

Vickrey on Taxing Air Pollution

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Source: *Land Economics*, Feb., 1992, Vol. 68, No. 1 (Feb., 1992), pp. 7-10

Published by: University of Wisconsin Press

Stable URL: <https://www.jstor.org/stable/3146739>

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An early, major paper on Pigouvian taxation was unfortunately never published. William Vickrey presented this invited paper at the economics session of the Air Pollution Control Association annual meeting in Cleveland on June 11, 1967, distributed mimeographed copies to the small audience of mostly engineers, and thereafter made no further effort to promulgate the piece. Nor does it appear that anyone outside that original audience in Cleveland saw the paper, for no mention is made of it, or of any other paper by Vickrey, in the surveys of the externality and environmental economics literature by Mishan (1971) and by Fisher and Peterson (1976), who cite a number of mimeographed pieces, nor is Vickrey among the more than 160 contributors to environmental economics cited by Baumol and Oates ([1975] 1988). Had Vickrey's paper been circulated or properly published, some issues that proved to be very important in this area might have been investigated and argued five to ten years earlier than they actually were.

The earliest paper cited by Fisher and Peterson (1976, 15, 16) relating nonconvexity to pollution taxation is that of Baumol (1972).<sup>1</sup> Although Baumol laid the groundwork for this important paper in a still earlier paper (1964), and although that paper must certainly have influenced Vickrey, Baumol's (1964) paper concerned external economies rather than diseconomies and did not refer to Pigouvian subsidies or taxes. Vickrey was the first to specifically address the "theoretical difficulty in the application of effluent charges . . . [posed by] the problem of nonconvexity or concavity of the cost function." He cautioned that "Where concavities exist, there will in general be the possibility that there may be a number of 'local maxima' at each of which the local equilibrium conditions may be satisfied." In such a case, Baumol and Bradford (1972) would later show that there are no price signals to indicate that an opti-

mum, once attained, is only a local optimum or whether there might be alternative optima superior to it. Much later, Shibata and Winrich (1983) would describe how the physical interaction between avoidance by pollution victims and abatement by polluters can generate the same kind of multiple optima that Vickrey had foreseen.<sup>2</sup> Vickrey himself was inclined to downplay the problem of nonconvexity, noting that in the case of air pollution "multiple local maxima, if they exist, probably will be so close together in terms of overall level of satisfaction that a decision as to which is to be preferred would be a very close one in any case, well within the margins of error involved in measurement, so that allowing the system to settle towards one of these local maxima at random is probably as good a policy as could be devised." Baumol's (1972, 319) argument for "satisficing" in the presence of multiple optima is very much in this earlier spirit of Vickrey.

In a recent paper, Griffin (1987, 41) credits Tietenberg "with being the first to recognize that spatial variability in the regional distribution of pollution can invalidate the efficiency properties of uniform effluent charges." More appropriately, Tietenberg (1974, 465) should be credited with his powerful first-order condition for the efficient number of zones in an airshed within which emissions of the same pollutant can be

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<sup>1</sup>A still earlier paper cited by Fisher and Peterson (1976, 24), having to do with nonconvexity though it is not included in that section of their survey article, is my own (Kohn 1971). I had just completed my first year of graduate studies when I heard Professor Vickrey present this paper, but his emphasis on nonconvexity made a lasting impression on me.

<sup>2</sup>I find (Kohn 1991) that the nonconvexity discovered by Shibata and Winrich (1983) may be present over the entire length of a production possibility frontier but that it poses a problem for Pigouvian taxation in only a small portion of that frontier.



taxed at the same rate; Vickrey had already recognized that uniform tax rates are ruled out by "obvious differences between say, discharge at street level in the center of the business area, discharge in a suburban area, discharge from tops of buildings, or from power plant stacks, or between discharges under varying weather conditions." The significance of variable weather conditions is the centerpiece of a contemporaneous paper by Teller (1967), except that Teller allows regulatory standards rather than emission tax rates to vary with weather conditions.

In an important paper most recently endorsed by Oates (1990), Terkla (1984, 108) quantifies the welfare gain from replacing traditional income taxes with taxes on emissions of sulfur dioxide and particulates, but remarks that "although economists have devoted much discussion to the overall advantages in using taxes as opposed to regulations to curtail pollution, little has been written concerning the freedom from resource distortion of revenues raised from effluent charges." Terkla (1984, 108) credits "a brief comment by Gordon Tullock . . . on congestion tolls" for this basic idea. At about the same time that Tullock's (1967) comment was published, Vickrey was independently making the similar point "that to the extent that effluent fees provide a flow of revenues into the public treasury, this makes possible the abatement of other taxes and impositions that have a baneful rather than a beneficial effect on the efficiency with which the economy operates. This would be true even at the Federal level, but it is painfully and particularly true if the funds become available at the local level, where metropolitan cities often have very hard financial problems to deal with and often resort to taxes that are quite injurious in their effects." What remained for Terkla (1984) was the ambitious task of assessing the dollar value of these "baneful effects."<sup>3</sup>

