Forslid, Rikard
Henriksson, Ruben (Ed.)

Book

Border carbon adjustments and climate clubs : in the EU context

RIKARD FORSLID

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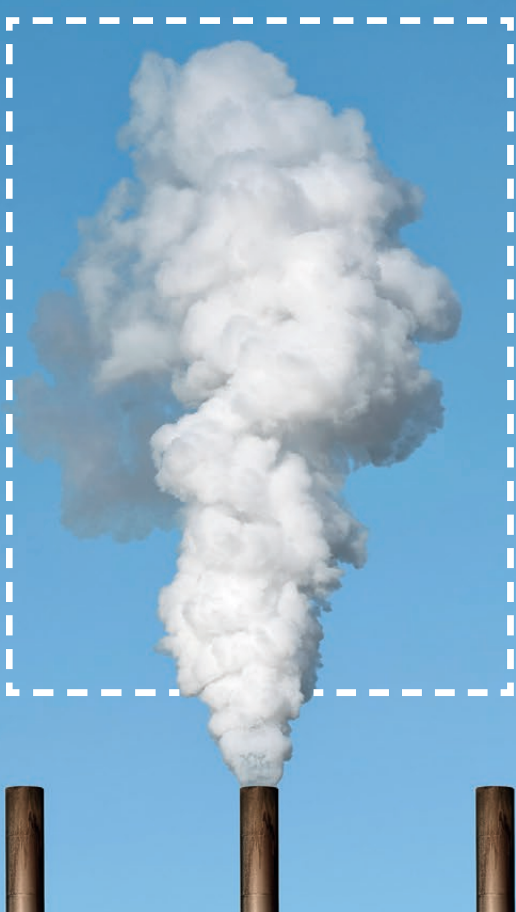

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Tryckt hos Spektar Bulgarien 2020
Graphic Design by Epiquestudio.com
1:a upplagan

ISBN: 978-91-87379-78-9

Published by the European Liberal Forum asbl with the support of Fores. Co-funded by the European Parliament. Neither the European Parliament nor the European Liberal Forum asbl are responsible for the content of this publication, or for any use that may be made of it. The views expressed herein are those of the author(s) alone. These views do not necessarily reflect those of the European Parliament and/ or the European Liberal Forum asbl.

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About the author

Rikard Forslid is professor of economics at Stockholm university. His research centers on international trade, and he is the author of a number of scientific publications on the relationship between trade and the environment. Rikard is also a member of the board of the Swedish National Debt Office and a member of the scientific council of The Swedish Agency for Growth Policy Analysis.

Foreword

Environmental-mitigation policies can take many shapes and sizes. They differ in presentation and use depending on how they are to be implemented, namely on an international, national, or regional level. Research shows that one of the most effective ways to tackle climate change is through the use of a carbon price, preferably a global carbon price. However, we are currently far from that being a reality. Instead, pricing carbon is mostly achieved through national taxes on emissions or through emissions-trading systems, such as the EU's emissions-trading system, EU ETS.

One of the main issues with national or regional pricing of carbon is the risk of carbon leakage. Carbon leakage occurs when a company moves production from a country or a region with strict climate or environmental laws to those with less-strict rules or a lower carbon price. The disparity in regulation and prices is what drives carbon leakage. One way to try to avoid carbon leakage is through the use of border carbon adjustments, or BCAs for short. The EU included the proposal of BCAs in their *European Green Deal* initiative that was presented in December

2019 to address the risk of carbon leakage. Another possible tool to prevent carbon leakage is climate clubs.

The use of BCAs has the potential to maintain the EU's competitiveness without causing carbon leakage[1]. The hope with BCAs is that they will incentivise all parties, inside and outside the borders of the mechanism, to reduce carbon emissions in production. The mechanism will act as a price signal to continue to innovate and develop into a low-carbon economy, both inside and outside the EU. There are also indications that since the BCAs will generate revenue, the EU will have the option to remove costs and fees that distort the market, which in turn will have positive effects on the EU's employment rate[2]. Overall, with the right design, BCAs can provide positive effects not only for the fight against climate change, but also for society as a whole.

Climate clubs are a similar policy tool that centre around the idea of a group of countries with harmonised actions to reduce carbon emissions. Non-members of the club are subject to sanctions that are intended to incentive membership of the club. An often-suggested sanction is that of tariffs on imports from non-members.

