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Policy Update: Managing carbon leakage

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When governments plan legislation to put a price on greenhouse gas emissions (carbon pricing), industry calls for exemptions. Industry claims that a price on carbon will increase costs, putting them at a competitive disadvantage and that production will shift to a country with no carbon pricing, thus increasing global emissions. This suggests that carbon pricing will cause jobs to be lost through a loss of competitiveness and global emissions to increase through carbon leakage. If these assertions are true, then policy makers may need to, for example, subsidize threatened industries and apply border tax adjustments to equalize the carbon price.

These claims can now be tested thanks to the EU's Emissions Trading System (ETS). Industry does not appear to have left the EU, although industry has received generous subsidies [101]. Global emissions, conversely, have increased substantially but few would claim this is due to the EU ETS [1]. Does analysis of the EU ETS and global

emission development provide any insight into how to manage carbon leakage in a world of unequal carbon prices?

Global emissions have grown substantially in the last decade, primarily due to the emergence of China as a global power [1]. Detailed studies show that approximately a third of Chinese emissions are due to the production of exported products representing up to a half of the growth in Chinese emissions [2]. In terms of carbon leakage, the key issue is whether this growth is partially due to carbon pricing. The growth of Chinese exports destined for the EU, the USA and developing countries has been similar [2], which indicates that climate policy is not the cause of Chinese growth, otherwise the differential climate policies would presumably cause differential growth patterns. Studies on carbon leakage due to the EU ETS show that leakage is small overall, despite being important in some industries in some locations [101]. Confirming this are studies that show that environmental regulations do not drive investment decisions [3].

The available evidence suggests, therefore, that current carbon leakage is negligible. Yet, the rapid changes in international trade show that a significant share of the growth in emissions in countries without carbon pricing occurs in order to meet consumption in countries with carbon pricing. This apparent contradiction can be resolved by taking a more holistic view of carbon leakage [4].

Carbon leakage, by its nature, is a component of international trade and great care is needed to separate the share of international trade that is due to carbon leakage [5]. From a broader perspective, one may first ask how international trade affects the distribution of greenhouse gas emissions between countries [6] and then ask the much harder question on what share of that is due to climate policy [5]. Based on this broader perspective, carbon leakage can be defined in two ways [4,7]:

- Weak carbon leakage (or demand-driven carbon leakage [8]) in country R is the greenhouse gas emissions outside of R that occur in order to meet consumption in R. Comparisons are made to the change in emissions in R (positive or negative).
- Strong carbon leakage (or policy-induced carbon leakage [8]) in country or region R is the increase in greenhouse gas emission outside of R due to climate policy in R. Comparisons are made to the change in emissions in R due to the climate policy (positive or negative).

Weak carbon leakage considers all international trade flows into R, while strong carbon leakage only considers a subset due explicitly to the imposition of climate policy. Most

studies of strong carbon leakage use static computable general equilibrium models [9], while studies of weak carbon leakage use attribution models [10,11]. For comparisons, it is also useful to refer to different emission inventories [12]:

- Territorial-based emissions are the emissions occurring in the administered territory of R.
- Consumption-based emissions (or footprint) are the global emissions that occur to meet consumption in R and are equal to the territorial-based emissions in R minus emissions in R to produce exported products plus the emissions outside of R to produce imports. Comparisons of consumption-based and territorial-based emissions are analogous to the study of weak carbon leakage.

There is a broad literature covering weak carbon leakage [10,11], with a strong methodological foundation [13]. Independent studies at the global level come to the same conclusions [7,14–15,102]. As a general rule, consumption-based emissions in developed countries are greater than territorial emissions, implying that developed countries are net importers of greenhouse gas emissions and that developing countries are net exporters. In the USA and UK, consumption-based emissions are growing faster than territorial-emissions implying that weak carbon leakage is growing [16,17]. Comparisons of independent global studies show that this trend is consistent across a wider number of countries [7,14,15,102]. Consequently, there is a high degree of confidence that weak carbon leakage is increasing significantly over time.

The disadvantage of studies on weak carbon leakage is that they say nothing about what caused the changes in international trade that led to the increase in weak carbon leakage. To isolate the effects of climate policy to strong carbon leakage alone is far more challenging and requires modeling assumptions [18]. In addition to empirical studies [101], the consensus view is that strong carbon leakage is not significant and may be offset by technology transfers [9].

The studies of strong carbon leakage suggest that minimal, if any, regulations are needed to protect domestic industries from differential carbon pricing between countries. Exceptions may occur for very specific industries, individual companies or if the differences in carbon pricing are greatly increased. Despite the rhetoric on strong carbon leakage, studies of weak carbon leakage suggest that policy makers are focusing on the wrong issue. Weak carbon leakage is substantial and, therefore, policy makers need to focus on how nonclimate policies affect international trade and

responsibility for emissions growth [6]. This will require close collaboration between policy makers in different government ministries and potential policy instruments in order to reduce weak carbon leakage.

Many factors in a competitive global market may combine to increase weak carbon leakage and a single mechanism is unlikely to intervene in all factors. A portfolio of policy responses is needed, but perhaps the single most important requirement is regular monitoring, verification and reporting of consumption-based emissions.

While climate policy may still be broadly based on territorial-based emissions, without knowledge of the corresponding change in consumption-based emissions, policy makers will never know if their policy portfolio is truly effective in reducing emissions in a globalized world. Monitoring, verification and reporting of consumption-based emissions is a simple and low-cost measure, yet it may hold the key to understanding and, hence, managing carbon leakage.

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A review of recent multi-region input–output models used for consumption-

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