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"The Choice of Pollution Control Policy Instruments in Developing Countries: Arguments, Evidence and Suggestions"

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I. Background

Concern about the environmental costs of economic development is now both widespread and intense. At one extreme, environmental deterioration, as through air and water pollution and deforestation, is seen as an unavoidable cost of industrialization, urbanization, and the growth of consumption (and the change in its composition) that are at the heart of "development" in the common use of the word. At the other, strongly influenced by the notion of "sustainability" that has been developed since the Bruntland Report (World Commission on Environment & Development, 1987), is the view that the environmental degradation being accepted by developing countries may well be enough to prevent them from continuing on a development path. Deterioration of natural resources and the health costs of pollution, may together overwhelm such growth momentum as has been generated by local and global policies and events. Somewhere in the middle of this polyphonic chorus of projection and advice lies the work on "environmental Kuznets curves", cross-section phenomena that seem to promise the possibility; at least, that growth and environmental quality may be reconcilable in the long run (e.g.; Stern, 1998).

In the terms of the above perspective, the choice of environmental policy instruments in developing countries has generally, though by no means always, been couched as a matter of "decoupling" development and the environment (e.g. Pearce, 1991, p. 51 and World Bank, 1992a, pp. 40 and 43). That is to say, the search has been for ways to attack environmental challenges that promise to have small negative, or perhaps even positive, effects on economic growth as traditionally defined. In the search for such desirable policy approaches, the early literature in environmental economics, when instrument choice was the dominant subject, and enthusiasm for economic incentive approaches was

very high, has been notably influential.[1]

Another intellectual thread worth teasing out as part of the background of the current situation, is the more general enthusiasm for free markets and undistorted prices that was generated by multilateral development organizations, with the strong backing of developed nations, during the 1980s. This was labeled the "Washington Consensus" by John Williamson (1990). The particular policy reforms being urged on developing countries under this approach included trade liberalization, unified and competitive exchange rates, fiscal discipline, the institution of secure private property rights, and deregulation (where government intervention was not justified by some clear evidence of market failure). This consensus, which also came to be called the "Universal Convergence" (Williamson, 1993), was officially extended to environmental matters when the World Bank publicly discovered and endorsed economic (or market-based) instruments (EI/MBI) of environmental policy in the 1992 *World Development Report* (World Bank, 1992a). This extension of the market consensus owed something to the stream of OECD publications in effect advocating the use of economic instruments in both industrial and developing country settings (especially OECD, 1989; OECD, 1991; Eröcal, 1991).[2] With the World Bank's weight behind it, the idea caught on widely that EI/MBI could be a major part of the resolution of the tension between the developing world's interest in industrialization and economic growth and the fairly obvious environmental damage they were doing themselves. (For an explicit claim that the "new" policy instruments de-link economic growth and environmental protection, see World Bank, 2000 pp. 40 and 43.) For a sense of the enthusiasm behind this movement, one of the best sources is Panayotou's paper in the Eröcal OECD volume (Panayotou, 1991). Under the prodding of the multilateral lending agencies and the OECD countries, developing countries have adopted a wide variety of EI/MBI, at least on paper. It seems, however, that the extent to which these instruments have been reflected at the level of

[1] For example, almost ubiquitously cited is the 1971 paper by Baumol and Oates that sets out some efficiency results to be discussed further below. Also Baumol and Oates, 1988.
[2] As Taylor, 1993, points out, however, it is not easy to trace the lineage of the World Bank's enthusiasm, since the Bank tended to cite primarily its own publications and working papers. In particular, it did not cite any of the OECD papers noted in the text.

decision making for the stack or wastewater outfall is a good deal less clear. On the other hand, some of the economic instruments adopted have been common-sense offshoots of the broader economic policy agenda of the Washington Consensus, for example, getting environmentally relevant prices, such as those for water and energy "right" by removing damaging subsidies.

II. Definitions, Distinctions, and The Plan of the Chapter

A. Definitions and Distinctions

Before laying out a plan for the rest of the chapter, this section will set out a few definitions and distinctions that will be useful later on

- Attention will be directed almost exclusively to pollution control policies. Much of the argument will apply with little change to other forms of human-induced environmental stress, but the chapter will not follow-up the parallels. It explicitly will not examine environmentally-related market pricing, such as that of irrigation water.
- Following the conventions of the literature the chapter distinguishes between the choice of policy goals or targets and the choice of instruments by which those goals are pursued. In principle, goals and instruments should be chosen together. Or, rather, if the proverbial can opener were available (in this case damage functions for each pollution discharge by source), the instruments as shadow prices (Pigovian charges) specific to source and pollutant would fall out of the grand minimization of the sum of damages and costs of reducing them. In practice, ambient environmental quality targets are chosen (or in more theoretical work, assumed to be chosen) by a political process, often with quasi-scientific rhetoric surrounding it. The debate about instruments is, then, a debate about how to meet those targets.
- "Efficiency" (or more accurately, static efficiency) is, then, the least-cost meeting of the targets in an assumed steady state. It is worth noting two phenomena accompanying this

narrow but practical view of efficiency. First, the outcome in physical terms (the pattern of discharges and resulting ambient environmental quality) will not in general bear any resemblance to the Pigovian ideal in which marginal damages caused by each discharge have been equated to the marginal costs of reducing that discharge. Moreover, damages may be quite a bit higher under a least cost solution to a regional pollution control problem of ambient quality standard attainment than under some "inefficient" alternative. For an illustration of this, see the dramatic contrasts in ambient air quality distributions under efficient and inefficient policy instruments in O'Ryan, 1996, who examines air pollution control alternatives for Santiago, Chile. Second, it is very difficult to observe efficiency, especially in situations in which location matters so that marginal costs at the efficient solution will not in general be equal across sources. Thus, in such a situation, for any policy instrument designed to meet an ambient quality target, there will be a total resource cost of the result. It is possible to say certain things *a priori*, based on economic models of the decision making of the dischargers in response to the instrument - - assuming, importantly, compliance with discharge standards or payment of proper emission charges. But it is a very big job to prove empirically that any one such observed result is or is not, in fact, least cost. To do so would require construction of a complete regional model containing all the dischargers' cost-of-reduction functions and the relevant natural world transfer functions.[3] Notice also that the available *a priori* models of discharger response are quite simple, certainly too simple to predict response to such information-provision instruments as eco-labeling of firms (dischargers) or products.

- The ability to produce static efficiency is only one of the several criteria on which

[3] A section of the literature (e.g.; Johnson, 1967; Atkinson and Lewis, 1974; Roach *et al*, 1981; Eheart *et al*, 1983; Krupnick, 1986; Seskin *et al*, 1983; Spofford, 1984; and O'Ryan, 1996; summerized by Tietenberg, 1996) "demonstrates" the efficiency results for EI/MBI using such regional cost minimization models containing empirically-based control cost models and mathematical representations of the regional environment. These are, however, just numerical extensions of the assumptions behind the more abstract results, not demonstrations that those assumptions are accurate representations of reality. For example, one cannot prove with a model that real tradable permit markets will proceed in a purely competitive and rational fashion.

environmental policy instruments may be and have been compared. The additional ones that are emphasized in this paper are:

- The extent to which the instrument's performance, especially in regard to static efficiency requires the responsible public agency to have access to information, especially information about polluters' cost of reduction functions.
- The possibility of a "second dividend" arising from the revenue produced by instruments such as emission charges or auctioned permits, when that revenue is substituted for distorting taxes on labor or products in the government's budget
- The relative size of the incentive to find and adopt environment-saving technological advances[4]
- The extent to which the instrument, in a particular application, is consistent with our ability to monitor and enforce continuing compliance.

Notice that the first three of these involve the same sort of application of *a priori* models as does static efficiency; and that compliance with instrument terms is also assumed in those models. The fourth criterion, what might be called "monitorability", is <u>not</u> symmetric with the efficiency, incentive, and revenue "theorems." This one involves empirical assertions about the ability to observe and usually to measure the outcomes relevant to the instrument. Most commonly, it must be possible to verify in a particular application that each pollution source is living within the terms of its permit to discharge, or is paying the correct total emission charge. But other instruments with quite different monitoring requirements exist as well. For example, a prohibition from using a particular input implies that the agency be able to identify when that input is in fact "slipped in." The requirement that a particular technology be in place requires that the agency be able to observe the relevant equipment and verify that it is properly installed.[5]

[4] This criterion may be seen as the practical fallback position when the "gold standard" would be dynamic efficiency with endogenous technological change. It is important to remember that there is no guarantee that a <u>larger</u> incentive is <u>better</u> in the full dynamic efficiency sense. It is emphasized in the literature because that is the problem economists can currently solve.