1 EU (2020) "Carbon border adjustment mechanism - Inception Impact Assessment"
2 Krenek, Sommer & Schratzenstaller (2019) "Sustainability-oriented Future EU - Funding A European Border Carbon Adjustment"

However, organisations such as UN Environment Programme (UNEP) and the World Trade Organisation (WTO) view trade as essential and beneficial to creating a more environmentally conscious and sustainable society[3]. So how should the benefits of trade be weighed against the need for effective climate policies? In the EU's Impact Assessment, it is stated that BCAs will be implemented if differences between the EU and other countries' climate-mitigation plans increase. The future of a potential BCAs will rest on how the design of such a mechanism is accepted by other parties, as well as, how well it adheres to WTO obligations.

Given the current developments within the EU, a good understanding of BCAs and climate clubs as policy tools is crucial. This publication takes a deep dive into their concepts in order to understand their respective benefits and drawbacks.

Ruben Henriksson
Climate programme
Fores

3 WTO and UN Environment (2018) "Making Trade Work for the Environment, Prosperity, and Resilience report"

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Introduction

1

This paper discusses the rationales for border carbon adjustments (BCAs) and carbon clubs in the context of the EU's trade policy.

Global warming poses a major policy challenge for politicians around the globe. The increasing temperature is caused by anthropogenic greenhouse gas (GHG) emissions. The magnitude of these emissions depends on global population size, lifestyle, energy use, land-use patterns, technology and climate policy. The rising temperatures are projected to cause severe risks for humanity: interruption in food supplies, more frequent weather events, and rising sea levels. Moreover, risks are unevenly distributed over the globe and among communities.

The basic problem is that the existing reserves of gas, coal and oil are very large, and the burning of these reserves risks devastating our planet by increasing greenhouse-gas levels above acceptable limits. The cumulative consumption of gas, coal and oil since the beginning of the industrial revolution has, as a comparison, been quite limited compared to the current reserves of these resources.[4]

The most efficient solution to this problem is to discourage emissions by putting a global price on carbon-dioxide (CO_2) emissions, which can be achieved either by imposing a global tax on CO_2-emissions or by creating a global cap-and-trade system in which, for example, companies or people buy and sell emissions permits.[5]

However, it has been shown that it is very difficult to agree on a common global policy for making CO_2-emissions costly. The UN Climate Change Conference, or Conference of the Parties (COP), takes place annually, and the most recent COP meeting (COP 25) took place in Spain in December 2019. These conferences have not resulted in binding commitments for reducing CO_2-emissions after the failure of the Copenhagen Summit in 2009. Instead, following the Paris Agreement in 2015, nations are required to come with their own pledges known as "Nationally Determined Contributions" (NDCs). Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions. A weakness is that there is no legal system for enforcing the pledges. The agreement instead essentially relies on global peer pressure. Early scientific evaluations of the agreement indicate that several major industrialised

4 See e.g. chapter 1 of IPCC (2011). "Renewable Energy Sources and Climate Change Mitigation".
5 The world Bank. (2014). "What does it mean to put a price on carbon?"

nations are not implementing the policies necessary to meet their pledged emissions-reduction targets.[6] The Paris agreement has also been weakened by the announced withdrawal of the US from the agreement, by the present administration, in 2019.[7]

Fundamentally there is a “free-rider” problem that exists for all common goods (such as clean air): a single country may not see the need to reduce their emissions provided that everyone else reduces theirs.

Many countries or groups of countries, have, in spite of this, introduced policies that put a price on CO_2-emissions. In 2005 the EU introduced an emissions-trading system known as the EU ETS. The system sets a cap on emissions for the firms included in the system, but allows for the trading of emission allowances, which implies that emissions receive a market-determined price. The system in principle allows for an efficient allocation of emissions among sectors and firms included, so that the cap on total emissions can be achieved at the lowest possible cost. The scope of the system has expanded over time to include more sectors and firms, and the emission cap has been reduced over time.[8]

However, policies that make CO_2-emissions costly, such as the EU ETS, risk putting domestic

6 See e.g. Victor et al. (2017). “Prove Paris was more than paper promises”.
7 The US can formally withdraw at earliest the 4 November 2020. The day after the presidential election.
8 European commission. (2016). “The EU’s emissions trading system (EU ETS)”.

firms at a competitive disadvantage compared with their foreign competitors if other countries do not apply carbon taxes or other mitigation measures. The cost disadvantage will tend to boost production in foreign countries and lower production in the country that applies a carbon tax. This means that lower emissions at home are paired with higher emissions abroad – a phenomenon termed carbon leakage.

