EU EMISSION TRADING AND ALUMINIUM IMPORTS: EMPIRICAL EVIDENCE FOR CARBON LEAKAGE

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Overview

In December 2022 the EU parliament and council reached an agreement on a Carbon Border Adjustment Mechanism (CBAM) foreseeing the policy to be implemented in October 2023 [1]. The purpose of the CBAM is to protect carbon-intensive industries that are covered under the EU Emission Trading System (EU ETS) from foreign competition that is not subject to a similar carbon pricing scheme. Such discrepancies in regional carbon pricing policies can cause the offshoring of CO_2-emitting production, commonly referred to as carbon leakage [2]. The potential for carbon leakage has been shown through numerous ex-ante models, most notably computed general equilibrium (CGE) models. These studies usually predict significant carbon leakage for the EU ETS [3]. The empirical ex-post research to back up these predictions, however, has been incapable of proving any significant carbon leakage at all from the EU ETS. This is likely partially caused by the EU pre-emptively allocating free emission allowances to sectors most at risk of carbon leakage [4].

Throughout the four phases of the EU ETS, all covered sectors, apart from the energy sector, have had around 100% or more of their emission allowances freely allocated to them. This means that the carbon price will have had little effect on the competitiveness of those sectors. While the energy sector in phase III & IV started to have most of its allowances allocated through auctions, it almost exclusively supplies electricity and heat which are goods that are hardly traded across the border of the European Economic Area (EEA). Given the protection measures for goods that are at risk of carbon leakage, it is plausible that carbon leakage from the EU ETS has not been observed empirically.

The aluminium sector was chosen for this study because the production of aluminium, unlike most other covered goods, emits most of its emissions indirectly. Rather than being caused by the production process itself, most of the emissions (74%) stem from the electricity generation mix that is used to power the electrolysis [5]. The aluminium sector only gets freely allocated allowances for its direct emissions, though, which means they have to indirectly pay for the auctioned allowances that their electricity generators have to buy. Being subject to international competition and indirectly having to pay for EU ETS allowances, the aluminium sector is in a unique position that has seen it most exposed to carbon leakage risks making it the perfect searching ground for empirical proof of carbon leakage from the EU ETS.

Several studies have attempted to empirically show carbon leakage from the EU ETS [6, 7, 8, 9, 10, 11]. All of them conclude insignificant, negligible, or even negative carbon leakage rates. However, only two of those studies [7, 8] specifically consider the aluminium sector and these only include data from phase I and II when all allowances were still allocated freely. This study attempts to fill this gap by investigating carbon leakage in the aluminium sector for all four phases with monthly data from 2005 to 2013.

Methods

Drawing and expanding on the previous ex-post studies, the proposed empirical model aims to explain the monthly EU net aluminium imports through two independent variables: the monthly average EU ETS allowance price and a monthly EU industrial output index to control for changes in domestic demand. In a novel approach that encapsulates data from several phases the interactions between the factor and allowance price variable are included in the regression to differentiate the impact of the allowance price in different time periods. To account for seasonal variation, dummies for each month were included.

The model was tested for serial correlation using the Durbin-Watson statistic, the Ljung-Box test, and the Breusch-Godfrey test. A normal error distribution is one of the core assumptions of a linear regression model and having serial correlation in the error term means that this assumption should be rejected which leads to incorrectly computed significance tests. Several different approaches were deployed to combat serial correlation in the residuals: Firstly, the previously mentioned phase and month dummies were included to control for seasonal autocorrelation. Additional regressors were also trialled to see whether they might correlate with the residuals and thereby explain their serial correlation. The tested variables were the USD/EUR exchange rate and the Baltic Exchange Dry Index. Lastly, common procedures such as the Cochrane – Orcutt, Prais – Winsten and Hildreth – Lu estimations were trialled, alongside taking the first differences of each variable. Additionally, a novel autocorrelation procedure was performed. This procedure is based on the same principle as the Hildreth-Lu estimation but instead of minimising the sum of squared errors, it minimises the Lagrange Multiplier of the Breusch-Godfrey test.

Results

Significant serial correlation was found to be present in the linear regression error term using all three statistical tests. Applying the conventional transformations succeeded in removing the autoregressive error correlation of the first order, and applying the novel Lagrange Multiplier Minimisation achieves the removal of serial correlation in the eyes of two of the three tests. Both before and after the procedures the regression showed significant positive carbon leakage for phase IV and insignificant or even negative leakage for the three phases before. This appears to coincide with expectations because the first two phases saw allowances being allocated almost entirely for free and the third phase saw extremely low prices for a large part of it. Only the fourth phase had high prices coinciding with a large proportion of allowances being auctioned rather than freely allocated. For phase IV, the model predicts a €1.12 million increase in net aluminium imports for every 1% increase in EU ETS allowance price. It should be noted that this result should be interpreted with caution because of the small number of observations in phase IV and the lack of statistical examination of the novel transformation.

Conclusions

Using monthly data for aluminium imports and ETS allowance prices, carbon leakage is shown for phase IV of the EU ETS. Autocorrelation in the errors is tackled using a variety of treatment methods which remove part of the autocorrelation. This piece of research shows that the aluminium sector is the place in which empirical evidence for carbon leakage from the EU ETS can be found. With the prospect of the CBAM coming into force soon, more research is needed to empirically quantify carbon leakage and thereby support informed policy decisions.

References

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