of a forest so that it can regenerate itself) is necessary. Also human intervention may use agents of nature (bacteria used to clear oil spills) to reverse an externality.

Second order analysis of these attributes may reveal whether internalization can be done at individual or collective level or both. This leads us to the search of an appropriate institutional route for internalizing externalities.

Part III: Internalizing Externalities

Traditional literature discusses internalizing externalities either through state intervention (Pigou, 1932) or through a process of bargaining between the 'polluter' and the 'victim' (Coase, 1960). State intervention is either through state imposed taxes/subsidies (market mechanism), through 'command and control' policies, or a mix of both²⁰. There is also another route of internalizing externalities through evolution of self-governing institutions²¹. They impose a

¹⁹ Forbearance can be provided through physical or 'social fencing' i.e. people restraining themselves from entering forest through self-control or other institutions. Nature may thus be able to reverse the externality only if allowed to do so.

²⁰ For a discussion on the various mechanism for pollution control, reader may see (Walter, 1975, 94-120); Opschoor (1991); IUCN, UNEP & WWF (1991, Chs.8,11,17); Barbier (1992); Eskeland & Jimenez (1992); World Development Report (1992, Ch.3); Patrick & Safadi (1992); Robert & Whitehead (1992); Swaney (1987, 1992); Hausker (1992); King et.al (1992); Down to Earth (1993).

²¹ The term 'institution' implies several meanings. It can "refer to specific organization in a particular country, such as the Department of Irrigation.. (or) it can describe established human relationships in a society, such as a family structure (the institution of a family)... (or) an institution is simply the set of rules actually used (*the working rules or rules-in-use*) by a set of individuals to organize repetitive activities that produce outcomes affecting those individuals and potentially affecting others" (Ostrom, 1992, 19).

code of conduct on their members without necessarily requiring the support of the state of the market²². “Responsible Care” code of operation ethics adopted by major chemical companies of the United States is an example of this process (Leighton, 1992)²³.

Process of Internalizing Externalities

Internalization of externalities can be viewed as a four steps process.

1. Recognition of the externality.
2. Identifying the ‘perpetrator’ and the ‘victim’.²⁴

Institutions have also been described as “collective action in control of individual action” (Common, 1934, 69-70); “sets of routine practices” (Koslowski, 1992, 674); rules in repetitive decision making situations so that participants have reciprocal expectations about their respective behaviour (Elsner, 1987, 5-14); “define you may and ‘thou shaltnot’” (Neale, 1987, 1180).

Institutions provide assurances about the behaviour of the participants. Sanctions against violator reconfirm the assurances so that ‘the good guy does not turn out to be the sucker’. Readers may also see Sen (1967) and Runge (1981) for an interesting discussion on the ‘assurance problem’.

According to Neale (1987, 1183), an institution is identified by three characteristics, (a) there are a number of people doing things; (b) there are rules which give the activities repetition, stability and predictable order; (c) there are ‘folk-view’ explaining/justifying both the activities and the rules.

²² A self-governing system is that segment of society which govern itself for itself (Hawkins, 1992, vii).

Readers may see Weick (1977) for an interesting discussion on self-designing systems. Weicks has illustrated the issues through the example of the tussle between the astronauts and the ground station of Apollo 3 (which also resulted in first sit-down strike in outer space) on who should plan the activities on the Apollo craft.

Readers may also see Ostrom (1992, Ch.4) for the design principles in self-governing irrigation systems. These principles can serve as a useful reference for designing self-governing institution for internalizing externalities.

²³ Self-governing institutions can replace the external sword to discipline the participants. “Contemporary political theories frequently presume that individuals cannot make credible ex ante commitments where substantial ex post temptation exists to break them unless such commitments are enforced by an external agent”. However, “self organized institutions have been devised without reference to central authorities and sustained over long periods of time without enforcement by external agents” (Ostrom, Walker & Gardner, 1992, 404-405).

We believe that the enforceability of the ex ante commitments would also depend on the process of arriving at these commitments i.e. arbitrary, authoritarian, majority vote, consensus etc. Readers may also see Ostrom (1966,1990) and Wade (1987) for theoretical aspects and case studies about self-governing CPRs. For a pessimistic view on the ability of human beings to act collectively for a common goal, see Olson (1965).

