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Efficient emission fees in the US electricity sector

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Abstract

This paper provides new estimates of efficient emission fees for sulfur dioxide (SO_2) and nitrogen oxides (NO_x) emissions in the US electricity sector. The estimates are obtained by coupling a detailed simulation model of the US electricity markets with an integrated assessment model that links changes in emissions with atmospheric transport, environmental endpoints, and valuation of impacts. Efficient fees are found by comparing incremental benefits with emission fee levels. National quantity caps that are equivalent to these fees also are computed, and found to approximate caps under consideration in the current multi-pollutant debate in the US Congress and the recent proposals from the Bush administration for the electricity industry. We also explore whether regional differentiation of caps on different pollutants is likely to enhance efficiency.

JEL classification: Q2; Q4; D61

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1. Introduction

The electricity sector is a major contributor to emissions of NO_x, SO_2, mercury, and CO_2 in the United States. This sector faces the prospect of having to make substantial reductions in the emissions of the first three of these pollutants over the next 10–15 years in order to comply with anticipated new US Environmental Protection Agency (EPA) regulations related to fine particulates, regional haze, and hazardous air pollutants. As an alternative to this expected cavalcade of regulations, some members of congress and the Bush administration have proposed plans for capping emissions of these three pollutants from the electricity sector at levels substantially below current emissions. This multi-pollutant cap-and-trade approach

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is intended to provide some regulatory certainty to the industry by creating a timetable now for future reductions. By regulating multiple pollutants simultaneously, this approach would allow firms to efficiently allocate their emission reduction activities across different pollutants and to take advantage of synergies in pollution reduction. Also, this approach would provide firms with the flexibility to achieve aggregate emission reduction goals at low cost.

A central question that arises when designing a multi-pollutant cap-and-trade policy is at what levels the emission caps should be set. Principles of economic efficiency suggest that the cap on emissions of each pollutant should be set at the level where the marginal benefit of further emission reductions is equal to the marginal cost of obtaining those reductions. An alternative approach is an emission fee that is set to equal marginal emission damages at that point. This strategy has the same efficiency implications as the cap-and-trade strategy in which emission allowances are auctioned to firms, but different implications for efficiency and the allocation of rents relative to a trading program that distributes emission allowances for free (Burtraw et al., 2001a).

In this paper, we seek to identify second-best efficient national emission fees for NO_x and SO_2 in the electricity sector. The estimates are second-best because we take as given many aspects of regulatory and fiscal policy that preclude ideal solutions, and search for the efficient fees within this institutional setting. The estimates are obtained by coupling a detailed simulation model of the US electricity markets with an integrated assessment model that links changes in emissions with atmospheric transport, environmental endpoints, and valuation of impacts. Efficient fees are found by solving the electricity model under different values for the emission fees and finding the associated value of the marginal damages associated with the resulting level of emissions for each pollutant. This methodology allows us to estimate the marginal damages and marginal abatement costs for different emission levels and then to approximate the optimal fee or range of fees where the marginal cost (emission fee) is equal to the marginal emission damages. It also allows us to estimate emissions at these tax levels. Because of the duality of the price and quantity instruments, the resulting emissions levels can be interpreted as the efficient permit caps, and can be compared to current legislative proposals.

We find that the efficient emission fee for SO_2 is between US$ 4700 and 1800 per tonne, which will yield 0.9–3.1 million tons of emissions in the year 2010. (All values are in 1999 dollars.) For NO_x, the best estimate of the efficient emission tax lies between US$ 1200 and 700 per tonne, which yields emissions between 1.0 and 2.8 million tons. These results suggest that the emission caps included in the Bush administration and congressional proposals are within the range of emissions that can be supported by current knowledge. We also find there is substantial regional variation in the benefits achieved by reducing pollution, suggesting that a regionally differentiated policy could yield greater net benefits than a uniform national policy.

2. Policy context and prior research

The Clean Air Act Amendments of 1990 ushered in large reductions in pollution. Title IV of these amendments created the first national cap-and-trade program for a major pollutant,