Forum

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The External Costs of Electricity Generation: An "Insider's" Perspective on the Lessons from the US Experience

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A paper recently published in this journal, 'The External Costs of Electricity Generation: Lessons from the US Experience' (Martin, 1995), gives an interesting perspective on recent developments in methods for estimating externalities in the electricity sector and on internalising these externalities through environmental regulation. This interesting paper motivated me to "set the record straight," from my perspective as one who was part of the US experience.

I discuss the major points that Martin (1995) raises about: (a) the magnitude of environmental externalities and methods for estimating them; (b) regulatory instruments for internalising externalities and their potential repercussions; and (c) general lessons that can be drawn from the US experience.

Controversies over Methods for Estimating Environmental Externalities

Martin (1995) suggests that recent studies have given rise to two areas of dispute. The first area of dispute is the distinction between environmental costs and environmental externalities. The distinction is an important one. Many recent studies have made this point (ORNL/RFF, 1992-1997; ExternE, 1996; and RCG/ Ha-

gler, Bailly Inc. and Tellus Institute, 1996), so that *in principle,* it is not particularly controversial. Rather, the problem is that *in practice,* it is sometimes difficult to define and to calculate the externalities. For example, ORNL/RFF (1994b) notes that the regulations that allow the trading of permits for SO_2 emissions do not strictly internalise the externalities associated with these emissions because their environmental damages depend on where the emissions take place.

The second area of dispute mentioned by Martin (1995) is that two approaches for estimating externalities, that were popular in the late 1980s and early 1990s (*i.e.,* the cost of controlling the emissions and the dollars of damage/ton of emitted pollutant), are unsatisfactory. Again, given the current state of the art, this point is a lesson of the recent US (and European) experience and is not particularly controversial. Both points are important, but they are controversial in the context of *past* studies, and not so much in the *current* literature.

After discussing these past controversies, Martin (1995) discusses "The Damage Function Approach and its Limitations." In particular, the paper notes that this approach has led to estimates of externalities that are lower than many of the previous estimates, including those used recently by some regulatory agencies in the US; that the magnitude of externalities depend on where the power plants are located; and that some of the most important and potentially sizeable externalities can not be reliably estimated. The important point that Martin (1995) fails to realize, though, is that for the most part these are *not limitations,* but *findings* of the damage function approach.

Low estimates of externalities are findings, rather than limitations, of damage function studies

Recent studies using the damage function approach have indeed calculated externalities that are generally less than those used by regulatory agencies in the US and less than reported in previous studies such as the Pace report (Ottinger *et al.,* 1990). But these differences reflect significant *findings* of the damage function studies, not limitations. In particular, these studies have revealed that, with best-available technology, many of the externalities of fossil and nuclear power may be much less than previously thought (though not necessarily "small"). Previous estimates were based on the aforementioned control-cost and dollar/ton approaches, that are now regarded as being unsatisfactory because they do not adequately represent externalities as effects on individuals' well-being. Also, estimates in Hohmeyer (1988) and Ottinger *et al.* (1990) are known to be significantly greater than more recent estimates, in part because they assume emissions that are an order of magnitude greater than those assumed in the more recent studies (Lee, 1997). The differences in assumptions partially reflect recent regulatory and technological changes.

The recent studies clearly demonstrate that the magnitude and the nature of the externalities do, in fact, depend on the location of individual power plants (as well as on the location of other activities of the overall fuel cycle of activities, such as resource ex-

traction and transportation, that are required to produce electric power). For example, if a fossil fuel plant were located in a very densely populated region, then the particulate matter and ozone formed from the plant's emissions would affect the health of a greater number of people, thus resulting in greater externalities. One should be aware that the ability of the damage function approach to calculate externalities that are location-dependent is an *advantage*, not a limitation, of this approach. Certainly, the fact that externalities are location-dependent makes it more difficult to estimate them accurately (and to implement regulations that reflect this location-dependence in some way). But this difficulty reflects the inherent complexity of externalities, not a limitation of the damage function approach.

Regulations will certainly have to be simplified in terms of their locational dependence, but they can still account for key parameters (such as exposed population). Recent research by Curtiss and Rabl (1995) indicate that, for a given level of emissions, externalities associated with airborne pollutants vary within a factor of six, regardless of where a power plant is located in Europe. They interpret their results to be a sign of robustness in estimates of externalities, rather than highlighting their wide variance.

The relevant notion of what is the margin depends on the question posed.

Martin (1995) notes that some of the potentially most important externalities are difficult to estimate. The damage function approach is, indeed, not ideally suited to estimating certain types of externalities such as the effects of global climate change and biodiversity. The reason is that the damage function approach is site-specific and incremental. It is generally used to estimate the externalities associated with one, or a limited number of, power plants, the marginal global impacts of which are *de minimus*. Whereas, climate change, for example, is generally considered in terms of the large-scale use of fossil fuel worldwide, rather than in terms of the addition of one fossil fuel plant.

Our notion of what is the "margin" depends on the question posed. Different decision makers, such as national legislators in contrast to regulators who consider one plant at a time, consider very different margins. The damage function approach can be used in either case, but care must be taken to note the difference between these extremes.

