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The effects of carbon prices and anti-leakage policies on selected industrial sectors in Spain – Cement, steel and oil refining

Alberto Santamaría, Pedro Linares*, Pablo Pintos

IIT – Universidad Pontificia Comillas, Spain

HIGHLIGHTS

- We simulate the impact of carbon prices on the risk of leakage in the cement, steel and oil refining sectors.
- We also assess the effectiveness of different anti-leakage policies in Europe.
- Cement production in coastal areas is highly exposed.
- The risk of leakage for steel and oil refining is smaller.
- Anti-leakage policies should be modified to be efficient.

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ABSTRACT

This paper assesses the impacts on the cement, steel and oil refining sectors in Spain of the carbon prices derived from the European Emissions Trading Scheme (EU ETS), and the potential effect on these sectors of the European Union anti-leakage policy measures. The assessment is carried out by means of three engineering models developed for this purpose. Our results show a high exposure to leakage of cement in coastal regions; a smaller risk in the steel sector, and non-negligible risk of leakage for the oil refining sector when carbon allowance prices reach high levels. We also find that the risk of leakage could be better handled with other anti-leakage policies than those currently in place in the EU.

1. Introduction

The European Union Emissions Trading Scheme (EU ETS) is one of the pioneer cap-and-trade systems in the world for regulating carbon emissions. As any other carbon pricing mechanism, the EU ETS may pose a threat for the competitiveness of European industry (particularly the more energy-intensive sectors), by imposing an additional cost (the cost of carbon emission allowances) that other industries located in countries with no carbon prices do not have to face.[1] This in turn may result in what is termed "carbon leakage", the increase in carbon emissions in non-EU countries as a result of the shift of production from European to non-European countries.[2] Carbon leakage reduces the efficiency of climate policies, and therefore is an undesirable consequence which should be minimised.

This has indeed been a concern of the European Commission since the system started. In the first two phases (2005–2007 and 2008–2012), allowances were freely distributed to all the agents participating in the system, based on their historic emissions. However, aware that this system, if maintained, generated perverse incentives (basically, to keep emitting to obtain more allowances in the future), the Commission put forward a new Directive (2009/29/EC) in which the allocation system was revised, and some provisions against carbon leakage were introduced.

Basically, the new Directive sets auctioning as the default method for allocating allowances, although, for the manufacturing industry, allowances will be allocated free of charge initially (80% in 2013, decreasing linearly to 30% in 2020). However, those sectors which are susceptible to carbon leakage will be awarded 100% free allowances until 2020 (based on benchmarked

* Corresponding author. Tel.: +34 915206257.
E-mail address: pedro.linares@upcomillas.es (P. Linares).

[1] According to the Coase theorem, this cost is in theory independent on whether the carbon allowances are auctioned or distributed freely, since there will always exist an opportunity cost for the allowance that firms must take into account.

[2] There is another source of carbon leakage, which will not be addressed in this paper: the price effect, that is, the increase in emissions in non-European countries due to the increased use of fossil fuels (which have lower prices because of the reduced European demand).

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emissions for the sector).[3] Of course, the question is, which sectors are subject to leakage risk? To answer this the Commission has developed a two-factor evaluation, which takes into account the impact of the carbon cost on the production cost (as a share of the Gross Value Added), and also the trade intensity of the sector with countries outside the EU. The list of sectors exempted according to these factors, which is revised every 5 years, has been already published by the European Commission (EC, 2010), and includes most of the heavy industry.

However, increased costs of carbon may not necessarily result in industry relocation and therefore carbon leakage, even with large trading intensity. As e.g. Eskeland and Harrison (2003) or Levinson and Taylor (2008) point out, industries do not necessarily relocate production when environmental policies are in place. Other factors, such as labour costs, consumer fidelity, or other regulations may also play a relevant role here. In addition, the risk of leakage, and also the effectiveness of anti-leakage policies will clearly depend on the characteristics of the production processes involved, of the demand, cost structure, etc. Therefore, it is generally acknowledged that the criteria developed by the EU may not be valid for all sectors, and that other more precise assessments are required. Given that the Commission has already started to work towards preparing the next list, which should be ready by the end of 2014, these assessments become particularly needed.

Droege et al. (2009) or Monjon and Quirion (2011) are examples of this kind of detailed assessments, covering the cement, steel, aluminium and electricity sectors both regarding their risk of carbon leakage and the specificity of anti-leakage policies. Other sectors have also been covered by Reinaud (2004) or de Bruyn et al. (2008). In general terms, they conclude that the risk of leakage is very different (in some cases, almost inexistent due to the possibility of passing-through the carbon cost to consumers), and that the anti-leakage policies to be applied to these sectors should also be different.

