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Communication

Assessment of the impact of the European CO_2 emissions trading scheme on the Portuguese chemical industry

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ABSTRACT

This paper describes an assessment of the impact of the enforcement of the European carbon dioxide (CO_2) emissions trading scheme on the Portuguese chemical industry, based on cost structure, CO_2 emissions, electricity consumption and allocated allowances data from a survey to four Portuguese representative units of the chemical industry sector, and considering scenarios that allow the estimation of increases on both direct and indirect production costs. These estimated cost increases were also compared with similar data from other European Industries, found in the references and with conclusions from simulation studies. Thus, it was possible to ascertain the impact of buying extra CO_2 emission permits, which could be considered as limited. It was also found that this impact is somewhat lower than the impacts for other industrial sectors.

1. Introduction

Climate change can be attributed to the greenhouse gas (GHG) effect, which is mainly due to the atmospheric gaseous emissions derived from human economic activities. Kyoto Protocol was signed in 1997, which originally aimed to attain, by 2012, a global emissions reduction of the six main GHG[1] of, at least, 5% less than the observed levels in 1990. As a result of the signature of the Kyoto Protocol, the European Union (EU) issued a global reduction aim of 8% of GHG levels, and Portugal, as a member of the EU, agreed to limit the increase of its atmospheric emissions to 27% regarding the 1990 levels. The EU abatement compromise was formalised in 2002 through the 2002/358/CE Directive, and later on, in 2003, by the European Directive 2003/87/EC, which created the European Union Trading Scheme (EU-ETS). The main objective of 2002/358/CE Directive was the promotion of emissions abatement measures having good cost-benefit ratio and also being economically efficient. In the first stage, only CO_2 and only some industrial sectors were considered. A future revision will probably include other GHG apart from CO_2, and will include other relevant sectors such as transportation, aluminium industry and chemical industry as well. European Directive 2003/87/EC requires that every member state has to establish a National Allocation Plan of emission allowances: (in the Portuguese case, Portuguese National Allocation Plan (PNALE)) which indicates, for each industrial sector, the maximum permitted emission amounts during the duration of the plan and even specifies penalties in case of non-compliance.

Competitiveness is a concept that may be defined in several ways. One way to measure an industry's competitiveness is through its production costs. In what way can GHG emission restrictions lead to competitiveness loss? What kind of impacts may be expectable if production costs increase due to the necessity of emission allowance purchase? Chemical industry is a global competing industry responsible for emission of several GHG, namely CO_2, which can result from industrial processes or power generation. Therefore, any emission allowance purchase would have an associated cost to be included in the production costs: a high CO_2 intensity and also a high production represent a higher number of emission permits that have to be purchased, resulting in higher production costs. Although the European Directive 2003/87/EC did not include the GHG emissions from the chemical industry, all emissions from this sector related with energy production in units having a thermal power higher than 20 MW, were included. The aim of this work is to assess the effect of emission allowances purchase on the chemical industry sector in Portugal, considering some pertinent scenarios, thus resulting in the economic impact of the cited European Directives in the Portuguese chemical industry. Also, this study comprised the need for any cost increase on

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[1] The six GHG considered in the Kyoto Protocol were carbon dioxide, methane, nitrogen oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.

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manufactured chemicals and also assessed the eventual adoption of any technological innovation in this sector.

