21 Options for avoiding carbon leakage

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Carbon leakage – the increase in foreign emissions that results as a consequence of domestic actions to reduce emissions – is of particular concern for countries seeking to put a substantial price on carbon ahead of their trading partners. While energy market reactions to changes in global fossil fuel demand are difficult to avoid, absent a global price on carbon, some options are available to address leakage associated with changes in competitiveness of energy-intensive, trade-exposed industries. This chapter discusses the main legal and economic trade-offs regarding the use of exemptions, output-based rebating, border carbon adjustment, and sectoral agreements. The potential for clean technology policies to address the energy market channel is also considered.

Ultimately, unilateral policies have only unilateral options for addressing carbon leakage, resulting in weak carbon prices, a reluctance to go first and, for those willing to forge ahead, an excessive reliance on regulatory options that in the long run are much more costly means of reducing emissions than carbon pricing. Recognising those costs, if enough major economies could agree on a coordinated approach to carbon pricing that spreads coverage broadly enough, carbon leakage would become less important an issue. Furthermore, a multilateral approach to anti-leakage measures can better ensure they are in harmony with other international agreements. If anti-leakage measures can support enough adherence to ambitious emissions reduction programmes, they can contribute to their own obsolescence.

1 Introduction

Carbon leakage is a chief concern for governments seeking to implement ambitious emissions reduction policies – particularly those that place high prices on carbon – ahead of similar actions on the part of their major trading partners. 'Emissions leakage' is generally defined as the increase in foreign emissions that results as a consequence of domestic actions to reduce emissions. Since greenhouse gases (GHGs) are global pollutants, emissions leakage in the case of carbon is a particular concern, as it directly undermines the benefits of the domestic emissions reductions.

Carbon leakage from economy-wide carbon pricing policies in major economies is centrally estimated by global trade models to range between 5% and 30%.[1] Higher rates are associated with smaller coalitions, higher carbon prices, more substitution through trade, and stronger energy market responses. Sector-specific carbon leakage rates can be much higher, as well – as much as three to five times the economy-wide leakage rate.[2]

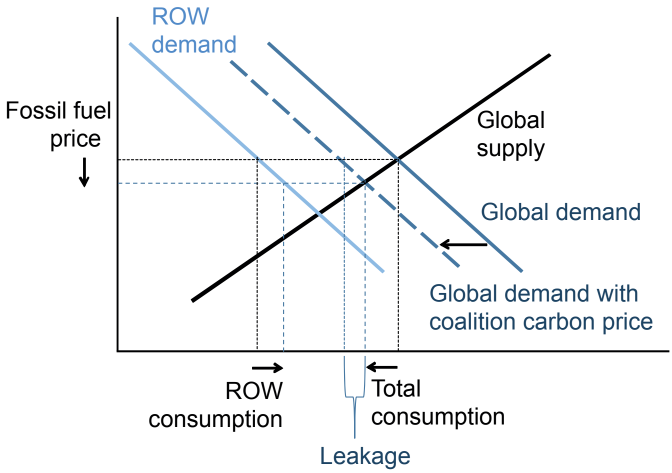
Carbon leakage occurs through multiple channels. The largest one, as indicated by the modelling literature, is the *energy market channel*. The idea is that if a major economy on its own withdraws a lot of demand for fossil fuels, the global prices for those fuels become depressed. As a consequence of cheaper prices, other countries consume more fossil fuels and their economies become more carbon intensive.

Figure 1 illustrates this form of carbon leakage with global supply and demand curves for fossil fuels. If a coalition of countries adopts carbon pricing, their demand (and thus global demand) for fossil fuels shifts inward. If the price did not change, the quantity that suppliers offer would exceed the quantity demanded at that price; thus, the price falls to find a new market equilibrium. However, since demand in the rest of the world (ROW) has not changed, they consume more at the new lower price. Therefore, the net reduction in global consumption is less than the reduction in coalition consumption.