²⁴ In some cases we also need to identify the ‘modifier’. Suppose ‘A’ emits a gas which by itself is neutralized by the ecosystem and no externality results. Enter ‘B’ who discharges water which reacts with the gas emitted by ‘A’ and causes ‘A’s action to become an externality. Now ‘A’ has become the perpetrator and ‘B’ the modifier.

3. Evaluation of the costs and the benefits of internalizing externality by each party²⁵.
4. Assignment of the costs and the benefits of internalizing externality.

First, a comment on the role of non-governmental third parties in relation to the 'perpetrators' and the 'victims' of the externality. Citizen groups, environmental groups, consumer groups etc., which (traditionally) have had no locus standi, can be an important influence in all four stages for internalization of externalities. Often the 'victims' are poor and illiterate who do not understand when their interests are being hurt. Hence the necessity for third party intervention on behalf of such citizens.

1. Recognition

Suppose there is a factory (Say 'A') discharging effluents into a river. Also assume that the quantity of effluents discharged is below the threshold so that downstream citizens using water from this river are not affected by effluents. Here the situation is piquant. Though the firm has externalized the cost, nature has diluted/absorbed the impact. Hence firm has not affected the utility or the production function of any other entity. Hence, by definition, no externality has arisen.

Now assume that, given this favourable cost situation, more factories (say 'B' 'C' and 'D') are attracted to this site, level of pollutants discharged increases, and down stream citizens are adversely affected. The occurrence of the externality is now recognized since utility functions of the citizens have been affected. 'A' has now becomes a perpetrator of the externality.

2. Identification

Pigouvians would view citizens as the victim and 'B', 'C' and 'D' as the perpetrators. How do we view 'A' ? Her actions become 'externality' only because other factories started operating ? Coasians would not debate about classification since, for them, assignment of liability by a third party is not needed. Bargaining amongst 'A', citizens, and 'B', 'C' and 'D' would decide compensation etc.²⁶

²⁵ As commented earlier, we should recognize cost and benefit of all living forms – human and non-human. The problem arises in operationalizing this concept as the non human world cannot tell us what the costs/benefits to them are. Invariably, human beings decide the utility function of the non-humans also.

²⁶ Externalities can be viewed as stock variables or as flow variables. In the given example, quality of water has deteriorated both because of accumulation of discharge of 'A' (stock variable) and due to increased discharge due to 'B', 'C' and 'D' (flow variable). We believe that liability be fixed separately for the two aspects.

3. Evaluation and Assignment

The pigouvian model would require a governmental intervention to decide the costs/damages. In a Coasian approach, bargaining amongst the three parties, given initial assignment of property rights, transaction costs and utility/production functions, would decide the compensation and assignment.

What Will happen in self-governing Institutions?

Continuing from the example discussed above, suppose all the factories are pronounced 'perpetrators' by the government and asked to pay compensation to the citizens. If these factories decide to self-govern their behaviour to eliminate the appearance of the externality. The following could be done.

1. Set a maximum aggregate limit of discharge so that nature is able to absorb the pollutants, and citizens do not feel its effect. A process of mutual bargaining shall decide on the distribution of discharge quotas, monitoring, penalties for violation, conflict resolution mechanism etc.²⁷
2. Install and operate a common effluent treatment facility themselves or through a contractor.

How to Internalize

Policy maker has to decide

- a) Which route/s to take to internalize externalities?
- b) What should be the criterion/criteria to decide the route/s?

First a slight digression. The concept of 'externality' has its parentage in neo-classical economies. Allocative efficiency (through adjustments at the margin) is the main concern of this school of economics. Neo-classical economies has also been extended to tackle issues of 'growth' and 'equity'. It is however (till date) unable to handle the issue of scale/ structure of the economy (Daly, 1990, 187-194; 1992, 187)²⁸. For environmental sustainability, both 'marginal' and

Suppose 'X' inflicts an externality on Victim #1 and the latter transfers it completely to Victim #2. Here both 'X' and Victim #1 would be viewed as 'perpetrators' and Victim #2 as the 'victim'.

²⁷ Readers may see Ostrom (1990, 50-55; 1992, 44-48) for a discussion on the need for a multiple level analysis (constitutional choice, collective choice, and operational choice) to understand rules affecting self-governing institutions.

