Dissertation Abstract **Mario Samano**

Essays on Industrial Organization, Energy, and the Environment

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My dissertation examines the social costs of changes in policies that affect certain energy markets. The first chapter estimates the impact of increasing gasoline taxes versus the impact of tightening a regulation on the car fuel-efficiency in the U.S. The second and third chapters evaluate the costs of the introduction in large-scale of intermittent sources of energy for electricity generation in southeastern Arizona.

Gasoline Taxes and Fuel Economy: A Preference Heterogeneity Approach

This chapter presents the estimation of an equilibrium model for the U.S. car market to measure the value of two policies aimed at reducing gasoline consumption. The first one is the Corporate Average Fuel Economy standard, and the second one is gasoline taxes. The standard acts on the extensive margin (the car model choice by the consumer) by modifying the incentives of manufacturers on their pricing schemes in order to attain compliance; it also acts on the intensive margin (how much the car is driven) through the rebound effect. On the other hand, gasoline taxes act on the intensive margin by increasing the cost per mile driven; and on the extensive margin by increasing the value of the high-fuel efficient cars. In order to evaluate their impacts on social welfare, we use modern techniques from industrial organization that allow for flexible substitution patterns across car models, measure preferences on cost per mile driven, account for the problem of endogeneity of prices, and jointly solve for the manufacturers' optimal responses. We take the model to data covering the period 2000-2007. The data include market shares, car prices, gasoline prices, car characteristics, income, and miles driven. Counterfactual results show that the welfare loss gross of externality costs from tightening the standard by 10 percent is about two times the cost of increasing net gasoline prices by 10 percent. When accounting for externalities, estimates from the model show that the two policies may be welfare increasing.

Intermittency and the Value of Renewable Energy

In joint work with Gautam Gowrisankaran and Stanley Reynolds, this chapter develops an empirical approach to estimate the equilibrium value of intermittent renewable energy. We calculate the optimal amount of generation capacity, operating reserves, and demand curtailment potentially in the presence of large-scale solar capacity in a social planner framework. We use generator characteristics, solar output, demand and weather forecast data to estimate parameters for southeastern Arizona. In the short-run, the social planner observes weather and demand forecasts, calculates optimal policies to avoid grid failures, and ex-post we can calculate the probability of system failure. In the long-run, the social planner makes decisions on the amount of extra capacity of fossil fuel plants to be built. As opposed to a levelized cost approach, the method in this paper can accommodate the short- and long-run costs of installing intermittent sources of electricity generation. Our results show that the equilibrium costs of a 20 percent mandate are $142.2 per MWh of solar generation, where unforecastable intermittency accounts for $10.3 of this. If the social cost of carbon were $21/ton this mandate would be welfare neutral if solar capacity costs dropped from the current $5/W to $1.42/W.

Dynamics in the Evaluation of Intermittency Costs and Renewable Energy

This chapter, a work in progress, looks at the interaction of a dynamic aspect of electricity grid management and the intermittency of renewable sources. From the perspective of a social planner, the introduction of large-scale solar capacity brings into the system costs through the variation in the amount of operating reserves needed for grid reliability and savings from the potential displacement of fossil fuel plants. Those costs have two components: the marginal costs of operation and the start-up costs. A coal plant, for example, although it has low marginal costs, it has high start-up costs, and therefore it might be cheaper to keep it on all the time. We develop a method to evaluate at what extent the frequency in the generation from renewable sources affects the dynamic decisions on scheduling fossil fuel generators. The method can quantify the impacts on welfare costs including grid reliability restrictions and the environmental benefits from introducing large-scale solar capacity.