The Reformed EU ETS - Intertemporal Emission Trading with Restricted Banking

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Overview

With the increase of the linear reduction factor (LRF), the implementation of the market stability reserve (MSR) and the introduction of the cancellation mechanism (CM), the EU ETS changed fundamentally. We develop a discrete time model of the intertemporal allowance market that accurately depicts these reforms assuming that prices develop with the Hotelling rule as long as the total number of allowances in circulation (TNAC) is positive. This extends the analysis of Perino and Willner (2016). A sensitivity analysis ensures the robustness of the model results regarding its input parameters. The accurate modelling of the EU ETS allows for a decomposition of the effects of the individual amendments and the evaluation of the dynamic efficiency. The MSR shifts emissions to the future but is allowance preserving. In contrast, the CM reduces the overall emission cap. It increases allowance prices in the long run but does not significantly impact the emission and price path in the short run. The increased LRF leads with 9 billion cancelled allowances to a stronger reduction than the CM and is, therefore, the main price driver of the reform.

Methods

We model the decision making of N polluting firms within the intertemporal market for emission allowances, namely the EU ETS, which is assumed to be perfectly competitive. Our model covers individual decision making on the firm level. We assume a rational firm with perfect foresight which aims to minimize the present value of its total expenditure consisting of abatement costs and costs of acquiring allowances in each time period. The model in its pure form is based on Hotelling (1931) and Rubin (1996). The firm may bank allowances for later use in time, however, borrowing is prohibited. The individual optimality conditions are derived as Karush-Kuhn-Tucker-conditions.

From these individual optimality conditions, we derive the market clearing and equilibrium conditions. The MSR and the CM are modelled as an exact replication of the current EU ETS regulation. The regulatory decision rules and complementary conditions are equivalently reformulated as linear constraints using binary variables and the big-M method. This allows combining the regulatory rules of the EU ETS with the market equilibrium model derived by the optimality conditions of the firms in a mixed integer linear program.

Results

The results for the post-reform scenario including all three amendments show that about 5\% of allowances issued from 2018 onwards are invalidated through a one-time cancellation in 2023. All remaining allowances in the MSR are reinjected into the market from 2029 to 2036. The assumed backstop costs of 150 EUR/t are reached after 2057.

The level of the backstop costs solely scales the price path but does not further impact the resulting quantities. Counterfactual emissions in the absence of the EU ETS can only be estimated with significant uncertainty, but the assumption strongly drives model results. Higher counterfactual emissions increase emissions, abatement and prices and diminish the impact of the MSR and the CM.

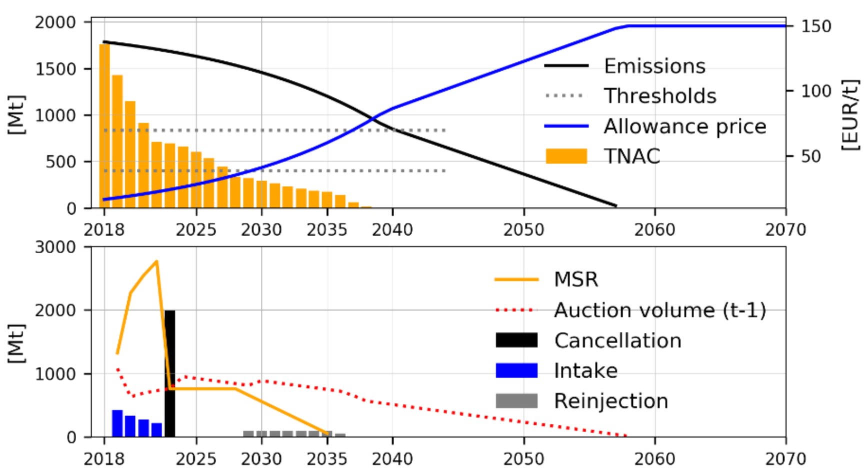

Figure 1: Development of emissions, TNAC, MSR, cancellation and allowance prices

Varying the interest rate has a similar effect. If firms have higher private interest rates, they choose to delay abatement and increase emissions in the short run, leading to a smaller MSR intake and cancellation volume. While the choice of the parameter values influences the numeric results of the model, it does not impact the underlying modus operandi.