1 Readers interested in more detail can see an Energy Modeling Forum exercise on carbon leakage and border carbon adjustments (EMF 29), published as a Special Issue of *Energy Economics* (Böhringer et al. 2012).

2 Fischer and Fox (2012).

Figure 1 Carbon leakage from demand and supply responses in energy markets



The reasoning is the same as many explanations for the drop in oil prices and their consequences over the past year: growth in worldwide demand has been lower than expected, and now lower gasoline prices are encouraging more sales of SUVs, which have higher fuel consumption rates. Importantly, the energy market channel operates via any changes in demand for fossil fuels, whether due to carbon pricing or regulation and energy efficiency.

The channel for carbon leakage that causes the greatest concern for policymakers, however, is the *'competitiveness' channel*. This channel relates to policies – like carbon pricing – that pass on higher energy costs to energy-intensive, trade-exposed (EITE) industries, making manufacturing in carbon-pricing countries less competitive. This causes economic activity, market share, and, in the longer run, investments in those sectors to shift abroad to jurisdictions with lower energy costs. Modelling results indicate that one-quarter to one-half of carbon leakage occurs through competitiveness effects. This channel is somewhat narrower than the energy market channel, as it primarily affects specific industrial sectors that represent a small share of the economy,[3] but they have outsized effects on emissions leakage, and may also wield outsized political influence.

3 In the case of the US, industries with energy expenditures in excess of 5% of the value of their output account for only one-tenth of the value of US manufacturing output and less than 2% of US GDP (Fischer et al. 2014).

A third channel, the *induced innovation channel*, has the potential to create negative leakage in the long term. If carbon mitigation policies induce innovation in clean energy technologies, lowering their costs globally, all countries will find them more attractive. Greater adoption of clean technologies in countries with low or no carbon prices will help displace fossil fuels and further reduce global emissions. On the other hand, countries with low carbon prices that become more competitive in energy-intensive sectors may see their technical change directed towards energy-using technologies, exacerbating carbon leakage. Thus far, this innovation channel has been theorised (e.g. Gerlagh and Kuik 2014) but empirical evidence of its scope is lacking.

1.1 Carbon pricing and carbon leakage

Understanding these different channels informs how we evaluate the options for addressing carbon leakage. Clearly, the best option for reducing emissions while addressing all channels of leakage would be to have harmonised carbon prices worldwide. Of course, this is not a likely outcome of the current framework for INDCs, although such commitments would certainly not be precluded. Several prominent economists are advocating for forming a club of major economies with minimum carbon prices (see, for example, Nordhaus 2015, Gollier and Tirole 2015, Weitzman 2013).

The challenge is that options for dealing with carbon leakage unilaterally are more limited. One, unfortunately, is simply to set lower carbon prices – that creates less pressure for leakage, but also less incentive for emissions reductions. Arguably, we observe a fair amount of this behaviour. Currently, about 12% or less of global CO_2 emissions is subject to a carbon price (World Bank 2015). With the exception of some carbon taxes in Scandinavian countries, current prices are well below $40 – the US Environmental Protection Agency's central estimate of the global social cost of carbon (SCC) – and all of the largest systems have prices below $15 (see also the contribution by Wang and Murisic in this book).[4]

One reason for individual jurisdictions to contribute too little to the global public good of climate mitigation is the free-rider effect: most of the benefits accrue to other

4 Prices as of 1 April 2015: California $13, EU ETS $8, RGGI $6, Japan carbon tax $2, Chinese provincial pilot ETS $5-8. (World Bank 2015).

jurisdictions, and those benefits can be enjoyed whether or not one contributes oneself. These types of incentives create challenges for an international climate agreement. However, many climate negotiators may take issue with the idea that their countries are seeking to free ride on the efforts of others. Indeed, many feel an ethical responsibility to contribute significant emissions reduction programmes, but not by using significant carbon prices when their trade partners are not facing similar policies. The US is an example – in its regulatory policy evaluations, it uses a global SCC, not a domestic (self-interested) SCC as one would expect of a free-rider. However, its main contributions involve regulatory standards for power plant emissions and vehicles, but not carbon pricing (see the chapter by Burtraw in this book). Thus, while free-riding would weaken intentions to take action, the fear of carbon leakage weakens the actions of the well-intentioned, thereby exacerbating the challenge of a strong international agreement on emissions mitigation.