²⁸ Daly (1992, 186) defines scale to be, "the physical volume of the throughput, the flow of matter-energy from the environment as low entropy raw materials, and back to the environment as high entropy wastes... its significance is relative to the natural capacity of the eco-system to regenerate the inputs and absorb the waste outputs on a sustainable basis".

Daly's contention of treating 'scale' separately from 'allocation' and 'distribution' is very persuasive. However the unanswered question is 'who shall determine the scale?' This becomes important for developing countries which are in the stage of resource intensive growth. Thus 'scale' issue gets linked with the issue of 'equity' between nations (Gupta and Prakash, 1993).

`structural' changes in the economy are needed (Bergstrom, 1993, 2). If environmental degradation at a global scale is primarily due to over consumption (a structural/ scale problem), then market mechanism (relying on marginal adjustments) may not be the right route. Markets may not generate the signals of environmental stress in time (since a market for such environmental services does not actively exist) (Dasgupta & Maler, 1991, 111), and the problem may have become irreversible by the time such signals are generated²⁹. Hence society needs to set a limit to the scale of exploitation by explicating, "social minims" (Kapp, 1963, 192-3)³⁰ or "ecologically bounded possibilities" (Dietz & Straaten, 1992, 45-51). Once these limits are set, we would then explore (market mechanism is one of the routes) the most appropriate route for internalizing externalities.

How to Choose

We propose that the criterion for identifying the right route should be minimization of total cost to the firm of internalizing externalities. Total cost has three components.³¹

1. Cost of Technology
2. Transaction Costs
3. Cost of Management/Organization

Reader may see Munshi (1951); World Commission on Environment & Development (1987); Foy & Daly (1989); Boja, Maler, & Unemo (1990); Panayotoy (1991); Lel (1992); Gupta (1993) for a discussion on sustainability.

²⁹ Chakravorty (1991, 69) observes, "the conventional approach based on the 'Hotelling rule' is not adequate to deal with the possibility of welfare loss over time... price interest regime cannot by itself cope with all the pertinent issues" (Chakravorty, 1991, 69). For a discussion on the 'Hotelling Rule', reader may see, Hotelling (1931) and Dasgupta & Heal (1979).

³⁰ Readers may see Kapp (1950, 1970) for a discussion on environmental problem from the perspective of institutional economics. Unfortunately, one does not find enough citations of Kapp's writings in contemporary articles, though he is one of the earliest proponents of a coherent viewpoint on this subject.

³¹ We are expanding on the framework proposed by Demsetz (1988, 146). He has identified the various costs which a firm needs to consider when evaluating 'make' or 'buy' decisions. Interested reader should also see Coase (1937, 1988); Teece (1980, 1983); Nooteboom (1992b).

Walter (1975, 21) talks of 'transactional costs' and 'recurring costs'. Transitional costs "involve the adaptation of existing plant and equipment, management practices, technology, labour and consumption pattern... recurring costs involve using more resources per unit of output.. in order to avoid environmental spillovers".

The choice between voluntary action and collective action, rests on the relative cost of organizing decisions, on the relative cost of social interdependence (sum of external costs and decision making costs) Buchanan & Tullock (1962, 43-62).

Cost of Technology

Internalizing externalities would call for modified/new process design and production equipment. This would entail adoption of modified/ new technology in the production, distribution, and disposal process³². The cost has two components:

i) Cost of buying the technology

Various technologies are available for internalizing the same externality e.g. soot emission from power utilities can be controlled by investment in coal washeries or by installing electro-static precipitators.

ii) Cost of using the technology

This refers to the efficiency (input-output ratio) of the technology. Which technology is cheaper to operate for a given level of performance?

Choice of the technology is not neutral to institutional design³³. Institutional choice is embedded in the technology e.g. big dams can be erected and maintained only by large bureaucracies, and not by small decentralized structures.

Transaction Costs³⁴

Transaction costs are costs associated with transfer, capture and protection of property rights³⁵. They arise when property rights are not fully delineated (Barzel,

³² Suppose firms are obliged to collect back the packaging materials (consumption externality) of its products from the consumer. The following institutional choices are possible: (a) municipal bodies collect/sort and the firms reimburse them, (b) firms use retailers to collect such material, (c) this task is sub contracted to a party which directly collects from the consumers on behalf of the firm/s.

³³ We thank Prof. Elinor Ostrom for highlighting this point.

