Evaluation of Environmental Taxation on Multiple Air Pollutants in the Electricity Generation Sector – Evidence from New South Wales, Australia

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Executive summary

In the state of New South Wales (NSW), Australia, industrial facilities including electricity generators, are required to comply with a system of environmental taxes designed to control emissions of a number of pollutants, including Nitrogen Oxides (NOx), Sulfur Oxides (SOx), Fine Particulate Matter (FPM) and Coarse Particulate Matter (CPM). This Pigouvian taxation scheme, called Load Based Licensing (LBL), has been in effect since 2000. The LBL scheme is different from other environmental taxation schemes due to a number of features such as spatial pollutant weightings and a fee rate threshold. While the LBL scheme has been lauded as an effective market based environmental policy instrument, questions about its effectiveness in reducing emissions of air pollutants and improving air quality have been raised in both regulatory and scholarly debates.

This paper aims at evaluating the effectiveness of the NSW LBL scheme to reduce air pollution, specifically focusing on the joint effect that this scheme has had on NOx, SOx, FPM and CPM emission intensities in the electricity generation sector. The paper contributes to the literature by

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considering these four air pollutants jointly because many abatement options that are encouraged by the LBL scheme may affect more than one pollutant. The evaluation consists of empirically identifying whether there is a link between emission reductions (through decreasing emission intensity levels) and policy changes, which implicitly reflect decisions made by firms to invest in end of pipe abatement technologies, adopt energy efficient practices or switch emissions intensive inputs that would not have occurred in absence of environmental taxation.

To evaluate the effectiveness of the LBL scheme, this paper uses econometric techniques to estimate a Seemingly Unrelated Regression (SUR) model with fixed effects based on data collected from electricity generators in NSW. The joint estimation provides more precise estimates, as it exploits any contemporaneous correlation in the error term across pollutant models, which may be significant as pollutants are often produced by common technological processes. In principle, the coefficients obtained with the SUR model should be consistent with those obtained with independent fixed effects models, but with additional gains in efficiency, which provides more accurate estimates of the policy effect.

The econometric analysis indicates that except for SOx, there is no evidence of emissions reduction that can be attributed to the effects of the LBL. In terms of enabling low-cost abatement through specific monitoring methods, there is no evidence of reduction in NOx or SOx emission intensities due to generators implementing continuous monitoring. By contrast, generators using periodic monitoring methods have lower emission intensities of CPM and FPM. Overall, the findings suggest that environmental taxes in NSW have been too low compared with marginal abatement cost estimates and so, they have not created sufficient incentives for generators to reduce their emission intensities across air pollutants.

At first glance, the finding that the response to taxation on air pollution has been relatively muted is surprising. It would be expected that the electricity generation sector would be more

responsive to environmental taxes, as this sector has by far the largest financial liability under the LBL scheme, and hence there should be strong incentives to reduce emissions. Moreover, a variety of abatement possibilities for various pollutants are available in this sector.

Potential reasons explaining the lack of response in terms of market characteristics specific to the electricity generation sector, and specific policy design features include: a) inflexible short-run supply of electricity and limited immediate competition, which allows generators to pass-on additional costs of taxes to retailers; b) the inelastic nature of electricity demand means that higher electricity prices due to environmental taxation may not create sufficient changes in end-users' behaviour; and, c) most generators in NSW were state-owned over the period of the analysis, implying that the profit maximisation model may not adequately represent the economic behaviour of this sector.

Moreover, this paper argues that policy parameters may have been set inadequately and therefore the policy fails to create incentives for abatement. The magnitude of the tax rates, apart from SOx, is likely to be too low when compared to the likely damage costs, or to the relevant abatement costs for the electricity generation industry in NSW, or indeed when subject to an international comparison.

The significant effect on SOx emission intensities, as compared to the other air pollutants, may be explained by the availability of inexpensive and simple abatement options – such as fuel switching –, which do not require high upfront investment costs or other post-combustion flue gas desulphurisation techniques which are well-known and established internationally. The data also indicate some reduction in CPM and FPM emission intensities due to periodic monitoring systems (PM) adopted from 2003/04. This can be explained by the fact that those relatively low-cost options for abatement of particulate matter such as filters and electric precipitators may be simpler to manage, since they do not involve any optimisation and, thus, no requirements for continuous monitoring.

Therefore, it is recommended that policy-makers take any potential correlation of pollutants as well as abatement technologies into account when determining the efficient tax levels for pollutants.

Overall, the findings of this paper suggest that the LBL scheme so far has not resulted with significant environmental improvement when it comes to air pollutants from the electricity generation sector. This calls for revision of the basic policy settings that will need to be adjusted in order to meet environmental objectives set out by the legislation more effectively.