Still, there are some other options that countries or clubs of countries might take to address carbon leakage unilaterally. Most of the commonly proposed options are only suited for addressing competitiveness-related leakage.

2 Addressing the competitiveness channel

Mitigating the leakage associated with the competitiveness channel has the additional benefit of addressing the competitiveness concerns that often create barriers to putting a price on carbon. Indeed, if carbon pricing is not possible in a domestic context in the absence of dealing with competitiveness-related leakage, then these measures can be argued to have a much bigger impact on global emissions reductions than just the leakage avoided. However, one must tread carefully, as competitiveness concerns are related to international trade, and trade-related measures are governed by disciplines agreed to in the WTO, as explained by Mavroidis and de Melo in their chapter in this book. Moreover, many of the EITE industries of concern are already experiencing dislocation and pressures through changes in international trade patterns, so it can be difficult to distinguish motivations for dealing with emissions leakage from baser motivations to protect domestic industries. Hence, it is important to consider these options in tandem with the potential constraints imposed by international trade law.

Firms face two kinds of cost increases from emissions-reduction policies. One is higher production costs associated with reducing emissions – that is, the changes in techniques or equipment that require less energy, emissions, or emissions-intensive inputs. These costs occur whether the changes are being directed by regulation or by price incentives. A second cost increase is associated only with carbon-pricing mechanisms, which require firms to pay for their embodied emissions (that is, the emissions remaining after reduction efforts, associated with their production), either by paying a carbon tax or by surrendering valuable emissions allowances. Generally, it is only these embodied carbon costs that can be addressed in a straightforward and transparent manner, in accordance with other legal obligations.

Anti-leakage policies for the competitiveness channel focus directly on the EITE sectors. In all cases, some determination of eligibility must be made. In order to buttress an argument that the measures are being undertaken for the purposes of avoiding leakage, the criteria for eligibility must be clearly related to leakage potential – that is, involving a combination of carbon-intensiveness of manufacturing and trade exposure. At that point, there are three main options for addressing leakage among identified EITE sectors: exemption from carbon pricing, output-based rebating, and border carbon adjustments.

2.1 Exemptions

A straightforward option is to exempt qualified EITE industries from the broader GHG reduction policy, in whole or in part. For example, in Sweden, industrial consumers pay no energy tax and only 50% of the general carbon tax; in Germany, heavy industry is exempt from the surcharges for renewable energy and EITE sectors can request exemptions from most energy taxes. While potentially simple from an administrative point of view, exemptions tend to be a highly inefficient means of addressing emissions leakage. By differentiating carbon prices among industries, some cost-effective options for reducing emissions will be left untapped, which will either limit overall reductions or leave a greater burden on the remaining non-exempt industries. As a result, exemptions would likely increase the total cost of achieving a given emissions target, unless leakage effects are very strong (and the alternative would be weakening the carbon price for all). Furthermore, exemptions do not address indirect emissions; for example, certain sectors like aluminium may see larger competitiveness impacts from the pricing of carbon in electricity than from their direct emissions.[5]

Exemptions are not terribly likely to be seen as a trade-related measure, as the coverage of an emissions trading system or the designation of a carbon tax base is typically viewed as an intrinsic policy decision. However, in some interpretations, they could be viewed as subsidies.