[5] Monitoring is logically prior to "enforcement", which is generally taken to mean the steps taken to punish non-compliance, most often application of fines. The existence of money penalties at the enforcement stage has led to a certain amount of terminological confusion in the literature on instrument choice. (For example, Panayotou, 1991, p.

- Finally, it seems desirable to draw attention to a bit of terminology, common in the instrument choice literature, but carrying such a load of misleading meaning as to in fact hinder the debate. This is the label "command-and-control" (CAC) for every policy instrument not included under the (often very broad) category EI/MBI. There are two problems with this label. The first is that it loads the dice against a very large set of instruments by implying that they have some kinship to or connection with the spectacularly failed command-and-control economies of the former Soviet Union and its Eastern European allies. This connection is made explicitly by Panayotou, 1991 (p. 87):

> "The non-spectacular performance of the regulatory approach and the promising potential of the economic approach have encouraged many countries, including a few in the developing world, to explore more seriously the market-based incentives. The massive collapse of the command economies of Eastern Europe, which incidentally revealed the failure of the command systems not only in economic but also in environmental management, gave added impetus to the search for workable market-based incentives."

But where is the usefulness of a parallel between an economic system, in which production was determined by central planners, and technology ordained by those same planners, and the use in pollution control of a permit allowing the owner/operator of a utility boiler, for example, to emit no more than X tons of SO_2 per month or year, with no requirement to use a particular technology to get there?

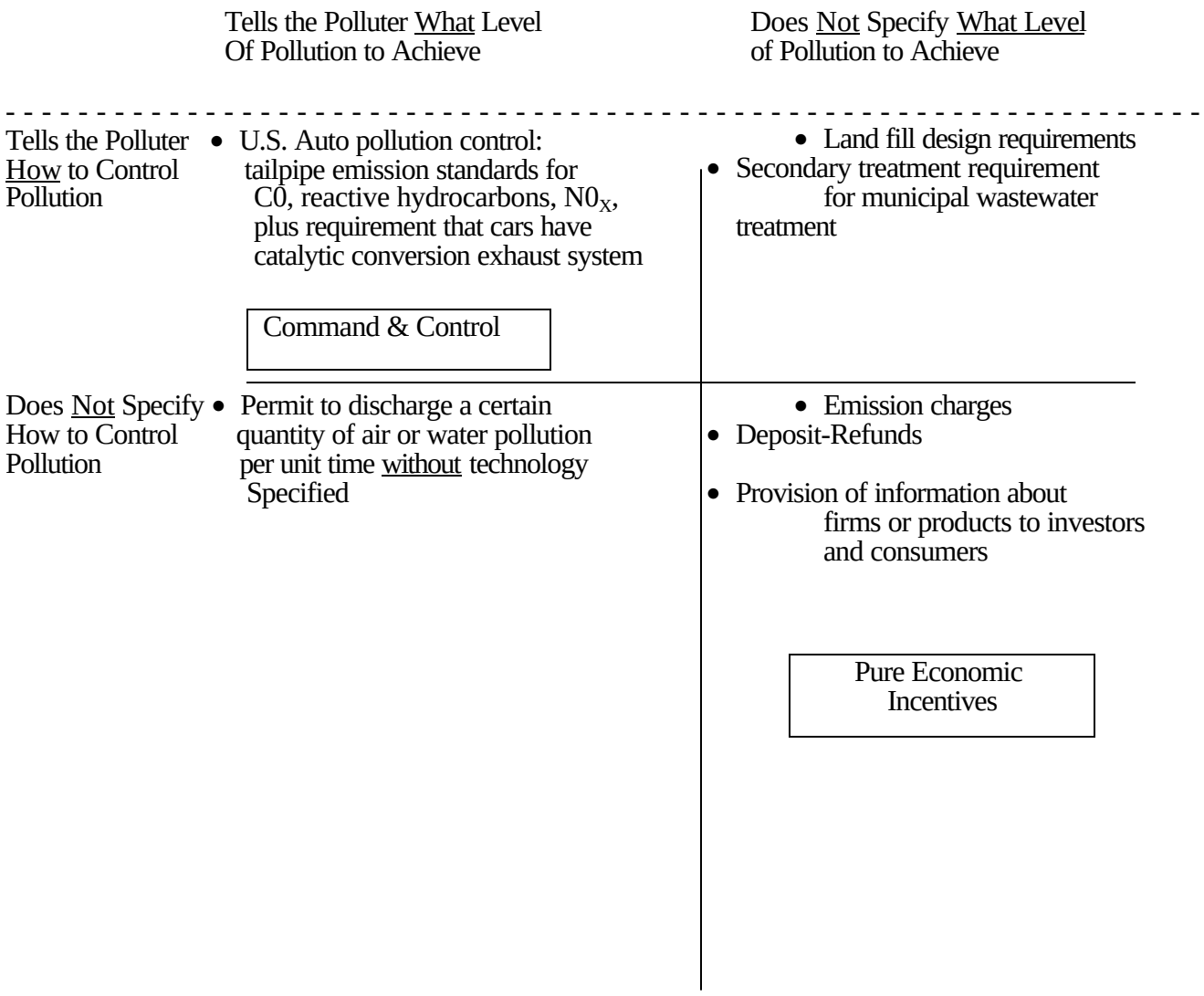
This objection should <u>not</u> be taken to imply that CAC methods were never used in pollution control in OECD countries. Indeed, the second objection to the use of CAC

94; Opschoor, 1994, p. 21; U.N. Commission on Sustainable Development, 1995; Serôa da Motta *et al*, 1999; Steele, 1999.)

as a label for “everything else” is that it fails to reflect the complexity of the situation. To see this point concretely, consider Figure 1 in which four varieties of instrument are distinguished on the bases: Does the instrument tell the source what to achieve or not? And, does the instrument tell the source how to go about achieving whatever is achieved or not?

Figure 1

Varieties of Pollution Control Instruments with Examples



The richness of the set of alternatives to "pure" EI/MBI is illustrated by this pair of distinctions.[6] In particular, the classic alternative of the discharge standard, however derived, is seen to be neither an EI/MBI nor a CAC instrument in any useful sense.[7] Thus, however convenient it may be to have a two-

[6]Marketable permits might arguably go in either of the bottom two boxes. At any one time, the source does face an upper limit on pollution discharge (what to achieve). That upper limit can be modified by market transactions; but this is not possible for all the sources collectively. The total upper limit is fixed. The provision of information as a regulatory tool certainly belongs in the lower right hand box (Not what/Not how), but because information operates on polluters via perceptions and decisions of investors or consumers, it is clearly not entirely symmetric with emission charges.

[7] Discharge permits can be derived from optimizing regional models, from the notional application of "best" technologies (as in U.S. water pollution permits) or via something as simple as equal percentage "rollbacks."

label system for argument's sake, the CAC label carries too much freight to make it useful in that role. It will be useful to substitute Panayotou's "regulatory alternatives" (RA) when it is necessary to refer to everything other than EI/MBI. More often than not, however, what will actually be at stake is the difference between a non-tradable discharge permit and a charge or marketable permit. [For a more inclusive list of available policy instruments, see Appendix 1 to this chapter.]

B. The Plan of the Chapter

The next section, III, will set out the major elements of the case being made by the enthusiasts for application of EI/MBI in the developing-country context. These elements are the same as those found in most discussions of instrument choice in OECD countries, but the relative emphases given them tend to be different because of the differences in the economic situations. In section IV, the case outlined in III will be examined with more care. In particular, some key places where the assertions of the enthusiasts go too far will be pointed out. More generally, the institutional demands implied by elements of the arguments will be made explicit. Then, in section V, the institutional theme will be expanded and a different consensus discussed, this one about the relative scarcity of institutional resources, both public and private, in developing countries. In Section VI, the chapter turns to the matter of developing country efforts to employ EI/MBI. It will be seen that many countries have one or more versions of these instruments on their books. The commentary of observers, however, suggests that on the ground, as opposed to on the books, the actual applications are tentative and not hugely successful. The last section, VI, will attempt to tie things together by linking institutional capacity building to "practice." In brief, the argument will be that a country is unlikely to be successful in policy result terms if it simply sets out to build "institutional capacity" through rewriting laws and training a few bureaucrats, and then turns on the EI/MBI policy implementation switch. Rather, it will be argued that institutional capacity is built by attacking policy problems with instruments that are chosen to be appropriate for the existing conditions and then altering and adapting both the institutional forms and rules and the instruments themselves as capacity grows. Bell (1997) has called this process the creation of a "culture of compliance", a phrase that seems especially apt because the analyses of

experience with EI/MBI in developing countries frequently find that failure to achieve compliance with whatever instrument is in use in the single largest implementation problem.[8]

III. The Case for Market Based Instruments in the Developing Country Context

There are many papers in the literature that make an *a priori* case for the desirability of EI/MBI in the developing country context.[9] In the process of distilling their arguments, about a dozen of them will be cited. Because there seems to be a broad agreement on the elements of the case, there is broad similarity in the structure and content of the papers, so it is not necessary to be completely inclusive to capture the important elements. Not surprisingly, the arguments depart from two major givens:

- That developing countries are, by definition, poor makes the saving of costs in pollution control especially important
- That developing countries generally have unsatisfactory tax systems, heavily dependent on distorting import duties and export taxes, makes potential new sources of government revenue especially desirable.