By decomposing the reform into its single amendments, we evaluate the economic impact and the dynamic efficiency of those amendments individually. In the increased LRF scenario, we find that with the higher reduction factor of 2.2\% the total emission cap is reduced by over 9 billion allowances, and thus prices increase in the short and long run. We identify the change in the LRF as the main driver of change in the post-reform EU ETS. The MSR itself shifts emissions from the present to the future. This does not impact the overall emission cap, but adds a restriction on banking and thus deteriorates dynamic efficiency.

The CM changes little in the short run because allowances are cancelled from the MSR, which is not available to the market in the short run. However, the CM reduces the available number of allowances in the long run by about 2 billion, which has a price increasing effect in the long run. Further, we show that an alternative cancellation of allowances from the long end increases the dynamic efficiency within the model. Altogether, the MSR increases abatement costs for firms by shifting additional abatement to earlier periods and increasing emissions later on. We find that the intended effect of the introduction of the MSR with CM - to increase prices early on - does not correspond to the design chosen by policymakers which impacts prices and emissions mostly in the long run.

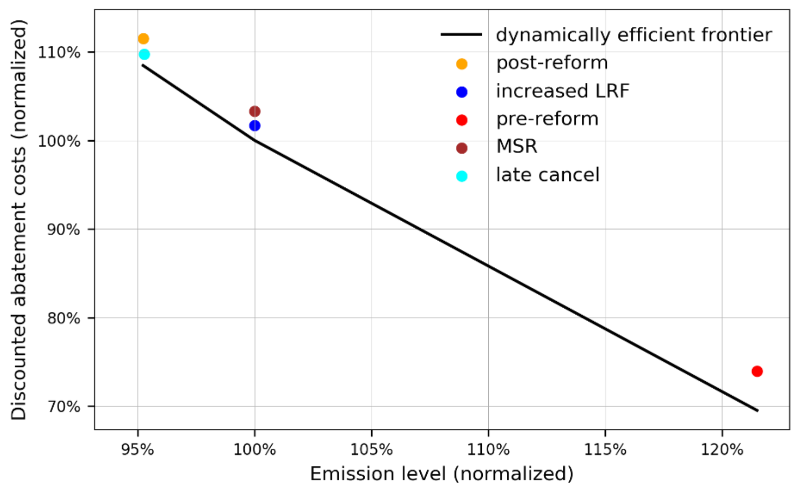

Figure 2: Comparison of discounted abatement costs and emission levels in different scenarios

Conclusions

With the increase of the linear reduction factor (LRF), the implementation of the market stability reserve (MSR) and the introduction of the cancellation mechanism (CM), the EU ETS changed fundamentally. This paper developed a discrete dynamic optimization model reflecting firms' optimal choice of abatement under the exact depiction of the regulatory setting.

We find that higher counterfactual emissions and higher private interest rates have a similar effect: Firms increase emissions in the short run to avoid abatement costs. This leads to higher prices, but a smaller effect of the MSR and CM. The decomposition of effect shows that the increase of the LRF has the greatest impact. The MSR itself shifts emissions to the future and therefore deteriorates dynamic efficiency due to more restrictions on banking. The main effect of the CM is a reduction of available allowances in the long run, increasing prices mainly at the long end.

Further research could evaluate market imperfections, such as regulatory uncertainty or short-run constraints like hedging needs that may cause the observed price increase. While the reinjection under the current regulation is - in contrast to the intake – rather stiff, a more flexible reinjection could help to avoid additional abatement costs stemming from the MSR and may increase the resilience of the EU ETS towards demand shocks.

References

Hotelling, H. (1931). The Economics of Exhaustible Resources. Journal of Political Economy, 39(2):137–175.

Perino, G. and Willner, M. (2016). Procrastinating Reform: The Impact of the Market Stability Reserve on the EU ETS. Journal of Environmental Economics and Management, 52:37–52.

Rubin, J. D. (1996). A Model of Intertemporal Emission Trading, Banking and Borrowing. Journal of Environmental Economics and Management, 31:269–286.