³⁴ There is proliferation of literature on Transaction Cost Economics. Nooteboom (1992a, 66-69; 1992b, 282-2) identifies three causal factors for transaction costs to arise – bounded rationality, opportunism, and transaction specificity of assets. For further reading see Coase (1936, 1988); Williamson (1975, 1985); Demsetz (1988); Barzel (1989); Libecap (1989); Eggertsson (1990); Williamson & Winter (1991); Nooteboom (1992c)

³⁵ Property rights over resources are the rights to “consume, obtain income from, and alienate” these resources (Barzel 1989,2). They are a “claim to a benefit stream that the state will agree to protect through assignment of duty others, who may covet or interfere with the benefit stream” (Bromley, 1991,2). For a detailed discussion on property rights, reader may see Randall (1975); North (1981); Dragan (1987); Barzel (1989); Libecap (1989); Eggertsson (1990); Bromley (1991), Bailey (1992).

Vogel (1992, 23-24) has differentiated between the legal view and the economic view of property rights. To the lawyer, such rights refer to capacity to control a resource with the assent and assistance of the state i.e. rights have a de jure character. To the economist, assistance and assent of state is not key to the definition. What separates de facto from de jure is the magnitude of costs required for enforcement. For de jure rights, cost of enforcement is lower versus de facto rights as state enforces such rights. For de facto rights, non governmental enforcement is necessary.

1989, 2). They can also be viewed as the cost of organizing resources across firms (Demsetz, 1988, 143).

Transaction costs can arise before contracting for the technology (ex ante) and subsequent to it (ex post) (Coase, 1960, 15; Eggertsson, 1990, 3-32; Nooteboom, 1992b, 66-69)

Ex Ante Costs

1. Information collection
2. Search for supplier
3. Negotiating with the supplier
4. Framing the contract

Ex Post Costs

1. Monitoring and enforcement³⁶
2. Conflict resolution
3. Renegotiating with the supplier

Transaction costs may have a multi-period character. In many situations, ex ante and ex post costs are inversely related e.g. more investment in the search for information, identification of the supplier, and drawing of the contract (all ex ante), lesser could be the resources devoted to monitoring, conflict resolution, and redrawing of the contract (all ex post) due to formation of trust and elaboration of mutual expectations among the parties. If these costs fall in different time periods, discount rate (to get ex ante and ex post costs to the same base) becomes a crucial factor in deciding the trade off between them.

Transaction costs also arise in search of an appropriate institution for the new technology e.g. if polluting units decide to install a common effluent treatment facility, resources would be required to draw up the rules (how fixed and recurring costs would be divided, how much each unit can discharge, when etc.), monitor them, and enforce them.³⁷

Cost of Management/Organization

Post purchase, the technology needs to be made functional on the shop floor. This requires commitment of the internal organization. A modification in organization design, retraining, and the side payments to the coalition which is hurt (Libecap, 1989, 4-6), may be necessary. These (i.e. management) costs arise for organizing resources within a firm. These are distinct from transaction costs which arise for organizing resources across firms. Demsetz, 1988, 143).

³⁶ North (1981, 18-19) considers the cost of measurement to be an important component of the cost of compliance (compliance refers to monitoring and enforcement).

³⁷ Ostrom's framework (1990, 50-55; 1992, 44-48) of constitutional rules, collective rules, and operational rules, is useful in conceptualizing the various rules needed for self-governing institutions.

Management costs, like the transaction costs, also have an ex ante and ex post character e.g. in case of a self-governing institution, members may seek information from one another on the terms of internal exchange, collective and individual stands on internalization of externalities etc. A negative correlation may exist between ex ante and ex post costs. The greater is the effort in clarifying values, building trust, and evolving norms (all ex ante), the lesser may be the need for compliance structures (ex post).

Are the Three Costs Related?

Some elements of the three costs may be related e.g. if the new technology is complex (and its cost high), a significant modification in the production process may be necessary. Management will have to invest in training (skills and attitudes) of the work force. Training in this case includes set up and maintenance costs. Cost of management may therefore be high.

In cases where the costs are related, the direction of relationship between these costs may not be predictable e.g. suppose the cost of technology is high, cost of negotiation may be low (different vendors offering standardized products) or cost of negotiation may be high (small number of suppliers with non-standardized products).

Institutions and Stages of the Externality?