Beyond these fundamentals, other points often, but by no means always, made include:

- That the industrial sectors of developing countries are often made up of many relatively small firms and that knowing much about such details as their pollution control costs would be a daunting task
- That judicial systems in developing countries may operate with long lags
- That technology may be a problem, either because industrial process technology tends to be old and "dirty" or because treatment technology may not be "appropriate" for

[8] "Compliance" when the instrument is a permit clearly means living within it. "Compliance" in the context of a charge system has to mean paying for the correct amount of discharge per unit time.

[9] Here is a sample that covers the decade of the 1990s including 2000. No claim for completeness should be inferred. Lyon, 1989; Anderson, 1990; Eröcal, 1991 (including Panayotou, 1991 and Pearce 1991); Halter, 1991; Eskeland & Jimenez, 1992; O'Connor and Turnham, 1992; Bernstein, 1993; Bruce and Ellis, 1993; Panayotou, 1994; GTZ, 1995; Hansen, 1995; U.N. Commission on Sustainable Development, 1995; World Bank, 1997a; O'Connor, 1999; Steele, 1999; Blackman and Harrington, 2000; Stavins, 2000; World Bank 2000; and Seckler, n.d.

local conditions. Both are attributed to the fact that the technologies tend to be imported from the OECD countries.[10]

Building on these foundational observations, the major elements of the case for EI/MBI are: static efficiency; saving of information costs; the "second dividend" (or more simply, the revenue possibilities); the greater incentives for polluters to seek and put in place environment-saving technology when they face payments or opportunity costs for all units of discharge instead of just a requirement not to exceed a standard; and a "self-enforcement" aspect to charges in particular. These are presented here and examined in the next major section.

A. Static Efficiency. This is almost always the first element and cornerstone of the argument, and the motivation for it almost always is based on the observation that a pollution source facing a charge per unit of discharge (or holding a marketable permit with a price per unit discharge, whether buying or selling) will rationally equate his marginal cost of pollution reduction to the charge or price. This is taken, sometimes explicitly, sometimes implicitly, to imply that the aggregate of pollution control costs will be minimized whether the policy goal is stated as a total amount of discharge in a city (or region or nation) or the maintenance of an ambient environmental quality standard. Thus, consider several quotes from papers that span the decade of the 1990s:

- "Emission charges are efficient means for achieving the desired level of environmental quality because they minimize the costs of pollution control by leaving the level of individual pollution control and the choice of technology to the polluter." Panayotou, 1991, p.100
- In contrast to a [CAC] regulatory approach, that impose[s] specific mandatory actions on economic agents, economic instruments use market signals for

[10] This point about technology may suggest to the reader the "Clean Development Mechanism" (CDM), created by the Kyoto Protocol. This is an internationally-created policy instrument that, in effect, legitimizes green-house-gas emission trades between developed and developing countries (e.g., Fichtner, *et al*, 2001). Developing countries are free to participate or not in such trades, but the adoption (or not) of the instrument itself is not within their purview. Should a country choose to trade under the CDM by selling emission "rights", it would face a separate decision on how to live up to its end of the bargain - - what purely domestic policy instruments to choose. The CDM is not included in the rest of this chapter, but the interested reader may want to look at: Painuly, 2001; Philibert, 2000; and Forsyth, 1999; in addition to the paper noted above.

influencing their behavior and are often highly efficient in achieving environmental targets chosen by regulators. Economic instruments leave it to participants to choose their own measures to reduce external environmental effects . . .U.N. Commission on Sustainable Development, 1995, p. 17, paragraph 79.

- The static efficiency advantages of direct EI instruments stem in part from the fact that they leave firms free to choose abatement technologies that minimize costs in their individual circumstances . . . Perhaps more important, direct EI instruments create incentives for individual firms to choose levels of abatement that minimize the aggregate costs of achieving a given level of environmental quality." Blackman and Harrington, 2000, p.11.

Frequently cited original sources for these arguments include Baumol and Oates 1971 and 1988.

B. Information Economy. Here the argument is that because the cost minimization cited as the basis for static efficiency is done by each source in a decentralized setting, nothing need be known by the agency about the abatement cost functions of the individual polluters. Again, here are quotes that capture the flavor of the argument against regulatory approaches and for EI/MBI.

- "This direct regulation . . . suffers from many weaknesses: . . .(e) it requires that the environmental agency masters the technologies of both production and pollution control for hundreds of different types of industries and all their technological alternatives, a monumental task that detracts from the agency's principal monitoring function; . . ." (p. 97) and "Enforcement is easier and simpler because charges require no knowledge of the production and

abatement technologies of different industries. . .” (p. 100) both from Panayotou, 1991.

- “For a CAC policy to achieve the same result [minimization of aggregate costs of achieving a given level of environmental quality], the regulator must know the marginal abatement cost of every polluter. . .” Blackman and Harrington, 2000, p.11.
- “Command-and-control approaches could- in theory- achieve this cost-effective solution, but this would require that different standards be set for each pollution source, and, consequently, that policymakers obtain detailed information about the compliance costs each firm faces. . . By contrast, MBI provide for a cost effective allocation of the pollution control burden among sources without requiring the government to have this information. Stavins, 2000, p.2.

C. Government Revenue Possibilities. If the policy instrument chosen for pollution control is either a charge per unit of pollutant emitted or an auctioned permit to emit so many pounds or tons of pollutant per period, the government obtains revenue while, presumably, pushing pollution sources to clean up. In the developing country setting, new sources of revenue are typically seen as vital, and rather than entering into the complexities of the second dividend debate (e.g., Goulder, 1995, Whalley, 1998; Bovenberg and Goulder, 1996; Goulder *et al*, 1999), the value of supplementing unsatisfactory tax collection systems is taken to be essentially self-evident.[11]

- “Taxes and user [discharge] charges can make environmental management self-financing (and possibly even generate a fiscal surplus)

[11]The second dividend was originally proposed as an additional advantage of revenue-raising EI/MBI, for the revenue came without a dead weight loss - - or so it seemed in the partial equilibrium setting - - but substituted for taxes on labor or product sales that produced such losses. Things are much more complicated in the general equilibrium setting. See, for example, the papers cited above in the text.

rather than posing a continual drain on the government's limited resources." O'Connor and Turnham, 1992, p. 20.[12]

- Second, market based approaches may have important fiscal consequences for governments. . . by raising revenues through user fees or environmental taxes [which in this source are taken to include emission charges]. These sums may be considerable. World Bank, 1997a; p. 10.
- "While [efficiency] is theoretically interesting, it misses the much more important practical point that . . . pollution taxes generate revenue . . .It is the revenue-raising advantages of MBIs much more than the efficiency gains, which has been most responsible for their application in developing countries." Steele, 1999, p.276.

D. Incentives for Environment-saving Technological Change. The key observation here is that a charge on emissions applying to <u>all</u> units of emission above zero, or a marketable permit scheme with a fully functioning market, mean that <u>every</u> unit of emission has a clear cash or opportunity cost attached to it. This is in contrast, in this line of argument, to the situation with a non-marketable permit. Once the permitted level is achieved by discharge reductions, there is no incentive to reduce further, since only costs and no rewards would result.

- "[With an emission charge]". . . the industry will be under constant pressure to develop more cost-efficient ways of reducing or abating pollution in order to reduce its control costs or payment of charges." (Panayotou, 1991, p.100)
- By acting as continuous charges on pollution . . .MBIs encourage the search for better and better environmentally-friendly technology. While CAC approaches can induce technological change by setting standards slightly ahead of what is

[12] This quote raises the question of earmarking of the funds raised - - by assuming it will be done. While earmarking is generally frowned on in the public finance literature it is often taken to be <u>politically</u> necessary to getting EI/MBI adopted in developing countries (e.g.; O'Connor, 1999, p. 99 and 106; Steele, 1999, p. 275).

the "best available technology", technology-based standards are typically static in concept (Pearce, 1991, p. 52.)

