The Role of Hedging in Carbon Markets

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(1) Overview

In the European Emissions Trading System a significant surplus of CO2 allowances has accumulated. This results from emissions that are lower than expected when the Cap was set and a large influx of international carbon offsets (K. Neuhoff et al. 2012). At the same time carbon prices have fell from 15 Euro to below 5 Euro.

Previous economic models assumed that surplus allowances are banked for future use at low discount rates (J.D. Rubin, 1996; A.D. Ellerman and J.P. Montero, 2007). The main demand for banking surplus allowances comes from power generators. They hold CO2 allowances to hedge for future power sales.

To analyse the role of hedging in the European Emissions Trading System, we model hedging with CO2 allowances by power firms and the interaction with CO2 banking by speculative investors and CO2 price dependent emission levels. We find that hedging flexibility can balance a CO2 allowance surplus in the range of 1.1 to 1.6 billion t CO2 at discount rates of future prices between 0 to 10%. If the surplus exceeds this level, then the rate at which today's carbon prices discount expected future prices increases.

(2) Methods

We model in a partial equilibrium framework the two factors determining hedging with CO2 allowances by power firms, as identified in 13 semi-structured interviews. With deviations of forward prices from expectations by firms, the volume of power sold forward and the allocation to different generation assets is adjusted. The more expectations exceed CO2 forward contract prices three years ahead of production, the more firms deviate from their hedging schedule contracting bigger volumes of coal, gas and CO2 allowances three years ahead and less later on. The hedging model is formulated as a mixed complementarity problem and programmed in GAMS.

We then model the equilibrium in the CO2 market for a simplified two-period framework. In addition to hedging with CO2 allowances by power firms, we consider CO2 banking by speculative investors and CO2 price dependent emission levels.

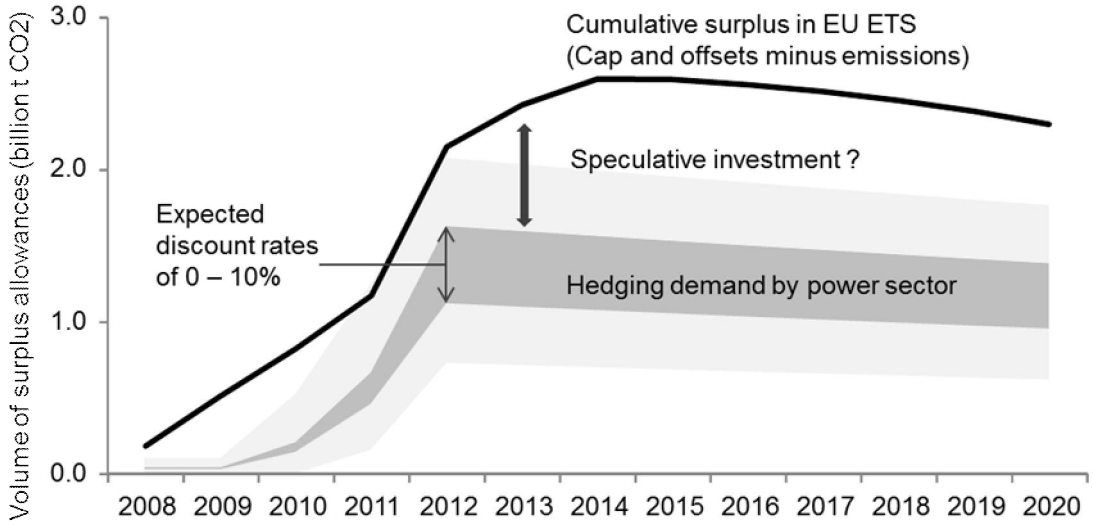
(3) Results

Power generators hold CO2 allowances to hedge for future power sales. They sell the power on forward contract up to three years ahead and acquire in parallel forward contracts for coal, gas and CO2. We find two main factors that determine the CO2 hedging volume: On the one hand, the CO2 hedging volume depends on the volume of power sold forward, which is a corporate strategy decision that can be adjusted where forward prices deviate significantly from expectations within firms. On the other hand, power firms can hedge with an emphasis on one specific generation technology when this is supported by attractive forward prices - both for carbon and for other fuels.

We find that hedging flexibility can balance a CO2 allowance surplus in the range of 1.1 to 1.6 billion t CO2 at discount rates of future CO2 allowances between 0 to 10%. With increasing surplus, the discrepancy between today's price and price expectations widens and discount rates of future prices increase. Once the surplus grows beyond the hedging demand by power firms, speculative investors are needed to balance the market. Since speculative investments in CO2 carry more risk, typically higher rate of return are required. This implies that higher discount rates are applied to future prices.

Figure 1 shows that the cumulative surplus could accumulate to 2.6. billion t CO2 by 2015 (Neuhoff et al. 2012). The hedging demand by power generators for the surplus allowances has increased in the last years, because power generators do not receive free allowances from 2013 onwards. The aggregate hedging demand is estimated at 150% of the allowances that are needed to cover annual emissions. In 2012 the hedging demand amounted to 1.4 billion t CO2. Our model results suggest that short-term adjustments to the hedging demand are possible in the range of +/- 250 million t CO2. According to our estimates, the cumulative surplus of CO2 allowances cannot be absorbed by hedging demand alone.

Fig. 1: Cumulative surplus of CO2 allowances and hedging demand



(4) Conclusions

Our analysis points to the value of reducing the surplus, estimated to be 2.6 billion t CO2 allowances in 2015, by about 1.3 billion t CO2, thus ensuring that hedging makes a significant contribution to stabilise carbon prices.

Open to further analysis remains the type of structural reforms needed to guarantee that the surplus stays in the corridor where banking can be pursued at discount rates of 0 to 10%. In particular, uncertainties remain around the variance of actual emissions, the responsiveness of emissions to prices as well as the inflow of international offsets. One way to reduce the exposure to external shocks such as the financial crisis is to determine the upper limit of allowances not for seven years, but rather for shorter time frames. For example, Australia allows for tightening the cap every five years (T. Nelson et al., 2012).

References

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