2.2 Output-based rebating (OBR)

A second, common option is to use rebates to relieve some, or all, of the burden from the price on embodied carbon. The idea is to keep all energy-intensive industry under the carbon-pricing system, but to offer rebates for the EITE sectors in proportion to their output, based on a benchmark of sector-wide performance. For example, the EU chose a benchmark of the performance of the top 10% of firms (i.e. those with lowest emissions intensities) in a sector, while New Zealand uses up to 90% of average emissions intensity, based on recent historical data. Since more output generates more rebates, the rebate functions like a subsidy to output of EITE firms, signalling that emissions reductions should not be sought through reductions in output (since that would result in leakage). The advantage relative to exemptions is that OBR retains the carbon price incentive to reduce emissions intensity. However, it does come at a cost of muting the carbon price signal passed on to consumers, who then have less incentive to consume less energy-intensive products or find cleaner alternatives.

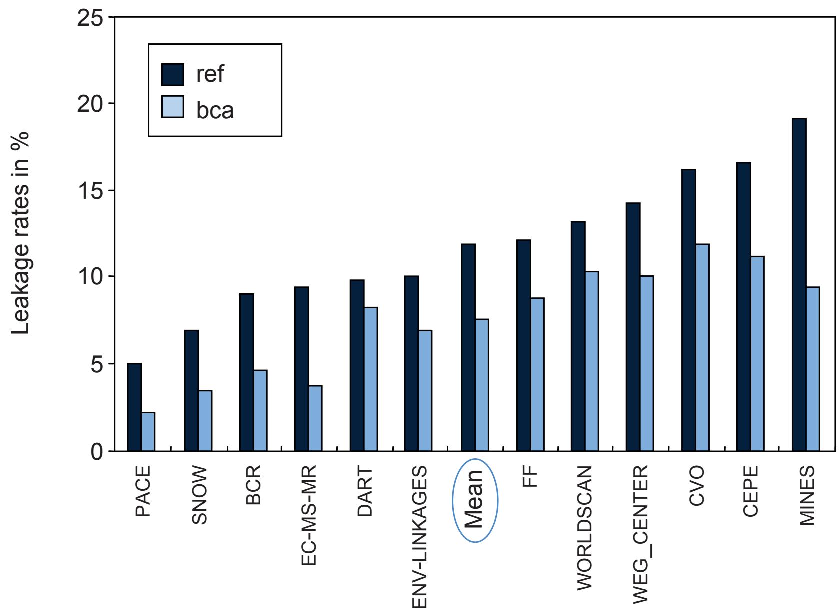
Preferential allocations or rebates to specific industries can, in theory, also be challenged as subsidies under trade rules. However, such a case has yet to be made in the WTO context, perhaps since to date such rebates have been implemented in domestic regulatory mechanisms (cap-and-trade programmes) with benchmarks that still imply some net tax burden on embodied emissions (Mavroidis and de Melo 2015).

5 Of the GHGs from global aluminium production unrelated to transport, electricity accounts for 62% of emissions, nearly twice that of direct process and thermal energy emissions (World Aluminium 2014).

2.3 Border carbon adjustment (BCA)

The third option is border carbon adjustment (BCA) of a domestic carbon price, which would levy charges on imports of EITE products to ensure that consumers pay the same price for embodied carbon, regardless of the origin. A recent Energy Modelling Forum modelling exercise on carbon leakage (summarised in Böhringer et al. 2012) found that BCA for EITE sectors for reduced carbon leakage from actions taken by OECD countries by one quarter to one half across most models (Figure 2).

Figure 2 Model estimates of leakage rates from OECD coalition carbon pricing (%)



Note: Vertical axis lists participating models by name. The dark blue bars represent simulated leakage rates in the reference scenario (OECD countries implementing emissions pricing to achieve global reductions equal to 20% of their baseline emissions). The light blue bars represent simulated leakage rates with the addition of BCA for EITE industries.

Source: Böhringer et al. (2012).

