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The cost of carbon leakage: Britain's Carbon Price Support and cross-border electricity trade

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Asymmetric carbon pricing by one country or region is likely to distort trade and give rise to carbon leakage. Regional schemes like the European Union's (EU) Emission Trading Scheme (ETS) partially mitigate this by agreeing a uniform carbon price for some industries (the covered sector responsible for about half the total EU's emissions). While this should reduce the distortions (from asymmetric carbon taxes) within the EU, it is still prone to leakage to the rest of the world. The main industries affected by carbon leakage are carbon-intensive traded goods such as steel, aluminium and cement. The electricity sector is, however, considerably more carbon intensive than these. In the EU-28 electricity accounts for just over 20% of total greenhouse gas (GHG) emissions, with very little decrease since 1990. The electricity sector is therefore of central importance when studying the impact of differential carbon prices. It has the added advantage that electricity is not widely traded outside the EU, but within the EU, Great Britain (GB) faces potentially a 13% import share. A study of differential carbon prices within EU's *Integrated Electricity Market* isolates the impact, and allows us to ignore the rest of the world, except for the impact on global emissions.

GB, The Netherlands and France have all been coupled since early 2014, while the interconnector between GB and the Single Electricity Market of the island of Ireland was only coupled in October 2018. Coupling ensures that interconnectors are either fully used or equalize prices at each end, making the impact of changes in

[1]This replaces an earlier version of EPRG WP 1918, which seriously under-estimated the deadweight loss. This paper substantially extends, updates and replaces the earlier EPRG WP 2005 *The Cost of Trade Distortion: Britain's Carbon Price Support and Cross-border Electricity Trade.*

prices on interconnector flows both transparent and easier to model. Britain uncoupled from the EU on 1 Jan 2021 as a consequence of Brexit. We therefore restrict our study to GB's trade with France and The Netherlands from early 2014 to 2020. In 2011, the UK Government enacted a gradually escalating Carbon Price Floor for fossil generation fuels. This came into effect in April 2013 in the form of a carbon tax (the Carbon Price Support, CPS, an addition to the EU carbon price) on generation fuels in GB (but not Northern Ireland). From 2016 the CPS has been frozen at £18/tonne CO_2, while the EU Allowance (EUA) price has risen from a low of €6/t CO_2 in 2011 to over €55/t by mid-2021. After leaving the EU, GB set up its own Emission Trading Scheme (ETS), with prices slightly higher than in the EU ETS. Together with the CPS GB generators faced a total carbon price of €80/t CO_2 by 2021, within the range of the Paris target-consistent carbon price. We therefore take €80/t as the social cost of carbon (dioxide).

This paper takes GB as a case study and quantifies the costs and benefits of cross-border electricity trading between interconnected countries in the presence of the CPS (an asymmetric distortionary carbon tax). We restrict our study to GB's trade with France and The Netherlands from early 2014 to 2020. We defend the assumption that the ETS acts as a carbon tax, and as such leads to carbon reductions. We find that the GB carbon taxes have a large impact on global welfare through their emissions reductions, but this is partly offset by carbon leakage to other connected countries. The paper quantifies the impact of the CPS on electricity prices, interconnector flows, congestion revenue. It also estimates the deadweight loss and carbon leakage caused by the asymmetric carbon price. This has implications for the design and ideally harmonisation of the EU carbon tax to improve the efficiency of electricity trading.

Results

We estimate that over 2015-2020 when the CPS stabilised at £18 (€20) /tCO_2, the CPS raised the GB day-ahead price by an average of €10.3 ±1.1 /MWh (about 24% of the GB wholesale price) allowing for replacement by cheaper imports. The CPS increased GB imports from France and The Netherlands by 14±1 TWh/yr (about 5% of the GB annual electricity demand), thereby reducing carbon tax revenue by €102±13 m/yr (about 10% of the 2017 CPS tax receipts). The commercial value of interconnectors (measured by congestion income) increased by €131±7 m/yr (by 80% relative to the zero CPS case), half of which was transferred to foreign interconnector owners. The asymmetric carbon taxes created deadweight losses of €72±16 m/yr, about 2% of the global emissions reduction benefit of the CPS at €2.9±0.1 bn/yr. Increased French exports raised French prices by 4% and Dutch prices by 3%. Finally, about 16.3±3.5% of the CO_2 emission reduction is undone by France and The Netherlands, with a total monetary loss of about €584±127 m/yr.

Despite the fact that the CPS has distorted the cross-border electricity trade, it has significantly reduced GB GHG emissions from electricity generation - the share

of GB coal-fired generation fell from 35% in 2015 to less than 3% in 2019. On 21 April 2017, GB generation achieved the first ever coal-free day. When the UK introduced the CPF, the hope was that other EU countries would follow suit to correct the failures of the Emissions Trading System, at least in the electricity sector. Since then the EU carbon price has risen but the asymmetry remains. As the electricity sector in most countries is the cheapest source of reducing CO_2 emissions and as carbon taxes are an attractive way to reduce the distorting cost of raising tax revenue, the case for an EU-wide carbon price floor are clear. This case is further strengthened by the desirability of correcting trade distortions. Now that the UK has left the EU, the simplest solution for GB is to replace the ETS by a target-consistent carbon tax, which would be close to the 2021 EUA level.