In the most cited of all externality articles, that of Coase (1960, 15), the principal actors are the polluters and receptors, who costlessly and without need of governmental intervention, arrange emission rights in such a way as to maximize the value of pro-

duction. The arrival on the externality scene of Buchanan and Tullock's (1975, 142, 143) "politicians . . . responding to citizenry pressures," legislators bending to temptation, and "intensely interested pressure group(s)" came as a surprise upon a stage in which, if government institutions had any role to play other than judicial, it was to omnisciently set and collect efficient Pigouvian taxes and redistribute them in equity-preserving lump sums. What Buchanan and Tullock (1975, 146) offered as their "positive theory of externality control" and "public-choice approach" has spawned one of the major new directions of enquiry beyond Fisher and Peterson (1976), culminating in a rich flow of work by Hahn (1990) and others. Among the economists who would *not* have been surprised by this new direction is Vickrey, for one of his principal reasons for advocating effluent fees was that "A decision as to whether or not a particular [polluting] activity is to be permitted, or whether or not a particular abatement practice is to be required, may in the absence of effluent fees be a matter of very substantial profit or loss to the firm or individuals affected; the opportunities for political favoritism or even minor corruption that this offers is not a matter to be lightly regarded." Vickrey believed that there would be less corruption if regulatory rules are replaced or even accompanied by effluent fees. However, he left open the policy-significant possibility that polluters prefer being regulated to paying effluent fees, which is a major conclusion of Buchanan and Tullock (1975).

Vickrey is best known to economists, and to the general public as well (see, e.g., Passell 1990), for his ingenious approaches to metering, and his paper is prophetic in this area. The "chimney monitoring device" that he foresaw is now a technological reality according to Russell et al. (1986,

<sup>3</sup> Elsewhere I quote Vickrey's passage on "baneful effects" (Kohn 1978, 226–27) and use Terkla's estimate of their value as a starting point (Kohn 1992). My citation of Oates (1990) at the beginning of this paragraph is especially relevant because Oates's paper, also an address, is a modern day, state-of-the-art, sequel to Vickrey's, echoing many of the same themes.

71). Vickrey's device on cars "which permits scanners located at suitable points along the road to identify the cars as they pass," and thereby create a record of the length of time in which they were driven in congested areas, is not unlike the electronic scanners used in Texas and Louisiana (see Passell 1990) for the purpose of billing automobile owners for tollway and bridge fares. Vickrey's vision of periodic inspections, in which each "car is given an emission rating" and car owners are billed "according to the location of the emissions and the pollution conditions existing at the time and place," is only a few steps beyond the technology now in place (see Collinge and Stevens 1990, 57–58) for measuring individual automobile rates of emissions and mileage traveled and assessing a fee to cover the pollution damages caused.

Vickrey's paper contains a rich trove of ideas on pollution taxes, some of which are yet to be explored. The possibility of a combination of fees and administrative rulings is broached, the advantage being that "an administrative ruling requiring some action, possibly fairly costly, to abate pollution will be greatly softened by the consideration that the resulting reduction in effluent fees will absorb a great deal of the cost. Compliance may thus be easier to obtain." Whereas economists at the time were assuming zero transactions costs and perfect compliance in their theoretical models of Pigouvian taxation, Vickrey was wrestling with the mechanics of implementation. His concern for "the practical difficulties . . . of administering such a system of charges . . . at a reasonable cost" pre-sages the modeling by Polinsky and Shavell (1982) and others of the administrative costs of Pigouvian taxation. Vickrey's foreboding of "tampering in the case of permanently installed apparatus" and "deliberate avoidance of the effluent charge" foreshadows work on imperfectly enforceable Pigouvian taxes by Harford (1978) and others.

Even if effluent fees are never actually instituted, Vickrey expressed a unique philosophy on the underlying approach. He maintained "that without at least exploring the possibilities and implications of such

charges a balanced approach to resolving the problems of pollution abatement is much less likely to be achieved." What Vickrey meant by this "balanced approach" is that a comparison of the marginal costs of abatement and the marginal damage of the various pollutants would signal whether abatement is insufficiently or overly stringent. In the latter case this would "put something of a restraint on the pure air enthusiast who might at times be inclined to impose standards that would entail too high a cost relative to benefits." Indeed, from time to time, major environmental economists have expressed concern (Mills [1978, 155, 213, 214] in the case of automobile emissions control, Portney [1990, 178] in the case of hazardous air pollutants, Krupnick and Portney [1991] in the case of ground-level ozone) that total costs and total benefits, and by inference, marginal costs and marginal benefits, of air pollution control programs in the United States are out of balance, entailing as Vickrey feared "enthusiasm for a cause . . . carried beyond the point of proper balance." To the extent that such somber assessments are correct, it is the more regrettable that Vickrey's message was not properly published in its time.

On a recent trip to New York City, I called on Professor Vickrey in his office at Columbia University and showed him my fading copy of the paper that he had presented twenty-four years before. He vaguely recollected having written it, but could not remember whether or not he had considered publishing it. Most likely, he thought, he would have been too busy to change its format from a public address to a journal article. I told him that I thought that it was a significant paper that economists would want to read in its original form. At my request he graciously gave me permission to submit his paper for publication along with my own comments, a preliminary draft of which I left with him.<sup>4</sup>

<sup>4</sup>I am grateful to our departmental secretary, Jean Tamayo, for her skill and dedication in accurately re-typing Professor Vickrey's mimeographed paper, portions of which were becoming illegible.



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