Choice of the institution also depends on the stage of environmental stress. Same institution may not be appropriate to arrest degradation, to regenerate, ad to sustain a resource³⁸. Let us illustrate. In many situations, command and control action have the fastest response time. Hence their appropriateness to prevent a major disaster or for emergency measures to combat a disaster e.g. a major oil spill³⁹. However in the long term, such policies may not be the most efficient (therefore fail on the basis of 'total cost approach')⁴⁰.

³⁸ The much quoted dictum of 'prevention is better than cure' is equally valid in case of internalization of externalities. The earlier we prevent and internalize, the lesser would be the cost (Kapp, 1963, 193). However the dictum throws no light on which institutions are best suited to 'prevent'. Hence the raison d'être of this paper.

³⁹ Mathur & Bhattacharya (1975) have highlighted how the district administration gears up to handle a crisis such as a drought. In such situations, the well rehearsed crisis drill comes into operation, and impediments/ inefficiency of a government functioning disappear.

⁴⁰ Most researchers on CPRs have recognized the need for institutions for generating option of sustainable resource use. For instance, Jodha (1992, 69) has observed in the context of Common Property Resource that their (i.e. CPRs) rehabilitation is less of an investment and technological problem and more of an issue of having appropriate institutions. Impact of investment and technology is short lived unless institutional aspects are effectively handled.

Contingency theories of organizational design (matching internal organizational structure with external environment) reflect a similar approach.

Externality Attributes and Institutions

Institutions differ with respect to transaction costs of creating them, management cost of their functioning, their response time to internalize externalities etc. Thus in many cases externality attributes may favour specific institutional arrangements. Let us illustrate.⁴¹

If occurrence of an externality is not measurable, markets and bureaucracies cannot function. Why will then a firm want to control such an externality? The self-governing institutions may provide the basis which is generated through collective processing of information and invocation of larger social goals.

Self-governing institutions (typically) require a long time to emerge though they may bring about durable changes in the behaviour of the participants. Further such institutions need time to stabilize; they go through a phase of experimentation before the norms are accepted. The rules help harmonize individual goals with collective goals.

In externalities, where both the damage is irreversible and quick action is necessary, such institutions may not work e.g. for sporadic catastrophic externalities (Chernobyl disaster); for certain almost irreversible externalities (Ozone hole); and when the polluter is not identifiable.

Government regulations can result in quick corrective action to change the behaviour of the actors (irreversible externalities, sporadic- catastrophic externalities). However, such measures may be inefficient in the long run if bureaucracy ossified due to absence of self renewal. In such cases market mechanism or self-governing institutions may become more efficient routes.

Government intervention may be appropriate for externalities which have a delayed action or which show up after a certain level of accumulation. Markets may not give timely feedback for corrective action as the externality has not yet been noted. Self-governing institutions may also not evolve to encounter such possibilities since the stake holders do not have the necessary motivation due to lack of information, short time frame, and large number of actors.

We may consider some other factors, in addition to the 'total cost' approach, for identifying the appropriate institutional route. Though the only criteria remains 'minimize total cost', these factors will help the decision makers to identify the trade offs involved in using the 'total cost' approach. These factors are: (a) fastest response time/speed of implementation (possible trade off between cost and time); (b) equity in distribution of costs and gains (trade off between equity and efficiency); (c) ability to weather hostile external environmental (trade off between survivability and cost).

⁴¹ A lucid discussion on the role of prices (measurability) rules (enforceability), and value orientation (predictability or assurance) in generation of market, bureaucracies, and clans or self design institutions is provided in Ouchi (1980).

Government intervention may not work for non-localized externalities (cross country pollution) where the origin of externality is outside the jurisdiction of the country. In such cases intervention by a super-national body may be needed. Market mechanism may be efficient for multiple source externalities where transaction cost of individual monitoring through government intervention or through self-managed institutions may be prohibitive.

Historicity in the Choice of Institutions

Institutions do not always arise spontaneously. They may have to be deliberately created and nurtured.⁴² Viability of an institution is context specific. Any society at any given point of time, has a given stock of institutions and tradition⁴³ which are critical in determining the viability of the new institutions i.e. there is a historical path dependency in determining the kind of institutions that can be adopted at any time (Libecap, 1989, 116). Existing institutions may hinder new institutions. These obstacles can be overcome at a cost. Such (transaction and management) costs are high specially when a `soft' state (Myrdal) tries institutional innovations which undermine the interests of powerful coalitions. This is pronounced in case of environmental issues where the generators of the externality typically belong to dominant groups (World Development Report, 1992, Ch.4)

Should All Externalities be Internalized?