- "…[the regulatory approach] provides little incentive to technical improvement once compliance has been achieved." (O'Connor, 1999, p. 92)
- "Because firms in direct EI programs can always increase profits by reducing emissions, such programs provide continuing incentives for emission reducing innovation." (Blackman and Harrington, 2000, p. 12.)
- "In contrast to command-and-control regulations, market based instruments have the potential to provide powerful incentives for companies to adopt cheaper and better pollution-control technologies." Stavins, 2000, p. 2.

E. Self-enforcing Character. The phrase "self-enforcing" is something of a show stopper for economists generally, for the profession has a tendency to assume that parties subject to <u>any</u> policy instrument wielded by an environmental management agency, be these regulations or charges or whatever, will be motivated to try to find ways around the situation, that is to cheat, in very direct common language. It appears, however, that the meaning of the phrase is that the use of charges on emissions, <u>assuming</u> accurate measurement of those emissions, implies that there is no need to <u>enforce</u> anything, as there would be if the instrument were a permit. Thus, if the measurements revealed a <u>violation</u> of the terms of a permit, the discharger would have to be penalized (perhaps after warnings and a chance to "voluntarily" come into compliance). The penalty is the enforcement mechanism and its imposition might well require passage through a hugely inefficient judicial system. With the charge, the measurement leads to a bill - - at least in a simple schematic version of the full process. So long as the bill is paid, there is no need to pursue "enforcement" as a separate and resource-using activity. [13] Thus:

[13] A certain amount of confusion is introduced into the discussion when some commentators classify the enforcement fines themselves (noncompliance penalties) as EI/MBI. For example, Bernstein, 1993; Steele, 1999; Serôa da Motta *et al*, 1999.

- ". . . the incentive structure facing the polluter is such that it promotes self-enforcement." (Panayotou, 1991, p. 100)
- In a broad sense the term "Market-based instruments of environmental policy" is used to cover all price-related and/or regulatory instruments that harness the commercial self-interest of actors (i.e. industry, farmers, transport users, or the population at large) for environmental goals. GTZ, 1995, p.1.

Taken together, the arguments presented above, in our words and those of the enthusiasts, seem to make a powerful case for the adoption of EI/MBI in developing countries. They are examined more closely in the following section in order that it be clear just how powerful the case really is, for that in effect is what will be given up if other instruments are chosen for reasons such as the fragility of developing country institutions.

IV. The Case for EI/MBI Examined and Related to Institutional Demands

In this section, the case just as presented is examined with some care, its strengths and weaknesses assessed, and its elements related to the demands they imply on institutional capacity, both public and private.

A. Static Efficiency. This is the weakest part of the case. The result that the enthusiasts take as writ (the result from the 1971 Baumol and Oates paper) is a special case. It assumes that only the sum of discharges matters, not the discharge locations. In the more general situation as for regional air and water pollution, location does matter. This implies that a single charge level applied to all sources (or a single market price for discharge permits) cannot, in general, produce the lowest cost meeting of given ambient quality standards. (This is demonstrated in Bohm and Russell, 1985.) Further, it has been shown (Russell, 1986) that the single charge or permit price solution cannot be asserted to be second best - - more costly than that produced by individually tailored (to the sources) charges or the ambient permit system of Montgomery, 1972, but cheaper than an arbitrary set of standards. (In the paper cited, the RA was a set of

discharge standards determined by the "rollback" method.) Evidence from a set of the regional models referred to above that demonstrates the result in particular settings may be found in Table 9, pp 68, 69 of Tietenberg, 1985. There, cost results for eleven runs from 8 models are summarized, with one column showing the ratio of costs of meeting the ambient requirements for the particular model using some version of a regulatory alternative to the cost using an emission permit trading system. In 5 of the 11 cases, the regulatory approach produces a cheaper solution. The lowest ratio is less than 0.5. That is, the regulatory approach is less than half as expense as emission trading in that run.

As hinted at in the quotations reproduced above, part of the argument for efficiency in the proponent literature is the notion that, because each source minimizes its costs, the aggregate of costs is minimized. This amounts to a version of the fallacy of composition. Each source is minimizing the sum of its abatement costs and its charge payments. But if the marginal charge payment - - the charge itself - - is incorrect for the attainment of the least cost solution to the regional ambient quality problem, then the sum of the individual costs will not be a minimum. (It is true that whatever total of discharges is attained will be attained at lowest total cost.)

As noted in Section II, there is a good reason why little is said about static efficiency in connection with newer EI/MBI, in particular the provision of information on polluters or their products. That reason is the lack of persuasive economic models by which the effect of information provision can be predicted. Proponents are thus limited to noting that it appears information can make a desirable difference (for example, on the environmental performance of firms: Afsah, *et al* 1996; Konar and Cohen, 1997; on consumer response to environmental product labels: Bjørner *et al*, 2002) and that it is comparatively cheap, especially if the agency relies on data supplied by the companies.

Finally, because it will be relevant in the next subsection, notice that, a trial-and-error approach to finding a single charge resulting in the meeting of a given ambient standard is conceivable (if not necessarily desirable).[14] But if individualized charges are required, trial and error will be impossible in any even remotely practical sense.

B. Information Economy. If static efficiency is to be attained (lowest cost meeting of given ambient quality standards) with either an EI/MBI or an RA, information on the marginal abatement costs of the sources involved will be required. This is true even in the simple case where location does not matter. The only way around this requirement is trial and error, and as just noted, that only seems even conceptually feasible when a single charge for all sources can be optimal.[15] If a marketable discharge permit approach is chosen, in the context of ambient standards, the problem is more complex. Even though a single permit price cannot produce static efficiency in general, the total of permits available has to be chosen with an eye to the ambient standard. In particular, some attention has to be paid to the possibility of "hot spots" - - violations of the standards resulting from a particular pattern of trades. With information on marginal costs, this process would be a good deal more satisfactory than without, for patterns of likely trades could be predicted in a regional trading model, and the total of permits to be created could be tailored so that predicted trades did not lead to hot spots. Without that cost information, to be completely confident of avoiding hot spots, the total of permitted discharge would have to be reduced until no set of trades (tending to aggregate discharges at one or a few points) could produce hot spots. This would

[14] Trial and error seems unlikely to be desirable because of the costs of the errors - -stranded capital from over-investment and cost penalties for building up capacity in too-small increments - -and because of the long lag each trial would imply.

[15] If the agency knew the marginal damage attributable to each source, and if that were constant, there would be no need for any cost information. This, in essence, is the earliest case for charges provided by Kneese (1964). If the marginal damages were not constant (damages were non-linear functions of discharge) the form of the charge would have to be more complicated, but if it were properly structured cost information would not be necessary.

probably lead to serious over control. (See Kruitwagen, *et al*, 2000 for a suggestion for "guided" trading to attain the cost-effective solution while avoiding hot spots.)

In summary, attaining static efficiency requires cost information and, in the general case, a modeling exercise to find the optimal price or permit set. Or else it requires an ambient permit system, which demands sophisticated trading from private business people.

C. Government Revenue Possibilities. This may be the strongest part of the case for at least the revenue-raising versions of EI/MBI. At one level, if a developing country is chronically short of revenue, and probably under pressure from international agencies to fix a tax system heavily dependent on import and export levies, any new source of revenue, but especially one with the side benefit of pollution abatement, will be attractive. At a more sophisticated level, recent work (e.g., Goulder *et al*, 1999, has shown that, in the second-best world of pre-existing factor taxes, the tax interaction effect, which raises the costs to society of policy interventions aimed at pollution control, non-auctioned, even if tradable, permits are much less attractive relative to pollution taxes or auctioned permits because the revenue recycling of those instruments partially offsets the tax interaction effect.