A large part of the problem in estimating the effects of global climate change lies in the limited amount of scientific knowledge on the subject, and not in the damage function approach itself. This lack of knowledge makes estimating the externalities associated with climate change a daunting task, regardless of the methodological approach. The second series of reports by the Intergovernmental Panel on Climate Change reflect the clear consensus among the scientific community that global climate change is occurring and that its consequences could be very significant, but the reports stop short of endorsing any specific estimate of externalities in terms of their mills/kWh cost (Houghton *et al.*, 1996; Watson *et al.*, 1996; Bruce *et al.*, 1996). Recent reports recog-

nize the limitation of not only the damage function approach, but of the state of scientific knowledge, and suggest the use of the damage function approach as one element within a broader multi-criteria approach for assessing environmental externalities (Boone *et al.*, 1995; Lee, 1995a; Lee *et al.*, 1997; Bruce *et al.*, 1996).

Questions about Internalizing Externalities through Regulatory Mechanisms

Martin (1995) also reviews several barriers to addressing externalities through regulations. The major barriers discussed are:

- the limited impact of these regulations on investment decisions, even if externalities are included in a power company's planning process;
- the possible *adverse* impact on the quality of the environment because regulations apply only to candidates for new power plants, and not to existing plants;
- the problems in implementing regulations extensively across many political regions (such as states in the US) – the "piecemeal" problem; and
- the industry restructuring that is taking place in the US and elsewhere.

The paper suggests that, especially with the advent of efficient combined-cycle gas turbines, externality values have a negligible effect on the selection of new investments. In three case studies in the US, Kanhouwa (1995) and Lee (1995b) find this to be true in practice. Reasons for their finding were:

- limited requirements for additional capacity (of any type);
- the decline in fossil fuel prices, especially natural gas, which is generally less polluting than other fossil fuels;
- improved efficiency and pollution-abatement technologies in fossil fuel plants;
- electric utilities' limited awareness and experience with renewable energy technologies;
- inter-jurisdictional issues that make it difficult for utilities that operate in several states to choose higher-cost renewable energy projects;
- use of low externality values in the comparative assessment of projects; and
- legislative restrictions on the use of externality adders (in Massachusetts).

Regulations to internalise externalities should apply to all power plants, not just to new ones.

There is no intrinsic reason that externality regulations should pertain only to new power plant decisions, and not to existing power plants. In fact, externalities emanate from existing power plants, even more so than new power plants. Older plants have older technologies and may be "grandfathered" to comply with older, less stringent regulations. Theory holds that regulations to internalise externalities should apply to all power plants, not just to new ones. Not doing so, as noted by Joskow (1992) and Martin (1995), may actually have the perverse effect of harming

the environment by providing incentives that prolong the life of existing fossil power plants.

In a second-best world, the only practical recourse in policy making is an incremental approach.

Likewise, Martin (1995) points out the "piecemeal" problem that was raised by Joskow (1979). Joskow (1992), Freeman and Krupnick (1992), and Freeman *et al.* (1992) subsequently entered into a lengthy debate about the appropriateness of internalising externalities when regulations are piecemeal. The point made by Krupnick (1992) is that policy making must always take place in a second-best world, in which various regulations exist throughout various sectors of the economy. Many, if not most, of these regulations are inefficient. The only practical recourse in policy making is an incremental approach that, it is hoped, takes existing regulations into account in an efficient way. Burtraw *et al.* (1994) have done theoretical work on this subject, deriving an "optimal adder" that takes into account other sectors.

That the author of the paper (Martin, 1995) is a European analyst, rather than an American one, is perhaps a testament to the continued interest in externalities in Europe and to the great decline in interest in the US. This situation is largely a result of the industry restructuring that is taking place in the US. This restructuring was set into motion by the State of California's retail wheeling proposal, which would deregulate much of the electric power industry by allowing electricity consumers to purchase electricity from any power generator, rather than from a regulated regional monopoly. Various forms of this proposal are now being actively debated, and taking shape, nationwide. It is because of this ongoing process of deregulation that public utility commissions in the US have largely abandoned their interest in externalities (not because of their concerns about how to estimate them). Among some people, there is still concern about environmental protection, and about mechanisms to achieve it. Martin (1995) mentions some of these mechanisms, such as emissions taxes and tradeable emissions permits. Additional discussions are given in Rosen *et al.* (1995) and Lee (1995c). Lee (1995c) suggests that a strong federal role is needed to reduce the piecemeal problem of singling out the electricity industry for externality regulations, and that policies that are "second-best" from a theoretical standpoint are likely more tenable in an era of deregulation. Notwithstanding, great obstacles remain before these mechanisms are adopted to any major extent. The current priority among most policy makers is to allow utilities and other generators to provide reliable power at the lowest rates (*i.e.*, prices). But if these policy makers wish, instead, to take the *full* social costs of electric power generation into account, then the recent US (and European) studies of externalities offer a sound basis for setting appropriate policies.