Societies/communities need to decide the extent of internalization of externalities. Since social utility functions differ, the societies may attach different valuation to the same externalities.

When stock of savings is limited, income levels influence may influence the level of investment for internalization of externalities.⁴⁴ Natural endowments, climatic

⁴² Polanyi (1944, 250) has argued in the context of evolution of the market as an institution that "Economic history reveals that the emergence of national markets was in no way the result of the gradual and spontaneous emancipation of the economic sphere from the governmental control. On the contrary, the market has been the outcome of a conscious and often violent intervention on the part of the government which imposed the market organization on society for none-economic ends".

Koslowski (1992) argues that privatization of public sector in Eastern Europe has run into trouble since institutions necessary for a market economy are absent.

Libenstein (1984, 75) observes that "markets exist as a powerful coordinating mechanism but only when supported by other coordinating mechanism of non-market character. The simplest example is the system of weights and measures".

⁴³ In this context, "Kapp emphasized very early the illegitimacy of development economics to concentrate on purely economic factors and to ignore institutional arrangements that block development and institutional change"(Steppacher, Logg-Waltz, and Hatzfeldt, 1977, xviii).

⁴⁴ It is often argued that per capita income and pollution have an `Inverse U Shape' relationship. The early stages of growth are energy and resource intensive, hence high degree of pollution. In later

conditions, genetic and physiological constitution of the population⁴⁵ also influences the society's willingness to tolerate externalities (Lucas, Wheeler, & Hettige, 1992; Low, 1992; Summers, 1992).⁴⁶

The choice of the time frame and discount rate, to identify the least cost option to internalize externalities, is also society specific.⁴⁷ Time frame indicates the horizon of our costing and discount rate enables us to bring multi-phased costs on a single base.⁴⁸ Cost of technology (specifically the cost of using as opposed to buying the technology) needs a multi-period analysis since the technology will be in use for more than one time period. Cost of management also has a multi-period dimension because major organizational changes are implemented only over a period of time. We have already discussed the multi-period character of transaction costs. Since institutions may differ on how the various costs are spread across time, role of discount rate and time frame becomes important.

stage, with the decline in the share of manufacturing sector and the increase in the share of service sectors, levels of pollution decrease (Lucas, Wheeler, & Hettige, 1992, 69).

From the demand side, we hypothesize that in the early stages of industrialization, societies may perceive a trade off between growth and clean environment and opt for growth. Only after attaining a certain income level would demand for a high income elastic product like environment cleanliness arise.

⁴⁵ Sherpas have a greater capacity than the plain dwellers to tolerate the variation in oxygen content of air.

⁴⁶ If ecological regulations become stringent, ecological comparative advantage may become an important variable in determining location of units.

For India, concepts like growth centre based on ecological conditions may be proposed. Fiscal and monetary measures may be provided for shifting/locating industries in ecologically resilient areas i.e. where nature has a greater capacity to act as a sink.

If the power to levy ecological taxes/subsidies is vested with local bodies, fiscal decentralization may result. Since these bodies would best know the local conditions, they can correctly formulate the fiscal response for inviting/dissuading industries in their respective areas. However, this alternative may be limited by the poor revenue base of these bodies. Also such policies may get diluted/strengthened by the policies of state governments (.e.g. sales tax exemptions) or by the policies of central government (.e.g. excise relief.)

⁴⁷ See Markandaya and Pearce (1991) for an interesting discussion on use of social discount rate for evaluating environmental projects.

⁴⁸ Suppose an economy has stipulated a minimum internal rate of return for evaluating investments. Also suppose that the rate of return on an investment for internalizing a particular externality is below this cut off. In such a situation, society has to decide whether it wants to subsidize such an investment or not e.g. for 'merit goods' (Dasgupta, 1982, 70), society may decide to overrule the IRR constraint. We thank Keshav H. for highlighting this point.

We have shown in this paper how, to internalize an externality, various attributes of an externality may influence the cost of acquiring the using technology, ex ante and ex post management costs, and ex ante and ex post transaction costs. These costs in turn influence the choice of institutions. However, detailed specification of the design of these institutions, to deal with various stages of an externalities, and its social context, remains to be further explored.

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