2. The basis for establishing the European emission trading scheme

In environmental policy there are two main types of regulation: instruments of command and control and instruments. The European emission trading scheme falls among the second category. Command and instruments are, nowadays, the dominant ones used for environmental regulation. The basic concept involved in this regulation is the specification, by the regulator, of the measures that polluting agents should adopt in order to solve the environmental problem. The regulator chooses the information needed in order to decide on the pollution control actions and notifies the polluting agents about the specific measures to be undertaken. These measures may also include penalties for non-compliance. These measures should not be mistaken with economic incentives which could also be adopted for pollution abatement. Although command and control instruments can be presented in several types, there are two distinctive features separating them from the economic instruments: the polluting agent is restricted in the choice of the means used to achieve the environmental goals and a lack of mechanisms to equalize marginal costs among all polluting agents. Economic instruments were derived from two different approaches: Pigouvian and Coase Theorem. Pigouvian approach is based on his works on the circumstances generating divergences between social and private costs (Pigou, 1920). If we consider an agent A, who is rendering a service to another agent B for which a payment is due, accidentally it also renders a service (or causes a damage) to other third agents, so that a payment from the benefited third agent, or a compensation for damages, is due, but it cannot be exactly quantified. The Coase Theorem (Coase, 1960) reflects the reciprocal nature of the problem associated with the effects of an activity of an agent on the welfare of other agents and uses the concept of property rights and its distribution. Considering two agents, A, a polluting agent and B, a pollution victim, a traditional overview of the problem tells us that A, being the problem originator should be held responsible. However, another overview, not so based on right and wrong, indicates us that agent B, the pollution victim, could be held responsible for not protecting himself against the pollution created by agent A. This means that, if B was not considered, the pollution generated by agent A would not be a problem. Coase Theorem reflects on the legitimacy of attributing property rights to one or the other agent. Coase concludes that, in the same conditions, to achieve an optimum level of global efficiency, there is no difference between being the polluter the owner of the property right to pollute or being the victim the owner of the right of not suffering the consequences of the pollution. It should be noted, however, that there is a considerable difference of having those property rights or not. As the right to pollute is a property right having a specific value, if the trading of that right is allowed, the objective of maintaining an optimum efficiency level should be attained independently of the agent who initially obtained the property rights.

The concept of emission trading scheme was popularized by Dales (1968) and later on formalized by Montgomery (1972), based on the Coase Theorem. It is based on the idea of creating a property rights system, or allowances, who grants, to who owns them, the right to emit a unit of a certain pollutant. These allowances may be considered as production inputs, such as any other raw materials or even energy, therefore having a market price and being traded as any other commodity. As the number of allowances is limited, implicitly or explicitly, its value is defined as a result of its availability. Montgomery (1972) showed that an emission trading scheme is liable to achieve the objective of attaining the required emissions reduction as it allows polluters a certain flexibility of options in choosing the best way to achieve this goal. Marginal costs, that is, costs related with the necessity to purchase additional allowances, have a tendency to equalize, which is a relevant issue for both the regulator, when deciding which environmental policy should be followed, especially and to the several operators active in the market, using different technologies and different capabilities, creating an "equal playing field", levelling-up cost factors and avoiding competition distortions. This is particularly important for energy intensive energy industries, such as the chemical industry.

3. The Portuguese National Allocation Plan and the emissions from the chemical industrial sector

Within the scope of the European Directive 2003/87/EC, the PNALE established an emissions cap for Portugal, which was then distributed among involved sectors, thus defining the maximum emission volume during the period for its application. The payment due for exceeding the emissions limit does not discharge the operator from the obligation to return a number of permits equivalent to the exceeded emission permits in the following year. The annual distribution of permits per sector for the first period (PNALE I) and for the second period (PNALE II) was done as presented in Table 1.

From PNALE I to PNALE II the net volume of emissions diminished. However, there was an increase of the emission allowances allocated to the combustion unit sector, which was mainly due to a redefinition of the combustion unit concept: PNALE I comprised all combustion units with a thermal power higher than 20 MW which supplied any energy product with utilization inside the plant or even outside (IA, 2004). For the period 2008–2012, the definition comprises some more units, namely the ones from the chemical industry sub-sector. This includes not only the units referred in PNALE I but also other emission sources such as carbon black producing units, steam-crackers and furnaces used in rockwool plants. However, for these plants, process emissions were excluded and only emissions

Table 1
Annual distribution of emission permits per sector according to PNALE I and PNALE II (Unit: tCO_2/year).

Sector	PNALE I	PNALE II	Diference (%)Difference (%)
Power plants	20,969,238	16,476,305	−21.4
Oil refineries	3,265,877	3,123,107	−4.4
Cogeneration plants	2,480,025	2,628,844	6.0
Combustion units	535,445	1.489,104	178.1
Ferrous metallurgy	308,784	336,376	8.9
Cement	7,135,493	7,044,795	−1.3
Glass making	681,153	701,586	3.0
Pulp and paper	362,841	361,848	−0.3
Ceramics	1,189,995	588,637	−50.5
Total	36,928,851	32,750,602	−11.3

Table 2
Weight of the chemical industry sub-sector within the cogeneration and combustion sectors for PNALE I and PNALE II (Unit: tCO_2/year).

Sector	Sub-sector	PNALE I	%Percent	PNALE II	%Percent
Cogeneration	Chemical	873,247	35	945,713	36
Combustion units	Chemical	225,061	42	1,173,762	79