But it does seem desirable not to oversell this, and some of the enthusiasts have responsibly pointed out the tension between the abatement and revenue goals (e.g., Serôa da Motta *et al*, 1999; U.N. Commission on Sustainable Development, 1995, p. 25, paragraph 138, 139). This tension can be expressed in different ways. One is to observe that only by the greatest good fortune will a charge (or permit auction price) that results in meeting the desired ambient quality standard be the one that maximizes

government revenue. Another is to notice that the technology-encouraging characteristic of these instruments amounts to a constant pressure on the tax "base." An additional complication, as noted below, is that earmarking of the funds raised is often suggested, or even assumed, as part of the price of political feasibility. Earmarked funds, whether for environmental or other programs are not, of course, equivalent to general revenues. In addition, it is reasonable to ask just how important pollution-related EI/MBI revenues can be in the total revenue picture of a developing country. The answer would appear to be not very, though this is not to deny that every little bit can help. For example, the Swedish tax on carbon is said by Blackman and Harrington (2000) to have generated revenue in 1995 amounting to about 1% of the country's GDP, or perhaps 2-2.5% of government revenue needs. This is the result from a tax on a production (and consumption) input for which demand is almost certainly quite inelastic, at a level that doubled natural gas prices and almost doubled coal prices (though oil prices were only raised by 20%) and in a country with a highly efficient and reputedly honest tax service.[16] It would seem unlikely that more could be accomplished taxing discharges for which reduction technology is available, at rates consistent with political acceptability, and where tax collection is liable to corruption. As support for this speculation, note the figures quoted by Blackman and Harrington (2000) for Sweden's sulfur tax. This tax is said to generate only about 0.005% the revenue of the carbon tax. It is set at a level equivalent to about $1 per lb. of $S0_2$ generation, said to have been chosen to approximate the "average marginal cost of abating sulfur emissions" (Blackman and Harrington, 2000, p. 19). Finally, a back-of-the envelope calculation can be done based on some pollution-control models of industrial processes created at Resources for the Future back in the 1970s (Russell, 1973; Russell and Vaughan, 1976). In these models, at levels of discharge reduction in the range roughly 60-80%

[16] The tax is quite complicated in detail, and discriminates against $C0_2$ emitters who do not compete in world markets. But it does cover "almost all $C0_2$ emissions." (Personal communication from Peter Bohm, July 2002.) Bohm also confirms the above rough estimate of government revenue produced.

(from the uncontrolled levels) charge payments were roughly equal to the resource costs of abatement.[17] Estimates of the national costs of abatement are of course subject to manifold caveats and no two seem to agree exactly. But figures well less that 5% of GDP are common. While less pessimistic than the Swedish carbon tax results as a predictor of total charge revenue, this calculation does not suggest that a developing country government should pin high hopes for fiscal betterment on pollution-related charges or permit auctions. In any case, these (effective) taxes are by no means trivial to collect. Monitoring is required, as discussed in the next subsection. Bills must be prepared and payments made checked against emission reality.

D. Incentives for Technical Change. The relevant literature by now leaves no doubt that the incentives for environment-saving technical change produced by emission charges and regularly auctioned marketable permits are greater than those produced by unmarketable permits (the most likely regulatory alternative). And, certainly, technology specification tends to freeze in place the technology specified, thus, in effect anchoring the scale of possible effects at zero. Some of the enthusiasts, including several quoted above, however, imply that the non-marketable permit offers no incentive to improve technology. This overstates the contrast between instrument types, but is perhaps understandable because it is clear that, with a non-marketable permit (a fixed discharge standard), there is no incentive to

[17] Had the marginal cost of abatement been linear, it is easy to show that equality of charge payments and resource costs would occur at an emission charge that inspired a reduction to **a** the uncontrolled level.

reduce discharges below the standard. It is still possible, however, to save costs by finding and adopting technology offering lower costs of getting to the permitted level. A problem for policy in the RA case, therefore, is how to gain an environmental quality improvement from the new technology. This would occur automatically with a charge or auctioned permit; as marginal abatement costs fell, so would discharges. To achieve this effect with a regulatory approach implies some version of "ratcheting down." For example, if the permit terms are "technology-based", as they are in U.S. water pollution control law, the definition of "best-available technology" could be changed to take advantage of the technical advance. But, if it were known in advance that this were going to be done, the prospective

> gain from seeking the advance would be reduced . . possibly even eliminated. Even if it were not known in advance the first time, it would be assumed for the future once the ratchet had been applied. Finally, however, it is worth pointing out that this line of argument goes beyond the social desirability of cost-savings in pursuit of a given level of environmental quality and assumes the social desirability of better quality. This may have intuitive appeal, but it is clearly not logically supportable as a general proposition.[18] See, however, footnote 4 above.

E. Self-enforcing Character. It has already been suggested that the interpretation of this asserted characteristic rests on an assumption of meaningful monitoring. And monitoring is by far the tougher half of the monitoring and enforcement problem. In the context of this chapter, the point is that the "self-enforcement" claim amounts to very little. Any policy instrument that sets limits or prices for discharges of pollutants requires the same sort of monitoring enterprise - -one sophisticated enough to have a significant

[18] Not usually mentioned in the case for EI/MBI in developing countries is the advantage of flexibility in the face of change that is a property of marketable permits. In the developing, which is of course to say, changing, context, a charge would require constant updating, just to maintain the originally desired ambient quality level, forgetting efficiency. This would not be necessary with marketable permit system, though the caveat about hot spots would apply.

probability of detecting a violation of a limit or an incorrect charge payment. The setup and operation of such a credible system is institutionally demanding, arguably at least as demanding as the collection of fines for the violation established by it. In addition, charge payments will in general be substantially larger than non-compliance fees and will therefore generate larger incentives for corruption of responsible officials, a problem mentioned frequently in the literature on the actual efforts at implementation of environmental controls generally in developing countries.

F. By Way of Summary. The lessons that fall out of the above examination of the case for using EI/MBI in developing country contexts are:

1. That case has frequently been exaggerated by its proponents. In particular:

   a. Static efficiency (cost effectiveness in the attainment of ambient quality standards) does not follow as the night the day from the adoption of an emission charge or marketable permit. Rather it would require a great deal of technical knowledge, including knowledge of abatement cost functions, unless an ambient marketable permit system were put in place - -an experiment that no nation, in or out of the OECD club, has tried.

   b. The asserted "self-enforcing" character of EI/MBI has little practical meaning. Monitoring is necessary, whether to ensure that marketable permits are lived up to (and not used two or three times over after trades) or that the proper quantity of emissions are being paid for under a charge. And successful monitoring takes organization, technical skill, and freedom from corruption.

   c. The revenue aspect of charges or auctioned permits and the extra spur, which being the source of this revenue gives to polluters to search for better technology, are both real and potentially valuable. The revenue is

probably quite limited, however, relative to government needs even in the short run. In the longer run, the two characteristics are clearly at odds, since the second erodes the tax base on which the first depends. Further, collecting this public revenue is by no means obviously easier than improving other parts of the tax system. It requires a well organized efficient and honest civil service.

2. As emphasized above, capturing the advantages of EI/MBI is institutionally demanding - - at least as much so as the RA routes. There is, fortunately for the world view of the economics profession, no free lunch.

V. Institutional Capacity as a Scarce Resource in Developing Countries

Section IV stressed the institutional demands of environmental quality management, and the proposition that EI/MBI are at least as demanding on this dimension as the regulatory alternatives. This is important because there appears to be widespread agreement on the scarcity of such resources in developing countries. This is also true both at what might called the synoptic level - - data on many components of institutional design and functioning for many countries - - and at the level of country (or region-) specific commentary aimed specifically at analyzing environmental performance.

At the synoptic level, consider Table 1, which shows the characterization of public institutions by region modified from Table 5 of Straub, 2000 (p. 25, 26). These characterizations are based on factor analysis of 17 variables covering 57 countries.

Characterization of Public Institutions by Region

Table 1

Region	Characteristics
Europe, North America And Oceania [High level of development]	Democratic and equilibrated political system Good institutions

Latin America & Caribbean [Relatively high level of development]	Democratic and equilibrated political system Bad institutions
Middle East and North Africa [Low level of development]	Undemocratic political system with few checks and balances Rather bad quality institutions
Asia [Relatively low level of development]	Rather undemocratic political system with few checks and balances Intermediate institutional quality
Sub-Saharan Africa [Very low level of development]	Undemocratic political system with few checks and balances Relatively bad institutions

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A very similar, though considerably more detailed picture is painted by Payne and Losada, 2000. These authors constructed their own data set for what they call "institutional output categories" covering seven dimensions of what in this context may be called institutional capacity:

1. a. Respect for the rule of law, enforcement
   b. Respect for the rule of law, corruption
2. Predictability of policies and the legal framework
3. Strength of system of checks and balances
4. Extent of democratic political freedoms and civil liberties
5. Effectiveness of market regulations and sectoral economic policies
6. Effectiveness in ensuring the efficient and equitable delivery of public goods and services.

