Jurate Jaraite

THE EFFECT OF THE EU ETS ON THE ENVIRONMENTAL AND PRODUCTIVE PERFORMANCE OF EU PUBLIC POWER PLANTS

University College Dublin, Ireland, jurate.jaraite@ucd.ie

According to most scientists, reducing the risk of catastrophic climatic change requires a stabilisation of the concentration of 450-550 parts per million (ppm) of carbon dioxide equivalent - a concentration that is roughly linked to limit a global warming to around 20 centigrade. There is little doubt that achieving such a target is a daunting task that requires a complete paradigm shift in the long-run. In particular, the transition towards low-carbon energy sources is paramount in the long run. In the short and medium run, however, a minimal strategy calls for the production of energy in the most efficient way. Therefore the role of climate change policies is to create incentives to follow carbon reducing practices or to install new technologies and to increase efficiency of power generation. The latter is the focus of this paper.

In this paper we study the productive and environmental efficiency of fossil-fuel based public power plants across EU member states (MS), responsible for about a third of the EU greenhouse gas (GHG) emissions, over a twelve-year period (1996-2007) that spans the ratification of the Kyoto protocol and the introduction of the European Union's CO_2 Emissions Trading Scheme (EU ETS). The main question is whether there has been an improvement in terms of environmental efficiency and productive performance in the energy generating sector in the EU, and whether it is possible to identify any influence that the EU ETS may have exerted, controlling for other contributing factors.

The EU ETS - at its launch titled as “the grand policy experiment” - today is recognised as the largest successfully working cap-and-trade system which is a centerpiece in the EU commitment to reach established GHG reduction targets. As there are more efforts to establish similar cap-and-trade like policies in other countries, answering the above questions is of fundamental importance to inform the debate on the design of effective and efficient policies aimed at reducing the carbon footprint of energy generation. The power generating sector is the largest sector in the EU ETS. Conventional wisdom is that the power generating sector has more low-cost emission abatement opportunities than other sectors. This and the fact that power generation is not directly exposed to international competition allowing to pass on additional costs to consumers without loss of output and market share are the main reasons of why many EU member states allocated fewer allowances to this sector compared to other sectors covered under the EU ETS (Convery et al., 2008; Widerberg and Wrake, 2009). This suggests that if any emissions abatement occurred, it occurred primarily in the power generating sector.

There are few studies documenting the early emissions abatement in the EU ETS (Delarue et al., 2008; Ellerman and Buchner, 2008; Anderson et al., 2009; Widerberg and Wrake, 2009). Delarue et al. (2008) and Widerberg and Wrake (2009) explicitly focus on the abatement in power generation. Delarue et al. (2008) analyse the European power sector's CO_2 short-term abatement possibilities through fuel switching. Using both a non-calibrated and a historically calibrated simulation model the authors' estimates of abatement are between 34.4 and 63.6 Mt in 2005, and 19.2 and 35 Mt in 2006 in the power sector alone. Authors note that there is no single constant relationship between the price of CO_2 and abatement. The abatement also depends on the load level of the system (a carbon price will have its greatest effect at relatively low load levels when more lower emitting capacity is available) and the ratio

between natural gas and coal prices. Widerberg and Wrake (2009) look at the effect of the price of the EU emission allowances (EUA) on CO_2 emissions intensity of the Swedish electricity sector for the period 2004-2008 and do not find any link between the price of EUA and the CO_2 emissions (their regression analysis show that EUA price has an insignificant negative effect). They conclude that it seems unlikely that there are significant volumes of low-cost CO_2 abatement measures with short response times in the Swedish electricity sector and this might be explained by the structure and characteristics of Swedish electricity generation.

Our paper contributes to this scarce empirical literature on the influence of the EU ETS on power generation. This paper measures the environmental efficiency and total factor productivity (TFP) based on Data Envelopment Analysis (DEA) - an approach that allows us to evaluate efficiency within a multiple inputs and outputs production framework allowing for substitution effects among production inputs which cannot be reflected in partial indicators constructed by assuming only one input and one output. The DEA provides an opportunity to highlight best practice, rather than average practice. In a semi competitive sector such as power generation with incentive problems, average performance may be well in the interior of the production possibility set. The multi-input, multi-output specification of the technology also increases the informational value of the benchmarking, in addition to the avoidance of a priori assumptions on the production possibility set. DEA, as any parametric or non-parametric production function, assumes that the observed productions belong to the same production possibility set, which is a prerequisite for comparability. Given the diversity of power generating industries in the EU with respect to technology, fuel mix, extent of cogeneration, this would pose some classification problems for a parametric method. In addition, the nonparametric models are easy to compute and most of their statistical properties are well established through use of bootstrap methods.

Once we measure the environmental efficiency and TFP for each country in the sample, we use the econometric techniques to empirically assess the effect of the EU ETS on both indicators by controlling for other influential variables. We find that the EU ETS has a positive effect on the environmental efficiency of the European public power generation. However, the looseness of this policy, reflected in the overallocation of the grandfathered permits, alleviates some of these improvements by “facilitating” the use of more carbon intensive and less energy efficient fuels. Furthermore, our results show that although the EU ETS does not affect TFP of power generation, but it significantly affects TFP components: technical change and technical efficiency change. The EU ETS triggers an upward shift in the power production function, while, the windfall profits from selling the surplus of the allowances encourage the inefficient use of all inputs in power production. We believe that most of the occurred technical change in fossil fuel based public power generation reflects the short-term abatement through fuel switching rather than the long-term abatement achieved through investments in capital stock. Overall our analysis imply that expectations about the first phase of the EU ETS as performance improving are fulfilled through the emissions trading nature itself but not through the allocation design.