Countries or groups of countries that unilaterally apply policies that make CO_2-emissions costly may have to consider other policies that maintain the competitiveness of their domestic firms and avoid carbon leakage. Examples are border carbon adjustments (BCAs) and carbon clubs, which correct the cost disadvantage of domestic firms by applying a tax on the carbon content of imported products. The three most common arguments for the use of border carbon adjustments are: (1) to address domestic constituencies' concerns about the loss of competitiveness, (2) to reduce carbon leakage, and (3) to incentivise other countries to participate in climate agreements.[9]

BCAs would level the playing field between foreign-based firms and domestic firms in the EU

9 See e.g. Condon and Ignaciuk (2013). "Border Carbon Adjustment and International Trade: A Literature Review".

market. A climate club, where members are exempt from border taxes, have the additional benefit of providing incentives for other countries to adopt policies that put a price on CO_2-emissions. However, the application of these policies also implies the risk of increasing global protectionism if other countries view them as disguised protectionism.[10]

This paper is organised as follows; first the basic theoretical arguments for policy interventions, such as climate clubs and BCAs, are discussed. The main argument for BCAs is to prevent carbon leakage, and the empirical evidence of leakage is therefore discussed in the following section. The section thereafter treats the design of border carbon adjustments, and climate clubs are discussed after. The paper ends with a concluding discussion and policy recommendations.

10 See e.g. Markusen (1975), "International externalities and optimal tax structures". and Horn and Mavroidis (2011), "To B (TA) or Not to B (TA)? On the legality and desirability of border tax adjustments from a trade perspective".

Chapter 1

The rationale for policy intervention

In this section the fundamental rationales for policy interventions against CO_2 emissions are discussed.

The free-rider problem

CO_2 emissions affect global warming irrespective of where on the planet the emissions occur. CO_2 emissions are therefore a global public “bad”. The flipside of this is that the abatement of CO_2 emissions is a global public good. Since CO_2 abatement is a non-excludable public good, the unregulated market will not supply it. This is simply because it is very difficult to charge a price for a good (such as clean air) that can be enjoyed by everyone irrespective of whether one pays for it or not.

The problem associated with this type of public goods is the incentive for free riding. This is traditionally illustrated by the "tragedy of the commons" where herdsmen sharing a common pasture overstock their herds, which destroys the pasture. Another more current example is the tendency of over-fishing, where the profit-maximising incentives of the individual fisherman can lead to a collapse of the entire fish population.[11]

In the case of CO_2 emissions, there is a severe free-riding problem in that a single country need not to worry about its emissions if all other countries cut theirs. This is particularly true in the case of a smaller country. Thus, a country can free-ride on the abatement policies of other countries.

There is also an inter-temporal free-riding problem. CO_2 accumulates gradually in the atmosphere, and emissions will have to be reduced over a long period of time in order to stabilise the amount of CO_2. The reduction of CO_2 in the atmosphere at a future date could, in principle, be achieved by reducing emissions now, or to emit more now and reduce emissions sharply in the future. The time

11 For example, in the summer of 1992, the Canadian Federal Minister of Fisheries and Oceans, declared a moratorium on the Northern Cod fishery, which for the preceding 500 years had largely shaped the lives and communities of Canada's eastern coast, after the Northern Cod biomass fell to 1 percent of earlier levels. See Hamilton and Butler (2001).

profile of abatement (and therefore of emissions) will determine which generation pays for the abatement. Lax emissions policies now imply free riding on future generations. These generations have no say in today's decisions, and it is therefore likely that future generations will have to bear a high share of the costs of reducing emissions.

The problem of carbon leakage

Greenhouse gases such as carbon dioxide are global pollutants. That is, it does not really matter for global warming where the gas is emitted. This implies that a policy that lowers carbon emissions in one country or in one part of the world but, at the same time, increases emissions by the same amount somewhere else has no effect on global warming.

Many countries or regions in the developed world have implemented some form of tax on CO_2 emissions or other regulation to encourage firms to use production technologies that imply lower emissions of CO_2. However, these policies may lead to higher emissions elsewhere if investors and firms choose to operate in regions without a CO_2 tax instead. Firms may move production to a country with less-stringent environmental standards, so-called pollution havens, instead of changing the production technology in response to the environmental tax. The CO_2-tax will also put domestic firms at a competitive disadvantage compared to untaxed foreign firms. This translates into lower market shares for domestic firms and increased shares for foreign firms, which effectively means that production has moved from the home country to foreign countries where CO_2 taxes are absent. Finally, leakage can occur via international energy markets. A CO_2 tax leads to a drop in domestic demand for fossil fuels. This lowers world prices for those fuels, which in turn stimulates combustion of fossil fuels in other countries.

