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## **THE IMPACT OF CO<sub>2</sub> EMISSION PERMITS ON WHOLESALE ELECTRICITY MARKETS**

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### **Overview**

Since 2005 electricity producers and a number of large manufacturers have been subject to emission quotas in the EU. Tradable emission permits (TEPs) are grandfathered to the included firms according to national plans taking into account the historical emission record of each one. These permits can be traded and a number of trading places for spot and forward trade are now available (some of them organised by spot market operators). A common European TEP price has developed whereas the electricity wholesale price is still settled in regional and national markets.

It is the aim of this paper to investigate how the European permit price influences the wholesale electricity price in the Nord Pool area and in particular in Denmark. The impact on spot and forward prices will be analysed separately as there are reasons to believe that the interaction of the permit price with these two markets will be different.

Each electricity producer will have the accounts for his CO<sub>2</sub>-emissions and permits settled once every year. If he then has a deficit of permits he must pay a fine but is still obliged to purchase the lacking permits.

When deciding their daily price bids on the power pool the producers will know the TEP price (spot and forward for the end of the year) at that day. However, the producers will not know the true marginal price of the TEPs, which will first be revealed by the end of the year as the maximum TEP price during the settlement period. Therefore, the producers will have to include a risk premium for TEP price variations in their spot market bids. Within a single year the mark-up to cover the cost of TEPs might deviate considerably in both directions from the true cost. As a consequence of the lack of foresight on the true marginal TEP price, all production decisions will tend to be inefficient in the sense that they are not first best. That means that the power producers will assign more TEP costs to their production than is actually incurred.

If forward markets for TEPs are sufficiently efficient, these markets can be used to assess the maximum TEP price within the settlement period leading to a reduced risk premium on the estimation of the correct TEP price for production decisions. Failure to estimate the correct TEP price might also lead to shifts in technology and fuel choices.

When deciding how to divide their bids between different electricity regions the electricity producers will not know the alternative value of the electricity. They prefer to allocate the full production to the region with the higher price, but this is impossible. On the contrary, to avoid over commitment, they must choose an aggressive bidding strategy with a high probability of ending up with excess capacity. Another alternative is to focus on optimising in only one market, in which case the electricity flows between regions and the price differentials between regions will be residual rather than optimal. If the electricity producer exercises market power in one market, he can increase his gains by being able to use his excess capacity in a second market. His strategic behaviour will be to submit bids high above his true cost in the market

with market power to increase the price in this market. He can do this fairly aggressively knowing he is able to sell the excess capacity in the other market. With only one market, the excess capacity would be of zero value.

## **Methods**

As a first step a micro economic framework modelling the joint behaviour on the TEPs and electricity markets is developed in order to identify the inefficiencies in the system described above. The Danish/Nordic and the German market represent such a system with the Danish producers exercising market power on their home market and using the German market as a second market. The framework is applied to an analysis of variations of the electricity prices in Denmark by applying data for the Danish/Nordic and German market during 2005 and the changes in pricing behaviour that have occurred when compared to the previous years.

## **Results**

The analysis tells us something about the reactions of the Danish producers to the introduction of tradable emission permits for CO<sub>2</sub> on the European electricity market. To which extent can changes in their observed pricing behaviour be explained by the behavioural assumptions included in the micro economic framework? Also other results of interest are derived from the analysis. To which extent are the TEPs costs passed to the consumers and which is their effect with respect to technology and fuel choices? Of relevance for competition policy is the possibility of separating the effects of the TEPs market from the exercise of market power. High prices that derive from the TEPs market and its inefficiencies should not be ascribed to market power.