

Essays on the Economics of Air Quality Control

av

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AKADEMISK AVHANDLING

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Abstracts

This thesis consists of five self-contained chapters:

Chapter 1: Effects of driving restrictions on air quality and car use in Bogota

Rationing car use at certain times of the day based on license plate numbers has become a popular policy to address traffic congestion and air pollution in several cities around the world. This paper analyzes the effects of moderate and drastic driving restrictions of the program *Pico y Placa* on air pollution and car use in Bogota. Because the program was implemented in phases, it was possible not only to study the impact of the program, but also to distinguish between the short- and long-run effects for each phase of restriction. Using hourly carbon monoxide data, monthly information on gasoline consumption, and vehicle registration and vehicle sales data, this paper shows differentiated effects of *Pico y Placa* on air quality and car use in the short- and long-run and between phases of the program. Although there was an initial improvement in air quality in both phases of the program, carbon monoxide concentrations, vehicle ownership, and total driving actually increased when drastic restrictions were implemented. Gasoline taxes, on the other hand, have tended to reduce gasoline usage in Bogota, suggesting that a price-based mechanism would be more effective in reducing driving.

Chapter 2: Air pollution dynamics and the need for temporally differentiated road pricing

Nowadays, road traffic is a major source of urban air pollution. In this paper we investigate the effects of the temporal variation of pollution dispersion, traffic flows and vehicular emissions on pollution concentration and illustrate the need for temporally differentiated road pricing through an application to the case of the congestion charge in Stockholm, Sweden. By accounting explicitly for the role of pollution dispersion on optimal road pricing, we allow for a more comprehensive view of the economy-ecology interactions at stake, showing that price differentiation is an optimal response to the physical environment. Most congestion charges in place incorporate price bans to mitigate congestion. Our analysis indicates that, to ensure compliance with air quality standards, such price variations should also be a response to limited pollution dispersion.

Chapter 3: Synergies and trade-offs between climate and local air pollution policies in Sweden

In this paper, we explore the synergies and tradeoffs between abatement of global and local pollution. We build a unique dataset of Swedish combined heat and power plants with detailed boiler-level data 2001-2009 on not only production and inputs but also on emissions of CO₂ and NO_x. Both pollutants are regulated by strict policies in Sweden. CO₂ is subject to the European Union Emission Trading Scheme and Swedish carbon taxes; NO_x - as a precursor of acid rain and eutrophication - is regulated by a heavy fee. Using a quadratic directional output distance function, we characterize changes in technical efficiency as well as patterns of substitutability in response to the policies mentioned.

Chapter 4: Diffusion of NO_x abatement technologies in Sweden

Though economists argue for the use of single instruments, we often observe the use of multiple instruments in actual regulations. These may include permit schemes, taxes, fees, subsidies and emission standards. In order to evaluate these combinations and to better understand their effects, we need more empirical analysis of how they interact. They might, for example, be either complements or substitutes; this might even vary between different types of instrument. As a case study we look at detailed data of NO_x emissions from large combustion plants in Sweden. These are regulated both by a refunded charge and at the same time plant level emission standards. We study the adoption of abatement technologies under the combined effect of these charges and standards. The results indicate that the net charge has an effect and one that is complementary to the standards, but only for end-of-pipe post-combustion technologies.

Chapter 5: Air quality combination forecasting with an application to Bogota

The bulk of existing work on the statistical forecasting of air quality is based on either neural networks or linear regressions. The present paper shows how forecast combination can be used to produce more accurate results. This is accomplished using both Monte Carlo simulation and an extensive application to air quality in Bogota, one of the largest and most polluted cities in Latin America.

JEL Classification: C45, C53, C54, D62, H23, L51, L94, L98, O33, O38, Q48, Q52, Q53, Q57, R41.

Keywords: driving restrictions, air pollution, vehicle sales, policy evaluation, road pricing, congestion, pollution dispersion, environmental policies, shadow pricing, directional distance function, climate change, local pollution, policy interactions, technology diffusion, NO_x abatement technologies, environmental regulations, refunded emission charge, air quality forecasting, Bogota, forecast combination, neural networks.

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