The numbers of countries for which they have observations for all the underlying variables within each dimension is different across the dimensions, and, perhaps to skirt this limitation, they present the results relevant to our discussion as averages of dimension scores across groupings of countries. For every dimension, the "high income" countries score substantially higher on average than the next best country grouping. That next grouping is Central and Eastern Europe for 4 dimensions, East Asia for 2, and Latin

America and the Caribbean for one. At the other end of this scale, the worst average scores are those for Sub-Saharan Africa, 3 times (tied twice); Former Soviet Republics, 3 times; Middle East and North Africa, twice (tied once); and South Asia, (tied once).

Average Regional Scores on the Regulation and Management Indicator

Table 2

Region or Group	Score
High Income Countries (23)	0.74
South Asian Countries (8)	0.24
Latin American/Caribbean Countries (22)	-0.15
East Asian Countries (8)	-0.22
Sub-Saharan African Countries (25)	-0.26
Central and Eastern European Countries (14)	-0.28
Former Soviet Union Countries (10)	-0.59
Middle Eastern & North African Countries (12)	-0.64

Data Source: Global Leaders of Tomorrow Environment Task Force World Economic Forum, 2001, Annex 4.

Another example of quantitative comparison of institutional strength is shown in Table 2: aggregated data from Global Leaders of Tomorrow Environmental Task Force, World Economic Forum, 2001, Annex 4, table of scores on the indicator labeled “Regulation and Management”, an environment-specific effort to capture regulatory capacity. The component indices of this summary indicator are: stringency and consistency of environmental regulation, degree to which environmental regulations promote innovation, percent of land area under protected status, and number of sectoral environmental impact assessment guidelines. The scoring has been “normalized" so that the mean of the country scores is zero. One suspects that the inclusion of the (nominally at least) protected land sub-indicator is responsible for a good deal of the difference in orderings observed between this and the previously reported rankings. In particular, the eastern and southern African countries show up well here and tend to pull up the Sub-Saharan country average. But the message is not fundamentally different: attempts to objectively compare institutional capacity across countries consistently show the poorest having the weakest public institutions.

Finally, not to flog the proverbial dead horse, qualitative comments about institutional weaknesses in developing countries are common in assessments of their experience with environmental policy alternatives and of their readiness to innovate in the direction (usually) of EI/MBI. Examples include: Gray, 1991; Bernstein, 1993; Oxford Analytica, 1994; Lovei, 1995; BCFSD, 1995; IADB, 1996; BNA, 1997; Hirschmann, 1999; Nolet, 2000; Romero-Lankao, 2000; UNEP, 2000.

At a finer level of detail, consider the specific weaknesses identified by commentators on developing country institutions.Four problem areas are noted quite consistently.

- A lack of well-trained people in the civil service bureaucracy - -whether the training be technical, as in running and maintaining complex equipment; implementing regulations in the field; translating laws into regulations; preparing cases against violators of regulations; or maintaining large databases. (For example, see: Gray, 1991; Tribe, 1996; UNEP, 2000; Huber *et al*, 1996; Kozeltsev and Markandya, 1997; Romero-Lankao, 2000; Bell, 2001; and perhaps most comprehensively, Hirschmann, 1999, who provides a history of changing fashions in development, of failed efforts to fix the civil service in line with the fashions of the decade, and of the negative impact all this has had on public institutional capabilities.)
- Lack of information available to responsible agencies, including such fundamental information as inventories of polluters and pollutants in the baseline situation. (For example: Tribe, 1996; BNA, 1997; UNEP, 2000).
- Quite specifically, a lack of point-source pollution monitoring equipment and of people trained to use it and analyze and interpret the results. (For example: IADB, 1996; BNA, 1997; Kozeltsev and Markandya, 1997; Lakhan *et al*, 2000; and Nolet, 2000.)
- A ubiquitous problem of corruption, usually traceable to underpayment of the civil service and a sort of tacit acceptance of the result - - the use of the regulatory system for private

gain rather than the achievement of intended public benefit. (For example: Oxford Analytica, 1994, especially chapter 7; Buscaglia *et al*, 1995; BNA, 1997; Ardila, 2000; Nolet, 2000.)

The result, regularly noted in surveys of country experience, tends to be a gulf between the laws and regulation on the books and what polluters are actually responding to in the field. Probably most important is the widespread failure to monitor discharges effectively. The frequency of measurement tends to be too low to imply a significant probability of finding a violation of permit terms or a mispayment of a charge. There may also be a failure to measure with "surprise", so that what is observed is not a sample of what is actually happening; rather it is a sample of what the polluter is capable of achieving given sufficient advance warning. When courts are relied on for enforcement (punishment) the process can be hugely drawn out so that, even if a penalty is eventually extracted, its present value at the time non-compliance is chosen as a strategy is very low. This reflects inadequate resources devoted to the judicial system, the availability of delaying tactics, and quite possibly better lawyering available to the private sector (e.g., Buscaglia *et al*, 1995).

Short of even going to court, the search by civil servants for "rents" to supplement low salaries, means that discovered violators are likely to be able to make side payments, amounting to less than possible penalties, directly to the local enforcement group.

When charges for pollution emissions are in place, their values seem regularly to be set and more or less forgotten, so that their real values are eroded by inflation. And, since high levels of inflation have been endemic in the developing world (including here the states of the former Soviet Union and its Eastern European allies) the erosion can be quite rapid and dramatic (e.g.: Golub and Gurvich, 1997; on the Russian experience from 1990 to 1996 with pollution charges).

While it is fairly easy to identify the symptoms of institutional weakness, it has proved to be far from

easy to fix the problem. Indeed, Hirschmann (1999) is pessimistic about even the possibility of repair, finding that the enthusiasm for privatization and the shrinking of governments, coupled with the budget crises that have reduced salaries of civil servants to very low levels, may together have pushed "morale and ethics of the bureaucracy" so low as to preclude turning things around (p. 303). Further, studies such as that by Straub, 2000, attempting to "explain" differential institutional quality across countries are not encouraging. Straub concludes: ". . . the results prove not robust . . .yielding no clear insights. We conclude regarding the fragility of existing data, in particular with respect to the incentive structure, and the need for a better theoretical understanding of the underlying mechanisms." This has not stopped national and multilateral development agencies from generating recommendations for "institutional capacity building." Prominent examples include: OECD reports stressing the development of legal structure, including property rights (OECD, 1993 and Opschoor, 1994); work by and for the Inter-American Development Bank, (for example, Dourojeanni, 1994; Oxford Analytica, 1994; Tlaiye and Biller, 1994; and IADB, 1996); the U.N. Environment Program (UNEP, 2000); and USAID (for example, the work of the Harvard Institute for International Development, as in C4EP/NIS 1996). The ideas and recommendations to be found in these published and unpublished works are neither surprising nor outrageous. They attempt to identify solutions for exactly the weaknesses noted above:

- Designing better organizations and legislation
- Training civil servants and judges in necessary technical matters for implementation, monitoring and enforcement of policies
- Encouraging greater and better-informed public participation
- Identifying sources of "sustainable" funding for environmental institutions.

Nonetheless, the institutional problems persist. Though particular observers argue that real improvements can be identified in particular places, seen broadly it would appear that progress is slow. Consider this statement from UNEP, 2000, and referring to Latin America (p. 92)

> ". . . Environmental policy implementation is often difficult given the lack of appropriate control, monitoring and start-up mechanisms. In some cases the legal framework for environmental management is diluted in numerous legal texts and throughout diverse institutions, and environmental matters are often delegated to several public institutions at different political levels. The creation of new policies and institutions does not always include a revision of previous legislation."

It is not necessary, nor is it particularly helpful, to posit incompetence on the one side or perversity on the other as explanation for slow progress. Changing institutions is inevitably slow work, if for no other reasons than that institutions reflect and are part of culture more broadly. But there may be one or two more specific observations that imply actions other than just exercising patience. One is from Turnham, a long-time student of the environmental management process in developing countries (Turnham, 1991). He worried back in the early days of the "new thrust on environmental management", that relatively too much effort was going into the design of new programs and relatively too little into the analysis of their subsequent success or failure. Arguing from what he, at least, saw as the failure of the World Bank's assault on poverty under Robert McNamara, he claims there was then too little learning from experience, a result that seemed likely to be repeated in the environmental policy area (p. 377-378). A second sort of observation comes from Bell, who has participated in institution building in several countries in Central and Eastern Europe. Her analyses of successes and failures suggest that obstacles to progress are created the combination of: the inevitable awkwardness of outside-in efforts ("We're from Washington [or London or Paris] and we're here to help you."); the fundamental difficulties of communication across language and cultural barriers; and the asymmetry of motivations of the parties (e.g., Bell, 2001).

