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Emission trading under the Kyoto Protocol—effects on fossil fuel markets under alternative regimes

Bjart Holtsmark[a,1], Ottar Mæstad[b,*]

[a] *Ministry of Finance, P.O. Box 8008 Dep., N-0030 Oslo, Norway*

[b] *Foundation for Research in Economics and Business Administration/SIØS, Center for International Economy and Shipping, Helleveien 30, N-5045 Bergen, Norway*

Abstract

The consequences of the Kyoto Protocol for the fossil fuel markets depend on which policy instruments are used in order to reach the emission targets. This paper uses a numerical model to assess the significance of international emissions trading for the oil, coal and gas markets. Three different trading regimes are compared. Particular attention is devoted to the EU proposal about limits on acquisitions and transfers of emission permits. We find that the EU proposal will be non-binding for buyers of emission permits but will significantly constrain the sale of emission permits from Eastern Europe. The EU proposal will increase the level of abatement in Annex B countries and will cause a sharp increase in the price of permits compared to the free trade equilibrium.

Keywords: Emissions trading; Fossil fuel markets; Kyoto protocol

1. Introduction

The Kyoto Protocol puts a cap on the emissions of greenhouse gases (GHGs) in the countries listed in Annex B of the Protocol. On average, the industrialised countries have committed themselves to keeping their emissions below 95% of the 1990 emission level in the period 2008–2012. Since CO_2 is the most important GHG, and since emissions of CO_2 mainly are attached to combustion of fossil fuels, the Kyoto Protocol will directly affect the demand for fossil fuels. But the exact consequences for the fuel markets depend on which policy instruments are used to reach the emission targets. This paper analyses how three different regimes for international emissions trading may lead to different effects for the oil, coal and gas markets.

Several mechanisms are built into the Kyoto Protocol, which allow countries to fulfil their national commitments in cooperation with other countries. The opportunity of international trade in emission permits among Annex B countries is one of them. The parties of the Protocol do not yet agree, though, about the rules that should govern the emissions trading. While some insist on free trade, others want to put restrictions on the number of emission permits that each country will be allowed to buy or sell. Such restrictions are defended by reference to Article 17 of the Protocol, which states that emissions trading "shall be supplemental to domestic actions …". The term "supplemental" is, however, not defined in the Protocol. Recently, the European Union Council of Ministers agreed on recommendations on definitions of this concept. Specifically, the Ministers proposed limits both on acquisitions and transfers of emission permits. This paper offers an operationalisation of this proposal and compares its consequences with a scenario with free emissions trading and a scenario without emissions trading.

We apply a numerical equilibrium model developed at Centre for International Climate and Environmental Research in Oslo (CICERO). The model divides the world into 32 countries and regions. Demand and supply functions for oil, coal and gas are specified for each country. All countries are assumed to establish a national market for emission permits in order to meet

*Corresponding author. Tel.: +45-5-959-500; fax: +47-5-959-439.
E-mail address: Ottar.Maestad@snf.no (O. Mæstad).

[1] The work was accomplished while being Senior Research Fellow at CICERO Center for International Climate and Environmental Research, Oslo.

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their obligations according to the Protocol. With no international emissions trading, these national markets operate independently, and the permit price may therefore differ substantially between countries. International trade in emission permits will establish a link between these national markets. Countries with a high permit price in the absence of emissions trading will buy emission permits from countries with a lower permit price. If the international trade in emission permits is unrestricted, a single price of permits will eventually be established throughout the whole Annex B area.

Restrictions on international trade in emission permits will have two types of effects. First, the international permit price may rise or fall, depending on whether it is the acquisition or the transfer of permits that is most severely restricted. Secondly, the price of emission permits in countries where the trade restrictions are binding will differ from the international permit price. In countries that are not allowed to buy as many emission permits as they want, the national permit price will be higher than the international price. The converse will be true in countries that are not allowed to sell as much as they want.

Restrictions on international emissions trading are costly, because differences in national permit prices will lead to differences in marginal costs of abatement. Thus, the costs of reaching a given emission target are not minimised. So what are the benefits? One of the benefits is related to the prospects of reducing the amount of hot air made available for emissions trading. There is concern that international emissions trading will not only shuffle around the emission permits among the Annex B countries; it may also increase the total number of permits used. This will happen if some countries are assigned a larger emission quota in the Kyoto Protocol than they are able to use in the no trade equilibrium. In order to limit the amount of hot air, restrictions on the sale of emission permits might be appropriate. But it does not justify restrictions on the acquisition of permits. The benefit of such restrictions is often thought to be that it will ensure a relatively high permit price in some well-developed, permit-importing countries, and thereby stimulate R&D activities that will reduce the costs of abatement throughout the world in the long run. One aim of this paper will be to investigate how well designed the EU proposal on trade restrictions is to achieve any of these benefits.

The link between the international market for emission permits and the fossil fuel markets is an important part of the model. Since the emission reduction commitments and marginal abatement costs vary between countries, and some countries have significant amounts of hot air, the different trading regimes that are analysed influence the regional distribution of abatement efforts. This has immediate implications for the demand pattern for the fossil fuels. Moreover, since not all fossil fuel markets are globally integrated, the regional distribution of abatement efforts also influences regional production patterns.

A lot of work has recently been put into numerical analysis of the consequences of the Kyoto agreement for the world economy. A special issue of the Energy Journal (1999) provides an excellent overview of this literature. Closely related to our study are the papers by Bernstein et al. (1999), MacCracken et al. (1999), and Bollen et al. (1999). This paper differs from previous studies by including details of the EU proposal to limit acquisitions and transfers of emission permits. The model allows us to evaluate whether the EU proposal is likely to successfully achieve any of the suggested benefits of limited trading, and to assess its consequences for the fossil fuel markets.

The paper is organised as follows. The next section gives an overview of the numerical model. Section 3 provides information about the applied data sets and the calibration method. The different emissions trading regimes, including the EU-proposal to limit emissions trading, are described in Section 4. Section 5 presents the simulation results, and Section 6 concludes.

2. The model

The numerical model is a simple, static partial equilibrium model. There are five markets for fossil fuels; one global oil market, one global coal market and three regional gas markets (North America, Asia, and Europe including Russia). High transportation costs for natural gas are the reason why it is appropriate to regionalise the gas market. Then, there is an international market for emission permits among the Annex B countries, and finally, there are national markets for emission permits in each of the Annex B countries. 26 Annex B countries and 6 non-Annex B countries or regions are modelled. The model determines equilibrium prices in the fuel markets, the quantities of fossil fuels produced and consumed, each country's import or export of emission permits, the international price of emission permits, and the permit prices in the national permit markets.

In each country, a numeraire good is produced using four inputs; oil (1), coal (2), gas (3), and non-CO_2 climate gases (4). The fossil fuels demand functions are interrelated through cross-price effects, while the demand for the right to emit non-CO_2 gases is assumed to be independent of the demand for fossil fuels. The assumed production technology yields linear demand function for all inputs. Let P_{in} and y_{in} denote the consumer price and the quantity used in country n of input i ($i = 1, 2, 3, 4$). Demand functions in country n