While theory and modelling tend to show that BCA is the most cost-effective option for addressing leakage, they also point to considerable tensions in design trade-offs. Furthermore, as an overtly trade-related measure, BCA is likely to raise disputes in trade circles, although a consensus has developed among international trade lawyers that they could be designed in accordance to WTO law. The key cases to be made are that the measure meets the WTO requirements for an Article XX exception – that is, it is essential and effective for reducing leakage – and that it conforms to the principle of common but differentiated responsibilities (CBDR) under international environmental law. Cosbey and Fischer (2014) and Cosbey et al. (2015) enumerate a full range of issues in designing a BCA regime that meets these goals, of which a few critical ones are highlighted here.

At its logical limit, if BCA were applied to all products, it would convert the carbon-pricing regime from one that taxes carbon arising from production to one that taxes carbon embodied in consumption (much like a value-added tax is a destination-based tax). While calling on consumers in developed countries to take responsibility for their carbon consumption sounds appealing, full BCA causes a strong shift in the terms of trade to the detriment of developing countries. For example, China's exports are eight times as carbon-intensive as those of the EU and three times those of the US (Atkinson et al. 2011). However, most of the avoided leakage benefits come from BCAs in the EITE sectors, and limiting the application of the measure to those sectors has less of a burden-shifting effect, supporting CBDR, as well as a stronger link to the legal motivations for an Article XX exception (Cosbey and Fischer 2014; Cosbey et al. 2015).

Another tension involves the use of the revenues collected at the border. Returning revenues to the exporting countries further mitigates the burden-shifting effects and can show good faith that the policy is being implemented for leakage rather than protectionist purposes. Another option conforming to these goals would be to earmark the revenues towards the financing of mitigation and adaptation activities in developing countries. On the other hand, larger burden-shifting effects make it more attractive for countries to be inside, rather than outside, the club of countries pricing carbon and imposing BCAs.

International legal obligations thus make it difficult to use BCAs to create leverage for getting other countries to take climate actions, although that would arguably have the greatest effect on limiting leakage. Some leading economists (e.g. Nordhaus 2015) have proposed using trade sanctions to enforce an agreement for high carbon prices among a club of countries; parties can always agree to a sanctions regime, but non-parties have not agreed to such measures. As a result, any sanctions against non-parties would need to meet the Article XX exception, which is likely to be limited to conforming BCAs. Unfortunately, for many countries, that may not be sufficient to ensure participation.

Some of the mundane practicalities of BCA are similar to OBR, requiring eligibility determinations for the products facing adjustment, and an exercise to calculate the embodied carbon emissions. The difference is that more accurate calculations would require foreign data, which is harder to obtain. Relying on domestic benchmarks is simpler and arguably less discriminatory (treating imported products the same as domestic counterparts), but gives blunter price signals to domestic consumers and foreign manufacturers. In addition, foreign carbon taxes paid should be taken into account, and any preferential treatment afforded domestic producers (such as rebates) must also be afforded imports. Again, a blunter instrument of exempting products from certain countries could recognise climate actions being taken, or least-developed status.

Overall, the design issues for this instrument are more complex and controversial; many experts think BCAs are likely still feasible (e.g. Cosbey et al. 2015, Mavroidis and de Melo 2015), though not all (e.g. Moore 2011, cited in Mathys and de Melo 2011). Many of the simplifications needed for administrative practicality and WTO compliance would mute some of the anti-leakage effects that one might achieve in theory with perfect information; however, the aforementioned alternatives to BCAs offer even blunter and weaker price signals for consumers. BCAs have some precedents: California has in effect BCA-like measures to discourage resource shuffling to out-of-state electricity generators. The latest carbon tax proposal in the US Senate includes a BCA. The failed attempt by the EU to include international aviation in the ETS offers a cautionary tale for BCA. A unilateral BCA measure will undoubtedly face resistance; to be accepted, BCA guidelines will have to arise out of some multilateral consensus.

2.4 Sectoral agreements

A final option for dealing with competitiveness-related leakage cannot be implemented unilaterally, but can achieve many of the goals. That would be to negotiate an agreement among major EITE trading partners for common actions to reduce emissions in those sectors. The actions may or may not be carbon pricing, but would alleviate competitiveness concerns and allow for greater emissions reductions in those sectors than simple exemptions from economy-wide carbon regulations.

