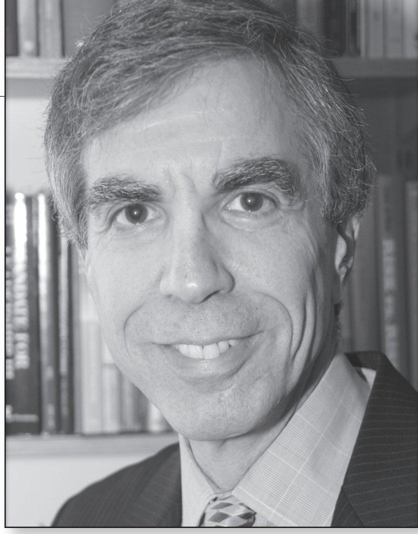

By Robert N. Stavins

Land-Use Change and Carbon Sinks

Increased concern about the threat of climate change has brought with it greater attention to forests as a means of removing carbon dioxide from the atmosphere. The Kyoto Protocol allows sequestration as part of national strategies to achieve CO_2 targets. When the United States chooses to implement a domestic climate program, it will be necessary to decide whether carbon sequestration policies should be part of its portfolio of compliance activities.

The costs of carbon sequestration will presumably be one major criterion in that decision. Since the late 1980s, it has been suggested that sufficient lands are available to use the approach to mitigate significant amounts of CO_2 emissions, and claims have sometimes been made that such forestry-based carbon sequestration is a relatively inexpensive means of addressing climate change.

In a previous column, I wrote — in broad terms — about the likely costs of U.S. carbon sequestration ("What Role for U.S. CO_2 Sequestration?" September/October 2006), and found that claims that biological carbon-sequestration would be inexpensive were unfounded. More recently, in an article which appeared in the *Journal of Environmental Economics and Management,* co-authored with Ruben Lubowski of the Environmental Defense Fund and Andrew Plantinga of Oregon State University, my colleagues and I investigated the cost of supplying domestic forest-based carbon sequestration using an econometric model of the revealed preferences of landowners who can use their land for alternative purposes.

In our analysis of carbon sequestration costs, we modeled six major land uses, employed detailed micro-data of land use and land quality that were comprehensive of the contiguous United States, and treated key commodity prices as endogenous (that is, determined within the analytical model) in simulations of the carbon-sequestration supply function.

We compared our estimated carbon sequestration supply function with ones from previous studies, which had employed bottom-up, engineering-cost analyses or optimization models. In "bottom up" or "engineering cost" methods, marginal cost schedules are constructed by looking at information on revenues and costs of production of alternative land uses on representative types or locations of land, and sorting these in ascending order of cost.

Benefits of biological sequestration achieved through changes in development patterns

We found that over the range of carbon prices considered in most studies, our marginal cost estimates were greater than those from the engineering-cost analyses. Because our cost estimates were derived from landowners' actual behavior regarding the disposition of their lands for alternative uses, our estimates may reflect factors such as option values associated with delaying irreversible land conversion, liquidity constraints, and unobserved benefits and costs of alternative land uses.

We found lower marginal costs of carbon sequestration when timber harvesting is prohibited on lands enrolled in a carbon sequestration program. Marginal costs fall because the additional (present value) costs of enrolling lands on which harvesting is prohibited are more than outweighed by the additional (present value) carbon sequestered. This result was reinforced by price effects. Restrictions on timber harvesting on enrolled lands raise timber prices, creating incentives for landowners to retain existing (non-program) lands in forest.

Importantly, the national scope of our study allowed us to compare our estimates of the marginal costs of carbon sequestration with estimates of costs from energy-based carbon abatement analyses. We found that the estimated carbon sequestration supply function is roughly similar to the central tendency of the carbon abatement supply functions from leading studies, indicating that as much as a third of the U.S. target under the Kyoto Protocol could be cost-effectively achieved by employing forest-based sequestration policies. At a minimum, forest-based carbon sequestration merits consideration as part of a cost-effective portfolio of domestic U.S. climate change strategies.

Much attention is being given to the long-term development of carbon-capture-and-storage technologies, or CCS, whereby CO_2 would be sequestered from stack gases at a new generation of coal-burning power plants and buried deep underground for long periods of time in abandoned salt mines and other deposits. Although the potential of CCS technologies is great, the technological, economic, and legal challenges to employing this approach on a commercial scale in the United States and other countries are tremendous. In the meantime, it is important not to lose sight of the short-term advantages of a kind that is feasible now — biological carbon sequestration achieved through changes in land-use patterns.

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