VI. Experiment and Experience with EI/MBI in Developing Countries

To say that more than a few observers share our concern about institutional capacity, and that fixing the problems identified is proving to be far from easy is, of course, not to say that EI/MBI are absent from the pollution-control policy tool kits actually employed by developing countries. Quite the contrary, a large number of countries have adopted specific versions of these instruments, and the adoptions have involved a variety of pollution settings.[19] Inventories and at least qualitative assessments of performance are available. Several of these have already been referred to in the institutional sections, because the performance remarks made in them tend to identify institutional weakness as the key to poor instrument

[19]The number of countries involved is not noticeably affected by adopting modest limits on what constitutes an EI/MBI. In particular, non-compliance fines are not taken to be EI/MBI, but part of the enforcement structure required with any regulatory or economic approach. Nor is the abandonment of environmentally harmful subsidies counted, though this is a useful policy action and undoubtedly "economic."

performance when that is observed. In any case, Table 3 summarizes information on the prevalence of the instruments, and Table 4 contains a list of country-specific studies of applications of EI/MBI. (Most of the country studies include many instruments that are outside the terms of reference chosen here. These include: changing subsidies on energy and water and introducing new fishery and forestry management tools.)

Table 3 contains some interesting patterns. Most obviously there appear to be regional "fashions" in adoptions of EI/MBI. The countries of Central and Eastern Europe (plus Russia) are committed to emission charges on specific air and water pollutants. A couple of Asian countries have air or water charges, and five use sewage treatment charges, as do four Latin American nations. But the latter regional group is far more committed to using lump sum and marginal subsidies (the latter as deposit-refund systems), albeit in fairly limited contexts. Both Asian and Latin American nations have information provision programs in place, the most widely publicized of which is the PROPER program in Indonesia (with a spin-off to the Philippines). It is not clear from our sources why these patterns exist, though some reflection suggests that one causal factor may well be the nature of the environmental challenges faced. Thus, in Central and Eastern Europe, there exists a substantial amount of heavy industry, much of it with an aging and energy-inefficient capital stock, and often with a history of using "dirty" fuels such as "brown" coal. It is easy to see that air pollution could seem the most urgent problem in such circumstances. Latin America, on the other hand, faces challenges created by rapid and essentially uncontrolled urbanization. Prominent among these are lack of piped water supplies with intake treatment, and "neighborhood" water pollution from lack of household sanitation facilities. Water supply, sewering, and sewage treatment are high priority efforts (e.g., Russell *et al*, 2001).

Table 3 Use of Economic Instruments in Transition and Less Developed Countries

Instrument	Asia	Central/Eastern Europe	Former Soviet Union	Latin America & Caribbean	Other
1. Emission Charges, Air[c] a. Carbon Monoxide		Czech Rep. (e)[a] Estonia (e) Lithuania (e 70) Poland (e) Slovakia (e)	Russia (e)		
b. Sulfur Dioxide	China	Bulgaria (e 70) Czech Rep. (e) Estonia (e 50) Hungary (e 70) Lithuania (e 70) Poland (e) Slovakia (e)	Russia (e)		
c. Nitrogen Oxides		Bulgaria (e 70) Czech Rep. (e) Estonia (e 50) Hungary (e 70) Lithuania (e 70) Poland (e) Slovakia (e)	Russia (e)		
d. Combined or Unspecified	China [Korea][b]		Kazakhstan		Egypt
2. Emission Charges (Water)					
a. BOD	Malaysia Philippines [Korea]	Bulgaria (e 70) Czech Rep. Estonia (e) Lithuania (e 70) Poland Romania Slovakia Slovenia		Brazil Colombia (e)	
Instrument	**Asia**	**Central/Eastern Europe**	**Former Soviet Union**	**Latin America & Caribbean**	**Other**
b. Total Suspended Solids	[Korea]	Bulgaria (e 70) Estonia (e) Lithuania (e 70) Poland (e)		Colombia (e)	
c. Nitrogen & Phosphorus		Estonia (e) Lithuania (e 70)			

d. Combined or unspecified	China India [Korea] Malaysia Philippines Thailand	Latvia Slovakia (e)		Brazil Mexico	
e. Sewage Treatment Charges	China Indonesia Malaysia Singapore Thailand			Brazil Chile Colombia Mexico	
3. Solid Waste Disposal Fees	[Korea] Thailand	Czech Rep. Estonia (e) Hungary Latvia Poland (e) Slovakia	Russia	Ecuador Venezuela	
4. Hazardous Waste/Disposal Fees	China Thailand				
5. Other taxes/fees					
a. Leaded gas price differential	Philippines Turkey			Mexico	Egypt
6. Tradable Permits or Quotas					
a. Air Pollution		Czech Rep. Poland (e)	Kazakhstan	Chile	
b. Ozone Depleting Substances	Singapore	Latvia		Mexico	
c. Vehicles	Singapore				
Instrument	**Asia**	**Central/Eastern Europe**	**Former Soviet Union**	**Latin America & Caribbean**	**Other**
7. Subsidies					
a. Capital or Lump Sum	Sri Lanka	Bulgaria Czech Rep. Estonia Hungary Lithuania Poland Slovakia	Russia	Barbados Brazil Chile Colombia Ecuador Jamaica Mexico Venezuela	

b. Marginal/Deposit Refund i. Beverage Containers	[Korea] Taiwan	Czech Rep. Hungary Poland		Barbados Bolivia Brazil Chile Colombia Ecuador Jamaica Mexico Peru Trinidad-Tobago Venezuela	
ii. Auto Batteries				Mexico	
iii. Other or Unspecified	Bangladesh [Korea] Philippines				
8. Information-Firm or Product "Labels"	Bangladesh China Indonesia [Korea] Philippines Taiwan Thailand	Hungary		Bolivia Brazil Chile Ecuador Mexico	
9. Liability				Bolivia Colombia Trinidad-Tobago	

Sources for Table 3

1. Serôa da Motta, Ronaldo, Richard M. Huber and H. Jack Rutenbeek, 1999. "Market-based Instruments for Environmental Policy-Making in Latin America and the Caribbean: Lessons from Eleven Countries", *Environment and Development Economics*, 4(2), 177-202.

2. Stavins, Robert N., 2000. "Experience with Market-based Environmental Policy Instruments", Discussion Paper 00-09, Washington, D.C., *Resources for the Future*.

3. World Bank, 1997. *Five Years After Rio: Innovations in Environmental Quality,* Environmentally Sustainable Development Studies and Monograph Series, No. 18. Washington, D.C., World Bank.

4. Anderson, Robert, 1997. The U.S. Experience with Economic Incentives in Environmental Pollution Control, Washington, D.C., Environmental Law Issue.

Notes:

[a] Stavins' Table 1 indicates where it is known that revenue from charges is earmarked and the percentage split between environmentally earmarked and general fund uses. Here (e) means that 100% of revenues are earmarked for environmental funds at one or more jurisdictional levels; (e 50) or (e 70) indicated 50% or 70% of revenue is earmarked.

[b] Korea, that is the Republic of South Korea, is put in brackets because it recently joined the OECD, but is still in some ways institutionally "developing."

[c] Anderson (1997) lists Romania as having air pollution charges but describes them as penalties for failing to meet a standard.

Beyond those observations, however, it is difficult to see reasons for some parts of the pattern. For example, why should the Latin American and Caribbean countries so enthusiastically have embraced subsidies, both lump sum and marginal (in particular, deposit-refund systems for beverage containers)? Granted that the latter instrument changes the burden of proof in situations of difficult monitoring, but why confine the application to beverage containers (with the one Mexican car-battery exception)? Along similar lines, the information-provision programs aimed at the performance of firms (as opposed to the characteristics of products) have explicitly been sold as substitutes for highly imperfect systems of monitoring and enforcement. The descriptions of the results in Indonesia (e.g., Asfah, *et al*, 1996; Wheeler, 1997) tend to be enthusiastic, and the World Bank's clout lies behind the effort. So perhaps a similar survey in 2005 will see a significant expansion of their application. For now, the information-provision instrument seems to be spreading in Asia with outposts - - less well documented - - in Latin America.

So much for cataloging efforts to use EI/MBI. Eventually, it will be useful to have a reasonably comprehensive assessment of these efforts. For now, much of what is in the law books appears to be only imperfectly implemented in the field, and even for systems that are in operation, the periods involved have been quite short. (Or else, as in Russia and Central and Eastern Europe, charging schemes dating back to Communist days, but admittedly ineffective then, are being "repaired" by new governments and responded to by newly privatized industry.) Relying on the research reported in the Table 4 sources, however, one can at least get an impression of the experience so far. Some of this has already been referred to; in particular, if there is an over arching theme it is that monitoring (and thus enforcement) has been almost everywhere weak, for all the reasons noted in the section on institutional weakness.