Lessons from the US Experience

As reflected in the previous discussion, Martin (1995) draws three

major lessons from the US experience:

- attempts to get better estimates of environmental costs have produced disappointing results;
- investment in renewable energy is still very weak, or even non-existent, even when the policy criterion is to minimise social cost (which is the sum of the marginal financial cost and the external cost); and
- choosing investments on the basis of social cost can have a negative effect on environmental quality.

These lessons seem to indicate that Martin (1995) is disappointed in recent estimates of externalities in part because they are smaller than what he was hoping for. The discussion in the paper is such to suggest that the author has decided *a priori* that renewable energy is good, and that he is looking for evidence to justify it. The phrase "Much Ado About Nothing," that Martin (1995) borrows, no doubt reflects the disappointment of some "environmentalists" who had hoped that the recent studies would result in estimates of large externalities. These analysts were looking for a means to a pre-determined end. Rather than being disappointing, however, the results of these studies have some positive lessons:

A lesson of the US experience is that analysts and policy makers can be justified in focusing on a few externalities that probably account for most of the damages.

- investment in technology R&D and deployment of efficient technologies can greatly reduce the externalities of electricity generation and the associated harm to human health and the environment;
- analysts and policy makers can be justified in focusing on a few externalities that probably account for most of the damages, and largely neglecting others, rather than being overwhelmed with considering hundreds of different externalities;
- greater understanding of externalities has raised our awareness of their complexity and has helped to identify additional research priorities (such as the formation and dispersion of acid aerosols, valuing ecological impacts, and policy instruments to internalise externalities efficiently); and
- the importance of issues such as global climate change has been confirmed.

Martin (1995) notes that investments in renewable energy have not been stimulated by externalities regulations in the US. But some of the reasons for this, such as the low demand for additional power plant capacity (of any type), do not apply to all countries. Recent studies that include the effects of acid aerosols in densely populated areas and the effects of global climate change estimate that externalities could amount to 5%-50%, or more, of the cost of electric power – not a trivial amount. Thus, the lesson is that renewable energy can be economically competitive on the basis of social costs in markets where there is significant demand for new capacity, when existing power plants are highly inefficient and have great emissions, and if the financial cost of renewable energy is not too much greater than the cost of electricity from fossil fuel plants. With improvements in renewable en-

ergy technologies, their costs are declining and becoming more competitive.

Choosing investments on the basis of social cost can have a negative effect on environmental quality, as Martin (1995) suggests, whenever current regulations are inefficient in minimising social cost. Such possibilities can arise in the regulation of individual power plant decisions, as well as in the context of broad national energy policy making. An example of the former case is the regulations that some states in the US have used. In these regulations, external costs are considered only in the planning and selection of *new* power plants, rather than in the form of an explicit tariff applicable to *all* power plants.

It is mistaken to use the results of poor application of theory as an indictment of the theory itself.

However, regulators and policy makers do not have to mimic past practice. It is mistaken to use the results of poor application of theory as an indictment of the theory itself. Thus, the lesson learned should be that investments should be compared, not just among new investments but also among options that include existing facilities, and that, ideally, the options should be compared on the basis of their effects on the national economy (not just to a narrow sector of the economy).

Martin (1995, p. 245) concludes by advocating "command and control" environmental regulations: "[i]t is therefore not a question of establishing such a (Pigouvian) policy, but of introducing incentives and making it possible to achieve environmental goals at least cost. The time has come to move on to policies that attempt to match ends and means, rather than seek to apply theoretical principles that are somewhat dated even by the standards of conventional environmental economics."

This conclusion is clearly *not* a lesson of the recent US (or European) externalities studies. As Martin (1995) notes, some states in the US have established externalities regulations, that have required utilities to consider externalities in their planning process, but these regulations are far from being Pigouvian. In fact, Pigouvian theory would call for taxes or tariffs on externalities, that would be applied to all generators, and indeed to all sectors of the economy. Such regulations have never been implemented, and it seems premature to reject the use of externalities estimates in setting regulations. Martin's (1995) call to "move on to policies that attempt to match ends and means" seems to suggest that environmental protection is a moral imperative that does not need to be justified by any (other) rationale or scientific theory. But then policy making, and *how much* environmental protection would be little more than *ad hoc*.

Whereas the conclusion of Martin's (1995) paper appears to reject the use of externalities and to encourage setting *ad hoc* environmental goals, the lessons that *should* be learned from the US experience suggest a different policy strategy, namely one that:

- builds on recent methods for estimating externalities, and simplifies these methods so that they can be used in practice;
- considers additional criteria in a multi-criteria framework that

reflects public goals other than minimising social cost;
- uses estimates of externalities, as well as other criteria, to develop and improve "second-best" policy mechanisms that use emissions standards and tradeable permits (assuming that direct environmental tariffs would be politically infeasible in an era of industry restructuring); and
- formulates these regulations so that they account for the current mix of regulations in the economy, and applies them across as much of the electric power sector, and the economy, as possible.

With these guidelines, one would have a basis for setting policies that: utilise current knowledge about externalities, account for criteria other than social costs, and are not *ad hoc*.

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