Letters

Old Cars and Taxation

In his letter of 3 March (p. 1125), Gordon Tullock states, "Unfortunately either a tax on six-cylinder cars or a tax on gasoline is regressive. The poor tend to own older cars that are larger and less economical than the small new cars that are owned by upper-income groups. Therefore, the poor pay more of either of these taxes." Fifteen years ago, I thought that this was true until I looked at the data. I found that most old cars were owned by middle- and upper-income families who also tended to drive more miles (*1*). I found that operating expenses as a percentage of family income were virtually constant across all income groups. A recent study by the Congressional Budget Office used data from the Survey of Consumer Expenditures to examine the incidence of a variety of federal excise taxes (*2*). When the gasoline tax is taken as a percentage of reported current income, the tax is regressive. But for a variety of reasons (for example, temporary unemployment, illness, student status), current income is not always an accurate reflection of economic status. When current expenditures are taken as a proxy for permanent income, the gasoline excise tax is approximately neutral across all income classes. Also the study shows that 70% of the total excise tax revenues are paid by families reporting annual incomes of over $20,000.

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Acid Rain Models

The review of acid deposition research by Stephen E. Schwartz (Articles, 10 Feb., p. 753) highlights the predilection of U.S. atmospheric scientists to denigrate the use of source receptor relations (SRRs) to develop deposition control strategies. (SRRs, which relate the proportions of deposition to the emissions from all sources, are derived from simulation modeling.) By constantly referring to the incomplete understanding of the very complex atmospheric processes leading to acid deposition, these scientists give comfort to industrial and political leaders urging inaction on control of acid deposition precursors until a distant future when perfect scientific understanding may be reached.

European atmospheric scientists have no such problem. Since 1977, SRRs for European nations have been calculated by a Norwegian group (*1*) with the use of an internationally accepted model. The model is exercised each year for comparison with precipitation chemistry monitoring in most of the European countries. The 1986 agreement by most of the nations in the European Economic Community to reduce sulfur emissions by 30% (or more) by 1993 reflects the general acceptance by the participating governments of the scientists' estimates of the transboundary flow of pollution.

Similar SRRs have been developed for eastern North America (*2*). The agreement of the simulation model with precipitation chemistry measurements is even better than for the European model, probably because the emission inventory and monitoring quality control is superior, rather than because of better science.

Econometric studies have used SRRs to determine the least costly methods for allocating emission reductions (*3*). Under some circumstances, the predicted national cost saving from emission control strategies based on a better understanding of atmospheric transport is a substantial fraction of the cost of brute force methods.

It is no longer necessary to resort to crude estimates ("what goes up must come down") to justify reducing acid rain precursor emissions. Better quantitative tools are available if we decide to use them.

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Response. Fay and Golomb say my article is a source of comfort to those who would argue for inaction on control of acid deposition. Others have read it as a call for action. It should not be taken as either.

As I stated in the article, much of the motivation for determining source-receptor relations (SRRs) has been to allow development of *optimal* strategies to reduce acid deposition at sensitive locations while minimizing cost. Although I concluded that present uncertainties in SRRs preclude their being confidently used in this application, I emphasized that such uncertainties should *not* be taken as grounds to defer decisions on emissions control. I stated that postponing decisions to control emissions is equivalent to deciding to emit large quantities of acidifying substances into the environment and that decisions regarding such control can be made now on the basis of regional-mean emission fluxes.

Fay and Golomb have estimated SRRs by solving analytically the partial differential equation describing advection and diffusion (in two dimensions) and oxidation and deposition of sulfur (or nitrogen) oxides. Wind speed and direction, horizontal diffusion coefficient, and first-order rate coefficients for reaction and wet and dry deposition are all assumed to be constant spatially (over eastern North America) and temporally (for seasons or for years). These parameters are determined by least-squares fit of modeled long-term wet deposition to measured values at various sites in eastern North America; the lack of variability in wind direction is compensated for by an unrealistically large eddy diffusion coefficient. Their model does reproduce annual wet deposition patterns; although it readily predicts the amount of deposition at any receptor site attributable (according to the model) to emissions at any source. There is little a priori reason to expect these SRRs to be accurate—in contrast to physical simulation models, their model does not realistically simulate the processes that actually occur between emission and deposition.

The Lagrangian trajectory model of Eliassen and Saltbones (*1*) should provide more credible SRRs, in my view, because it more realistically simulates the processes occurring in the actual atmosphere. In particular, transport is described by trajectories computed from measured wind velocities. However, this model also contains many simplifications and approximations. Because of its simplicity, long runs are practical; modeled 2-year average concentrations of atmospheric SO_2 and SO_4^{2-} in precipitation agree with measurements sufficiently well to support the credibility of the general features of the model. Although the details of the simulations differ substantially within models and from model to model (*1*), the general results appear to be robust. These results have convinced the research community that in most of Europe, sulfur emissions from