Emissions Trading in the Presence of Price-Regulated Polluting Firms: How Costly Are Free Allowances?

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Overview

Market-based pollution permit trading programs have become a centerpiece of environmental policy in Europe and the United States.1 In a competitive setting with full information, the creation of a market for emissions permits works to equalize marginal abatement costs across sources and minimizes aggregate compliance costs (Dales, 1968; Montgomery, 1972). A particularly appealing feature of emissions trading – that helps to explain why it has emerged as the preferred instrument in a variety of environmental policy settings – is the independence of permit market outcomes and the initial allocation of permits (Hahn & Stavins, 2011). Importantly, this enables separating efficiency (or cost-effectiveness) from equity considerations, creating the flexibility to secure political support for such policies. Free allowances or the revenue from auctioned permits can be used to relieve participating firms from their compliance costs and o_set profit losses (Hepburn et al., 2012; Goulder et al., 2010), or to address unintended distributional outcomes (Stavins, 2008). The independence property also means that the central design question of emissions trading regulation, namely whether to auction or give away emissions permits for free, does not a_ect the aggregate policy cost. This paper challenges this view by investigating the extent to which the presence of price-regulated firms affects the choice between alternative permit allocations rules.

We study whether to auction or to freely distribute emissions allowances when some firms participatingin emissions trading are subject to price regulation. We show that free allowances allocated to price-regulated firms e_ectively act as a subsidy to output, distort consumer choices, and generally induce higher output and emissions by price-regulated firms. This provides a cost-effectiveness argument for an auction-based allocation of allowances (or equivalently an emissions tax). For real-word economies such as the Unites States, in which about 20 percent of total carbon dioxide emissions are generated by price-regulated electricity producers, our quantitative analysis suggests that free allowances increase economy-wide welfare costs of the policy by 40-80 percent relative to an auction. Given large disparities in regional welfare impacts, we show that the inefficiencies are mainly driven by the emissions intensity of electricity producers in regions with a high degree of price regulation.

Methods

To get a sense about the likely order of magnitude of efficiency costs and distributional impacts of alternative designs for emissions trading regulation, we examine the situation of the United States economy. We develop a numerical general equilibrium model with deliberately simple behavioral assumptions based on standard neoclassical optimizing behavior of firms and households. However, beyond the conceptual simplicity of the underlying economic framework, the quantitative model exhibits a number of features that are essential for being able to provide an empirical analysis of the likely economic impacts. In fact, the key methodological contribution of this paper is to integrate these multiple features consistently within an applied general equilibrium context.

First, to characterize abatement opportunities in the electricity sector, we use data on all 16,891 electricity generators active in 2006 published by the Energy Information Agency (EIA) (2007a). Generators are owned by a set of operators, and we identify 319 operators subject to cost-ofservice regulation (EIA, 2007b). Regulated operators are treated as cost-minimizers charging average costs, whereas generators owned by non-regulated operators trade on imperfectly competitive regional wholesale markets. By providing a structural "bottom-up" representation of abatement options in the electricity sector, we avoid using overly simplistic aggregate production functions typically employed in aggregated economy-wide general equilibrium models for electricity generation (Paltsev et al., 2005; Goulder et al., 2010). On the one hand, it enables us to capture some of the complexity of the market structure in the U.S. electricity sector. On the other hand, and relevant for studying the impact of a carbon pricing policy, substitution among di*ff*erent types of electricity technologies is modeled at the generator-level and is based on detailed data for generation costs, fuel switching possibilities, and time-varying (diurnal and seasonal) demand for electricity (see Lanz & Rausch, 2011).

Second, we embed the operator-level representation of electricity generation into a static general equilibrium model of the U.S. economy calibrated based on a set of regional Social Accounting Matrices for 2006. The sub-national

detail of the model allows us to capture region-specific detail of energy use and production of various industries and final consumption sectors. The economy-wide representation is important for our analysis as it provides a structural economic model of how, among other things, electricity demand by various types of private and industrial consumers changes in response to a carbon pricing policy. Moreover, it characterizes abatement possibilities in non-electricity sectors and allows us to evaluate economy-wide welfare costs of alternative emissions trading design consistent with the equilibrium allocation of abatement among (electricity and non-electricity) sectors and the equilibrium price for tradable emissions permits.

Third, to illustrate the distributional impacts of alternative policy design, we build on previous work by Rutherford & Tarr (2008) and Rausch et al. (2011) and integrate "real" households as individual agents in the model. In particular, our framework recognizes the considerable heterogeneity among households both in terms of preferences and sources of income with data on all 15,588 respondents from the Consumer Expenditure Survey (CEX), a representative sample of the U.S. population (Bureau of Labor Statistics (BLS), 2006). Using a general equilibrium model with heterogeneous consumers allows us to measure household impacts both on the uses- and source-side of income, i.e. how do consumers spend and earn their income.

Results

This paper has studied the efficiency and distributional implications of alternative designs for emissions trading systems in the presence of price-regulated firms. An emissions trading policy that is designed to distribute emissions permits for free is likely to effectively subsidize output prices of polluting firms that are subject to price-regulation. The failure to pass through the carbon price signal can impede cost-effectiveness and lead to substantial additional welfare cost. To shed light on the empirical relevance of this issue, we focused on the case of U.S. economy where about one fifth of economy-wide CO2 emissions are produced by price-regulated electricity suppliers.

Our quantitative analysis suggests that, for an emissions reduction target of 20%, efficiency costs of freely allocating permits are about 60% higher relative to auctioning of allowances. We have shown these large welfare costs to be driven by two main factors. First, given the large share of emissions stemming from price-regulated firms, the value of free permits used to subsidize electricity rate is quantitatively important, and has a significant impact on electricity output. In turn, U.S. regions with a large share of electricity produced under cost-of-service regulation suffer from relatively large distortions. Second, as free permits induce a higher output by regulated electricity producers, the economy forgoes low-cost abatement opportunities in the electricity sector associated with fossil-based, in particular coal-fired, electricity generation. The marginal abatement cost schedule in non-electricity sectors is relatively steep compared to regulated electricity producers, so that shifting abatement to other sectors induces a substantial increase in the equilibrium marginal abatement cost.

At the household level, our analysis suggests that auctioning permits can lead to substantial increases in the price of electricity, ranging up to 250% for highly CO2-intensive producers for a 20% emissions reductions target. Subsidizing electricity rates for price-regulated firms with free allowances may thus be expected to make low-income households better off as these tend to spend a larger fraction of their income on energy. We have shown, however, that this is not necessarily the case: low-income households bear a disproportionately large fraction of the additional effciency costs brought about by free allocation of permits in the presence of price-regulation. The explanation for this result rests on the incidence of the sources side of income e_ects that outweigh the alleged progressive effects from the uses side of income.

Conclusions

In light of still ongoing attempts in many countries to introduce market-based instruments to control pollutants, this paper highlight the fact that a price on carbon does not automatically guarantee cost-e_ectiveness. In fact, if the policy is poorly designed, the market-based instrument may even lose its superiority over command-and-control-type instruments. While the fundamental design aspect of emissions trading systems, namely whether to auction or freely distribute permits, has already been investigated from a variety of angles (for example, to provide compensation of profit losses as in Goulder et al., 2010, or to lower pre-existing fiscal distortions as in Goulder et al., 1999), this paper points to the importance of pre-existing regulatory interventions affecting price-adjustment mechanisms.