However, it is difficult to generalise these results to all regions. Most of the studies have addressed central European countries which, while certainly accounting for a large part of the European emissions, are much less exposed to the risk of leakage than, e.g., coastal Mediterranean areas, which are closer to (and therefore more exposed to competition from) non-European countries.[4] Another shortcoming of previous assessments is that they have not covered the oil refining sector, which accounts for more than 3% of the EU carbon emissions (almost 10% of energy industry carbon emissions). Finally, most of the studies have used top-down methodologies that do not allow for a detailed representation of the production processes, and therefore of the mitigation options in each sector, relying instead on exogenous marginal abatement cost curves.

Our objective therefore is to determine whether the cement, steel and oil refining sectors are exposed to carbon leakage in a coastal region like Spain, as an example of an area more exposed to international competition for heavy industry. We will also assess the effectiveness of different anti-leakage policies for these sectors. We plan to do so by developing sector-specific, bottom-up models which will allow us to have a more detailed view of the abatement options within each sector in an endogenous way.

The paper is structured as follows. Section 2 describes the general modelling approach and how it has been applied to the cement, steel and oil refining sectors. Then Section 3 shows the major results obtained in terms of changes in production and risk of leakage when a carbon price is introduced, and Section 4 puts these results into context and compares them with previous studies. We conclude with the answer to our research problem and the policy implications derived.

2. The modelling approach

The modelling approach used for this study is a bottom-up, engineering representation of three sectors: cement, steel and oil refining. We explain first its general characteristics, and then we proceed to describe how it has been implemented for each of the three sectors. The formulation of the models and the input data for the models are presented and described in Appendix A.

2.1. General features

We have developed partial equilibrium, linear optimisation models for the three sectors considered. For each, we represent the production technologies in use, and also the alternatives available to reduce carbon emissions (including both changes in operation, in fuel used, and new investments or retrofittings). Each alternative option is represented by its operation and investment costs, its production efficiencies, its technological and capacity constraints, and of course, its CO_2 emissions. The options for reducing emissions have been taken from the literature, and also checked with industry representatives so that they are as realistic as possible.[5]

The models combine the available options to satisfy a given, exogenously set demand at the minimum cost, subject to either a carbon price or an explicit carbon constraint. Imports are considered as an additional option to reduce emissions, if the price of imports is lower than the domestic production cost, subject to the Armington elasticities of substitution between domestic and imported production, which represent to a certain extent the premium consumers who are willing to pay for local goods. The Armington elasticity data were obtained from the GTAP5[6] database. The model is steady state, so it does not show the evolution of emissions and use of abatement measures endogenously, but it does include the possibility of investing in low-carbon technologies, retrofitting, or building new installations to satisfy demand. This is modelled by including the depreciation of new investments in the cost of abatement.

This modelling approach differs from others applied to the sectoral analysis of carbon leakage in a number of ways. Compared to the CASE II[7] model (Monjon and Quirion, 2009), our approach generates an endogenous marginal abatement cost curve, which allows for a better representation of non-linearities in production changes within the industry. The CASE II model instead uses a linear-quadratic, monotonous marginal abatement cost curve exogenous to the model (derived from the PRIMES model). Other studies take a different approach, looking at the possibility of pass-through of carbon prices, based on the characteristics of the

[3] Article 10a(6) of the revised ETS Directive gives Member States the possibility to compensate the most electro-intensive sectors for increases in electricity costs resulting from the ETS through national state aid schemes.

[4] Typically, heavy industry products are expensive to transport, therefore creating regional markets when access to the sea is difficult.

[5] We have double-checked with the major industry associations and administrations in Spain (and in some cases in Europe) the realism of the options considered for mitigation. These include Oficemen (the Spanish cement industry association), UNESID (2011) (the Spanish association of iron and steel industries), Tata Steel, AOP (the Spanish association of oil refiners and distributors), the Spanish National Energy Commission, and the Spanish Office for Climate Change.

[6] GTAP, the Global Trade Analysis Project (http://www.gtap.agecon.purdue.edu), maintains a global database describing bilateral trade patterns, production, consumption and intermediate use of commodities and services, which is the standard reference for the assessment of international trade in economic models.

[7] CASE stands for Cement, Steel, Aluminium and Electricity, CASE II being an evolution of CASE (Demailly and Quirion, 2008).