The CO_2 tax has in these cases lowered domestic emissions, but at the same time increased foreign emissions. Thus, the tax moves emissions geographically. This process is termed CO_2 leakage. The definition of CO_2 leakage is the increase in CO_2 emissions outside the country (or countries) implementing a policy to mitigate emissions, divided by the reduction in the emissions of these countries. Thus, leakage is defined as a share normally ranging between 0 and 100%.[12]

12 It is in some cases possible that the increase in emissions outside the country is larger than the reductions at home. Leakage would in these cases be above 100 percent.

The larger the country or group of countries that implement a CO_2 tax, the more difficult it becomes for firms to relocate production elsewhere, and therefore less leakage would occur. There would be no scope for leakage at all if the CO_2 tax were global.

Chapter 2

Carbon leakage in practice

How big is the problem of carbon leakage in practice? The answer is that while there is considerable theoretical support and an intuitive appeal for pollution havens, they have been more difficult to identify empirically.[13] Stringent environmental regulations could affect comparative advantage. A highly taxed domestic industry may, for example, no longer be competitive in the international markets and therefore be unable to export using the home country as the base for production. This would mean that production moves to foreign low-tax countries, which alters international patterns of trade. But such effects have been hard to pin down empirically, especially among studies using more

13 The surveys by Copeland and Taylor (2004) and Brunnermeier and Levinson (2004) find conflicting results across the literature.

aggregate data on the country or sector level. There are several reasons why this may be the case. First, most trade takes place among developed countries, which share similarly high levels of environmental stringency. Second, industries that are unable to relocate easily will be insensitive to regulatory differences between countries. Cross-industry studies that average over multiple industries could conceal the effect of environmental regulations on trade in the more footloose, i.e. mobile, industries.[14] Finally, it may be that environmental regulation represents a significant portion of total production costs only for a few industries, and these effects are masked when industries are aggregated.

The empirical literature on carbon leakage has two branches. First, there is a literature that uses large-scale theoretical models, so called computable general equilibrium (CGE) models, to simulate the effects of environmental regulation. The studies are of *ex ante* type, meaning that they try to infer the effect of the regulations beforehand. These studies find carbon leakage of very varying degrees (5 to 130%).[15]

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14 See Ederington et al. (2005). "Footloose and pollution-free".
15 They range from lower to moderate rates of 5 percent to 40 percent (Felder and Rutherford, 1993; Bernstein, Montgomery, and Rutherford, 1999;Burniaux and Oliveira Martins, 2012; Elliott et al., 2010) to 130 percent (Babiker, 2005).

The second branch of the literature tries to empirically establish the *ex-post* effect of actual cases of environmental regulation. This is done by establishing statistical relationships between environmental regulation and leakage. More recent studies have tried to combine parts of the theoretical models with statistical analysis (so called structural estimation). [16] Many of these studies are based on the gravity trade model which shows how trade flows depend on the size and distance between markets. Carbon leakage is equivalent to more emissions embodied in imports and fewer emissions embodied in exports, and carbon leakage could therefore be estimated using a gravity-type equation. Many recent studies use disaggregated data at the firm level that has become available recently.[17]

An important challenge is to statistically identify the leakage effects, so that a causal relationship between environmental regulation and trade can be established. That is, to establish that the environmental regulation and nothing else has caused the leakage. A number of recent studies use natural experiments to solve this issue. It is for instance concluded in a study by Aichele and Felbermayr

16 See e.g. Eskeland and Harrison (2003), Javorcik and Wei (2004), Ederington et al. (2005), Cole and Elliott (2005), Levinson and Taylor (2008), Kellenberg (2009), Wagner and Timmins (2009) and Cole et al. (2010).
17 E.g. Martin et al. (2014), Martin et. al. (2016) and Dechezleprêtre et al. (2014).