3 Addressing the energy channel

While there are several options for addressing competitiveness-related leakage, there are few realistic unilateral options for addressing leakage related to global energy market adjustments. The available measures would have to either (1) raise global energy prices, or (2) lower clean energy prices.

3.1 Raising global energy prices

Raising global energy prices requires withdrawing more fossil fuel supplies than demand for them. For example, major energy producers could raise royalty payments, reduce their production subsidies, or simply commit to not extract unconventional resources. Few observers expect such commitments unilaterally.

Carbon capture and sequestration (CCS) presents another option. Incentivising or requiring the use of CCS as part of a domestic climate policy sustains demand for fossil fuels, avoiding leakage abroad, while ensuring reductions at home. However, CCS is still a relatively expensive mitigation option, and likely to remain so for the foreseeable future (see Tavoni 2015).

3.2 Lowering clean energy prices

Lowering the cost of clean energy technologies has the potential to offset the allure of cheaper fossil energy prices. However, these cost reductions must be global, and it must be noted that for the same emissions reductions, they must also be much bigger than if common carbon pricing were helping to make clean technologies competitive.

Technology policies are a popular option, particularly relative to carbon pricing; for example, over 50 countries have financial incentives or public procurement for renewable generation, and many more have feed-in tariffs or mandates.[6] The question is how well measures perform in lowering global costs. Toward this end, we may need to

6 See http://www.iea.org/policiesandmeasures/renewableenergy/ and http://www.map.ren21.net/ (accessed 1 June 2015).

distinguish between upstream incentives for manufacturers and downstream incentives for domestic deployment (see also Fischer et al. forthcoming).

Upstream measures encourage R&D and support domestic production of clean technologies. They shift out total supply, which lowers global technology prices, spurring additional deployment both at home and abroad and reducing leakage. They also benefit domestic producers at the expense of foreign ones, and may be constrained by WTO disciplines.

The effect of downstream measures depends on how global supply responds. In the short run, they shift out global demand for clean technology, which tends to bid up global equipment prices. Thus, expanded clean energy deployment at home can crowd out deployment abroad and exacerbate leakage. In the long run, however, strong learning-by-doing, complementary innovation, or scale effects may bend the global supply curve downward. In that case, both upstream and downstream policies – anything that increases clean energy scale – can lower global prices and crowd in cleaner technologies abroad. The potential for these effects is important to understand; recent work indicates that the global benefits of negative leakage from subsidies to manufacturing that lower the costs of clean technologies to all countries may be much larger than the trade-distorting effects of preferential upstream subsidies (Fischer 2015). As renewable energy subsidies are becoming contentious in the WTO, the time seems ripe for serious discussion about whether the Subsidies Code needs to make room for some clearly defined environmental exceptions to those disciplines, which are currently lacking (see the chapter by Mavroidis and de Melo in this book).

4 Conclusion

Addressing carbon leakage is a priority for supporting concerted action for mitigation, and in particular for supporting levels of carbon pricing that resembles the global social cost of carbon. In the current framework of countries individually contributing INDCs, convergence to multilateral carbon pricing will be a long time coming. With unilateral policy determinations, we are left with unilateral options for addressing carbon leakage, resulting in weak carbon prices, a reluctance to go first and, for those willing to forge ahead, an excessive reliance on regulatory options that in the long run are much more costly means of reducing emissions than carbon pricing.

Perhaps recognising those costs – not only the costs of climate change, but the costs of delayed action and the costs of second-best approaches to mitigation – enough major economies can agree on a coordinated approach to carbon pricing that spreads coverage broadly enough that carbon leakage becomes less important an issue. Furthermore, a multilateral approach to anti-leakage measures can better ensure they are in harmony with other international agreements. Ultimately, if anti-leakage measures can support enough adherence to ambitious emissions reduction programmes, they can contribute to their own obsolescence.

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