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Carbon leakage and capacity-based allocations: Is the EU right?

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ABSTRACT

Competitiveness and carbon leakage are major concerns for the design of CO_2 emissions permits markets. In the absence of a global carbon tax and of border carbon adjustments, output-based allocation is a third-best solution and is actually implemented (Australia, California, New Zealand). The EU has followed a different route; free allowances are allocated to existing or new capacities in proportion to a benchmark, independent of actual production. This paper compares these two schemes in a formal setting and shows that the optimal one is in fact a combination of both schemes, or output-based allocation alone if uncertainty is limited. A key assumption of our analysis is that the short-term import pressure depends both on the existing capacities and the level of demand, which is typical in capital intensive and internationally traded sectors. A calibration of the model is used to discuss the EU scheme for the cement sector in the third phase of the EU-ETS (2013–2020). This allows for a quantification of various policies in terms of welfare, investment, production, company profits, public revenues and leakage.

Introduction

Nowadays a number of countries have set up their own national or regional Emission Trading Scheme (ETS) or intend to do so (Australia, California, China, India, New Zealand…). The EU implemented its ETS in 2005 and has significantly revised the allocation rule for the period 2013–2020. In all these schemes, the allocation mechanism has been, or will be, an important factor in the success of their actual implementation.[1] This importance comes from competitiveness and leakage issues and their implications in terms of potential loss of profit, employment and reduced environmental impact due to the transfer of emissions from one country to another.

Indeed, the implementation or otherwise of these national ETS will generate major differences in carbon prices worldwide. Internationally traded carbon intensive sectors may be significantly affected by these differences resulting in production and investment transfers from high carbon price countries to low carbon price ones. While border adjustment mechanisms may limit these competitive distortions, they are seen by many emerging countries as indirect protectionist measures incompatible with the philosophy of the World Trade Organization (Wooders and Cosbey, 2010).

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[1] See Hood, 2010 for a review of existing and proposed ETS worldwide, and a presentation of their respective designs.

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The main approach to circumventing this political constraint relies on "output-based" allocation (implemented in New Zealand and California, and to be implemented in Australia if the new majority does not repeal the "Clean Energy Future legislation"). The EU has followed a different route, free allowances are allocated to existing capacities and new capacities based on an industry benchmark, but without reference to actual production: we refer to this scheme as "capacity-based" allocation. This paper compares these two schemes. A major ingredient of the comparison relates to the fact that the schemes are designed ex-ante for a number of years over which economic conditions may vary. We show that when uncertainty is large the socially optimal policy is a combination of output- and capacity-based allocation, while output-based allocation alone is optimal if uncertainty is limited. By "socially optimal", we mean the third-best policy, assuming that neither a global carbon tax nor border carbon adjustment is feasible.

More precisely, we consider a homogeneous good produced competitively with either home or foreign plants, both types of plant emitting pollutants. Firms can invest in a fixed input, capacity, to reduce the home production cost. Home production is subject to environmental regulation whereas imports are not regulated. If emissions from home production are taxed but emissions from imports are not, this regulatory asymmetry creates a positive externality, an increase in the home production having a positive environmental effect via the reduction of imports. The positive externality associated with leakage calls for a subsidy on home production in addition to the tax on emissions. This is the rationale for the output-based rule of free allocation.

The precise value of the optimal production subsidy is related to the output demand and if this demand is random or variable but the subsidy fixed, the use of a complementary policy could be justified. A subsidy on capacity (i.e. capacity-based allocation) could be justified to discriminate between different demand states. A necessary condition for this result is that new capacity has a stronger influence on home production when demand is large and leakage occurs than when demand is low and leakage does not occur. This condition may be expected to hold true in a number of energy-intensive and trade-exposed sectors. Such sectors are typically capital-intensive and capacity decisions are planned over long time horizons so that capacity constraints and short-term demand levels significantly influence the level of imports.

It is well known that output-based allocation has two positive impacts and one negative one. Firstly, abatement incentives continue to operate; secondly by reducing the perceived cost of home production, it preserves a level playing field where foreign production is unaffected by carbon prices. However, these positive impacts are obtained at the cost of eliminating the output price signal for consumers so that there is an excessive consumption of products that benefit from the scheme. The introduction of a social welfare function allows a balance to be achieved between positive and negative impacts. This is particularly relevant if, in some states of the world leakage is low so that the regulator would like to have the carbon price signal for consumers in those states. This calls for a reduction of the production subsidy. If a capacity subsidy does not affect the home production in the case of low demand and reduced leakage in the case of high demand, this will increase the benefits of lowering the production subsidy. However, investment subsidy has its own negative impact in that it encourages over-capacity.

Several authors have analyzed output-based allocation schemes. Quirion (2009) provides an early survey of this literature. Böhringer and Lange (2005) discuss its advantages compared to an emissions-based allocation rule. Böhringer et al. (2010, 2012) compare it to border tax adjustments and industry exemptions. Fischer and Fox (2012) and Holland (2012) analyze its effectiveness in addressing the issues of leakage and competitiveness. Uncertainty is not discussed in these articles.

Capacity-based allocation has received much less attention in the literature. It is related to the question of reserves for new entrants. The economics of such a scheme was first investigated by Ellerman (2008) in the context of the EU electricity market. His analysis points out that it may have resulted in excess investment in carbon-intensive electricity production. Ellerman also discusses the possible impact of this excessive investment on the electricity price, giving due consideration to peak and off-peak periods. Other authors have also discussed how the EU allocation mechanism has influenced the energy mix in the electricity industry (see Neuhoff et al., 2006; Zhao et al., 2010; Golombek et al., 2011).

In our model the demand function and home productive capacity determine imports, while the home productive capacity is endogenously determined prior to knowing the actual demand but knowing the climate policy. Meunier and Ponssard (2014) consider how, in such a setting, the introduction of a carbon tax at home influences leakage in the short-term (without capacity adjustment) and in the long-term (with capacity adjustment). In this paper we show that output-based and capacity-based allocation schemes are complementary instruments for maximizing social welfare. The idea of distinguishing between short-term and long-term effects has been recognized in the applied literature (see Ellerman et al., 2010) but has so far rarely been made explicit in the welfare analysis of allocation schemes. One notable exception is Fowlie et al. (2012) who consider a Markov dynamic oligopoly model. They adopt a normative approach and determine the optimal output-based rule. They focus on the influence of the long-run entry process with imperfect competition while we focus on capacity investment and demand uncertainty.

We apply our model to the case of the cement industry in Europe. The actual allocation scheme is modeled, as is the optimal scheme. With our calibration, it turns out that the optimal scheme is a pure output-based one, this is so because of the low level of demand uncertainty relative to the high level of existing capacities. We carry out a sensitivity analysis which shows that a combination of instruments may be optimal if regulation could differ among Member States. In coastal Member states the uncertainty relative to existing capacities may be higher and the international competitive pressure may also be higher due to the accessibility of maritime imports.

The section "The model" introduces the model. The optimal regulation is determined in the section "Optimal regulation". Two extensions are also discussed in this section: the possible interaction between the home and foreign markets;