Citations to Sources of "Case Studies" of Particular Countries

Table 4

Argentina	IADB, 1996; Margulis, n.d.
Barbados	Huber *et al*, 1996
Bolivia	IADB, 1996; Huber *et al*, 1996
Brazil	Tlaiye and Biller, 1994; Huber *et al*, 1996; IADB, 1996; Benjamin and Weiss, 1997.
Chile	Huber *et al*, 1996
China	Blackman and Harrington, 2000
Colombia	Tlaiye and Biller, 1994; Huber *et al*, 1996; Ardila, 2000
Czech Republic	Opschoor, 1994
Ecuador	Huber *et al*, 1996
Estonia	Opschoor, 1994
Guyana	Lakhan, *et al*, 2000
Hungary	Opschoor, 1994
India	Bradley, 1998
Indonesia	O'Connor, 1993
Jamaica	Huber *et al*, 1996
Kenya	Ayoo and Jama, 1999
Korea	O'Connor, 1993
Mexico	Huber *et al*, 1996; Margulis, n.d.; Bradley, 1998.
Paraguay	IADB, 1996
Peru	Huber *et al*, 1996
Poland	Opschoor, 1994; Zylicz, 1995; Anderson and Fiedor, 1997; Bradley, 1998; Blackman and Harrington, 2000.
Russia	Opschoor, 1994; Kozeltsev and Markandya, 1997
Slovak Republic	Opschoor, 1994

South Pacific Island States	Hunt, 1997
Sri Lanka	Steele, 1999
Taiwan	O'Connor, 1993
Thailand	O'Connor, 1993
Uruguay	IADB, 1996
Venezuela	Huber *et al*, 1996; Ardila, 2000

In addition, there is a widespread problem of the levels of charges being too low, either because they were set that way for political reasons or because inflation has eroded their real value. On a more positive note, there has been reasonably good experience, so far, with the use of "environmental funds" at every level of jurisdiction, from local to national. These have most often been funded from the proceeds of emission taxes (see Table 3 for evidence on the extensive use of earmarking) and used to pay for pollution control equipment, both public and private. The effect seems to be that charges do little to affect discharges, but subsidized investment in control equipment is seen as more successful, at least in the short run.[20]

VII. A Concluding Suggestion

The environmental economics literature on policy instruments rests on a carefully developed base of *a priori* arguments (including regional modeling studies under this label) exploring the advantages of EI/MBI in relation to regulatory alternatives. Two aspects of this literature seem to have been underplayed - - even ignored - -by the most enthusiastic proponents of the application of EI/MBI in developing countries. The first of these is that there are links among the dimensions of advantage that imply the impossibility of the proberbial free lunch. Two important examples are: 1) Achieving static efficiency in the general case in which source location matters requires either that the responsible agency have an enormous amount of polluter-specific knowledge and the technical ability to use it in a regional optimizing model, or that tradable ambient permit system be put in place, which would place heavy demands on the skills of the sources themselves; and 2) Revenues gained from charges are in tension with desired incentive effects, are politically expensive, and over time tend to erode the taxbase by encouraging technological innovation that cuts discharges. The second major aspect of the literature that requires emphasizing is that it is all based on assumed compliance, whether this means emitting no more than is consistent with owned (tradable or non-tradable) permits or paying a charge on actual emissions.

The first observation is a reminder us that the cost of not adopting EI/MBI is a good deal lower than much of the writings of proponents claim. The second, when taken with the near-universal observation

[20] It is worth pointing out that earmarking and "recycling" into environmental investments is not what the double-dividend argument is about, unless those subsidies would have been paid out of other revenue sources. The country assessments lead the reader to conclude that the charge revenues are treated as extra, not as a substitute for labor or sales taxes.

that compliance monitoring is the weakest link in the developing country institutional chain, suggests that it may be worth considering alternative paths into the future. Such paths would be designed to avoid overtaxing weak institutions in the early days, and to be adjustable as institutional capability grew. Indeed, it is possible to view the process of policy evolution as part of the institutional development exercise . . .as cause as well as result. The goal may be seen as creating Bell's "culture of compliance", in which social norms make compliance the first rather than the last choice (Bell, 1997). Two examples will give a bit more life to this rather abstract notion:

- One possible path would begin with a technology requirement - - all sources in a certain industry would be required to install a particular technology. This is easy to monitor. Almost as easy would be the requirement that it be kept operational. (For some technologies, the remaining variable costs of actual operation would be small, raising the probability that this would occur.)
- As discharge monitoring capability and general civil service morale increased, the technology requirement could be translated into a technology-based discharge standard, as in the U.S. water pollution control system permits. These would not require the technology *per se*, but only the results it was judged by experts as capable of achieving.
- Finally, the permits could be made marketable when the information and record-keeping intrastructure was judged ready to support the move. For some small water pollution sources, or any source appropriately located, the path might be short-circuited with a requirement that they be connected to sewers (possibly with pre-treatment) and that all sewage be treated in certain ways before discharge. Sewer charges could be presumptive, based on industry, capital vintage, and size.

Lest this proposal be seen as merely the nattering of eccentric "instrument Luddites", compare it with the analysis by Cole and Grossman, 1999, of pollution control policy in the U.S. Their view is essentially that, whether by conscious design or happy political accident, policy evolved here along similar lines - - from instruments that economists found less than desirable, toward applications of EI/MBI - - as institutional capabilities grew.

A second possible example could build on the notion of the self-financed marginal subsidy found most

often in deposit-refund systems.

- The idea would be to begin with a tax on inputs based on their presumed implications for pollution discharges in the absence of control efforts. The source could claim a pro rata refund by proving to the satisfaction of the responsible agency that it was engaged in pre-discharge control that was accounting for some claimed percent reduction. This owes something to the presumptive charge of Eskeland, to which it is a close cousin (Eskeland and Devarajan, 1996). The system could be started at the simplest end, where input characteristics translate very directly into pollution loads (as in sulfur in coal and fuel oil used in utility boilers) and gradually extended to more complex settings, such as sulfur in crude oil charged to refineries, where intervening technologies leads to multiple fates and release pathways.

The point, to make it a final time, is not to deny that EI/MBI are useful tools, or to oppose their use in appropriate settings. It is rather that they are being oversold to developing countries, many of which will find it difficult to meet the implied institutional demands. And it seems there are other ways to skin the cat of sustainable development - - ways that both take current institutional weakness seriously and provide practice fields on which new strengths can be developed. The above suggestions only scratch the surface of the set of such possibilities. The application of imagination and technical skill, with which the environmental policy world has been blessed, will doubtless produce new and more promising ideas, if it can untrack itself from infatuation with EI/MBI.[21]

[21] It is worth reminding readers here that the first operational version of something very like a tradable discharge permit system was created by imaginative perople within US EPA as a way around the political train wreck looming because new businesses would not have been allowed to start up within air quality non-attainment areas.

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Appendix 1

Instruments of Environmental Policy

1. Prohibition (of inputs, processes or products)
2. Technology specification (for production, recycling or waste treatment)
3. Technological basis for discharge standard[a]
4. Performance specification (discharge permits)[b]
5. Tradable performance specification (tradable permits)
6. Pollution charges
7. Subsidies
   (i) Lump sum for capital cost
   (ii) Marginal for desired results[c]
8. Liability law provisions
9. Provision of information
   (i) To polluters (technical assistants)
   (ii) To investors, consumers, activists (e.g. US Toxics Release Inventory)
   (iii) To consumers (green product or process)
10. Challenge regulation and voluntary agreements

Notes:

[a] In a technology-based standard setting, the amount of allowed pollution is determined via an engineering study in which a legally designated technology is applied on paper to a particular polluting operation with known uncontrolled pollution load (raw load). The result of this exercise is an achievable discharge amount.

[b] Performance specification can be based on any of a number of rules or methods from uniform percentage reduction by all sources to modelling that determines the cheapest way to attain a given ambient quality standard.

[c] The deposit-refund system, for example for drinks containers, is a self-financed marginal study for container return.

Source: Russell & Powell, 1999."Practical Considerations and Comparison of Instruments of Environmental Policy," in Handbook of Environmental and Resource Economics, Jeroen C.J.M. van den Bergh (ed.), Edward Elgar Publishing Ltd., 307-328 October, 1999.