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General equilibrium benefits for environmental improvements: projected ozone reductions under EPA's Prospective Analysis for the Los Angeles air basin

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Abstract

This research demonstrates how locational equilibrium models can be used for benefit measurement with the detail required to match EPA's benefit analysis for the first Prospective Analysis. Using the projected changes in ozone concentrations for 2000 and 2010 together with the Sieg et al. (Int. Econ. Rev., forthcoming) estimates for household preferences for housing, education, and air quality, this paper measures general equilibrium willingness to pay for the policy scenarios developed for the Prospective study as they relate to households in the Los Angeles area. Benefits are evaluated taking account (at the household level) of initial air quality conditions, relocation based on changes in ozone, and price changes. The framework generalizes the partial equilibrium/general equilibrium comparisons available with conventional computable general equilibrium and property capitalization models. Estimated general equilibrium gains from the policy range from \$33 to \$2400 annually at a household level (in 1990 dollars).

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1. Introduction

Research using revealed preference methods in environmental economics has generally sought to measure the benefits associated with small changes in environmental quality. For example, hedonic property value methods offer measures of the incremental willingness to pay for small changes in site specific amenities. By contrast, the tasks that must be addressed by policy analysts require a framework capable of measuring the benefits from large, often spatially diverse, changes in amenities. In our previous research, summarized in [29], we demonstrated that locational equilibrium models offer a new framework for evaluating these types of policies. In that paper, we developed the basic general equilibrium framework, discussed estimation of the model's structural parameters, and illustrated how it could be used with actual changes in air quality conditions between 1990 and 1995.

In this paper, we expand this line of research by considering EPA's policy alternatives, developed for the evaluation of the 1990 Clean Air Act Amendments and reported in the first Prospective Analysis. The main purpose of this paper is to demonstrate that locational equilibrium models of the type considered in [29] can be used for benefit measurement at the level of detail required for realistic policy assessments. In particular, this paper uses the same projected spatial variation in ozone concentrations as was developed for the Agency's benefit analysis for the LA Air Basin as part of the Prospective study to compute partial and general equilibrium benefit measures.

Our analysis indicates that the estimated annual general equilibrium benefits in 2000 and 2010 associated with the ozone improvements due to continuing the policies mandated under the 1990 Clear Air Act Amendments will be dramatically different by income group and location within the South Coast Air Quality Management District. The gains range from \$33 to about \$2400 per household (in 1990 dollars). These differences arise from variations in air quality conditions, income, and the effects of general equilibrium price adjustment.

This paper builds on a large literature in environmental economics considering the relationship between partial and general equilibrium welfare measures.¹ Models for comparing partial (PE) and general equilibrium (GE) effects can take a variety of forms. Most of the empirical measures have used static computable general equilibrium (CGE) models that focus on consistent treatment of product and factor markets with boundary conditions that utilize both the zero profit condition for firms and (in static models) zero savings for consumers. For the most part, they have evaluated general equilibrium price effects. Examples of this research have found that large changes in environmental regulations [17], or in climate attributes influencing production [19], can result in appreciable price changes outside the sector(s) directly affected. Hicksian measures of consumer surplus indicated marked differences between the partial and the general equilibrium welfare measures.

¹Over 30 years ago Harberger [16] observed that "While it is clear that no theoretical obstacle stands in the way of taking such considerations (general equilibrium effects) into account, it is in fact rarely done in studies involving applied welfare economics" (p. 791, parenthetical phrase added). There have been few exceptions to his judgment in applied policy analysis in the 30 plus years since he prepared these remarks. Only the cases cited above, along with efforts to evaluate the welfare costs of introducing standards, permits, or taxes in distorted economies (see [6,14] as examples) and some analyses of trade and the environment [13] have attempted to consider general equilibrium welfare measures.

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