Figure 1: CO_2 European Emission Allowances in USD – Historical Prices

Source: Business Insider

(2015), which also accounts for the carbon content of intermediate goods, that the Kyoto Protocol led to leakage effects of some 40%.[18]

However, it is probably fair to say that the empirical results concerning leakage remain fairly mixed, in spite of the advances in econometric techniques.[19] Also, studies find evidence of some sectors being at larger risk of carbon leakage than others.[20] Leakage is found particularly in basic industrial sectors, such as cement, iron and steel, and pulp and paper, that are characterised by energy-intensive production processes and limited ability to fully pass through

18 Aichele and Felbermayr (2015). “Kyoto and carbon leakage: An empirical analysis of the carbon content of bilateral trade”.
19 See for instance the survey by Dechezleprêtre and Sato (2017). “The impacts of environmental regulations on competitiveness”
20 Martin et al. (2014)

pollution-abatement costs to consumers, which could be due to regulation or international competition that limits the ability to raise prices. These sectors typically also have a lack of innovation and investment capacity to advance new production processes.

Does the EU ETS create leakage?

The literature specifically estimating the leakage related to the EU ETS is of particular interest to this study. The EU ETS was launched in 2005 and is a major pillar of EU energy policy. It covers an increasing number of installations in 31 countries: 27 EU member states plus the United Kingdom, Iceland, Liechtenstein and Norway.[21]

Sectors covered are power and heat generation, as well as energy-intensive sectors such as aluminium, bulk organic chemicals, cement, oil refineries, pulp and paper, and steel works. Aviation was brought into the EU's emissions-trading system in 2012. In 2020, emissions from sectors covered by the system will be 21% lower than in 2005.[22] The system is based

21 The status of installations in the United Kingdom is subject to negotiations. See https://ec.europa.eu/clima/index_en.
22 European commission. (2016). "The EU:s emissions trading system (EU ETS)"

on the "cap and trade" principle. A maximum (cap) is set on the total amount of greenhouse gases that can be emitted by all participating installations. Allowances for emissions are then auctioned off or allocated for free and can subsequently be traded. The scheme has been divided into a number of "trading periods", and the system is currently in its third trading period (2013-2020). The system has over time turned to auctioning more permits rather than allocating freely. However, it is important to note that it does not matter for the incentive to abate whether emissions allowances are awarded for free, as in the beginning, or if they are auctioned out, as present. The market price of an emission allowance represents the marginal cost of emissions for a firm in both cases.[23]

The literature on the effects of EU ETS generally finds little evidence that the policy has generated leakage to countries outside the EU.[24] An oft-mentioned reason for this is that the firm-level costs related to the EU ETS are often very small compared to international differences in factor prices (wages).

The price of emission rights turned out to be very low during the first "learning-by-doing" trading

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23 However, free allocation of emission rights, instead of auctions, tends to reallocate resources among firms toward the most productive ones, and this does affect the market structure. See Anouliès (2017), "Heterogeneous firms and the environment: a cap-and-trade program".

24 See e.g. Branger et al. (2016), Dechezleprêtre et al. (2014), Koch and Basse Mama (2016), Naegele and Zaklan (2019), and Sartor (2013).

period (2005-2007). The total of allocated emissions permits was higher than verified 2005 greenhouse-gas emissions, and the price of the emissions permits fell to essentially zero by January 2007 and onwards.[25] The cap on allowances was reduced during the second phase of the EU ETS (2008-2018). The price of allowances was initially considerably higher, but after the financial crisis, as the economic crisis led to emissions reductions that were greater than expected, the price fell. Figure 1 shows historical emission prices in USD. Prices stayed very low until mid-2018, but have thereafter risen significantly, and the price has essentially been above 20 euros per ton during the last two years.

The strong increase (300-400%) in the price of emission allowances the past couple of years, seen in the figure, makes leakage more likely, since the cost of emissions starts to have a more significant effect on the total cost of firms in the EU ETS. It is also the case that the next phase of EU-ETS, phase 4 (2021-2030), will increase the pace of annual reductions in allowances.[26] This is likely to put an even stronger upward pressure on the price of the emission allowances within EU ETS.

The conclusion from this must be that even if the scientific literature has found no or few signs of

25 European commission (n.d.-a). "Phases 1 and 2 (2005-2012)"
26 European commission (n.d.-b). "EU Emissions Trading System (EU ETS)".

leakage from the EU during the period with a very low price for emission allowances, leakage becomes much more likely in the future. The usefulness of BCAs can therefore not be discounted on the basis of empirical results from the 2011-2017 period, when the price of emissions allowances was very low.

Chapter 3
Border Carbon Adjustments (BCAs)

The EU ETS makes CO_2 emissions costly for European firms that are part of the system, and as the price of CO_2 increases in the EU, so does the risk of leakage. A way to handle the leakage problem is to apply a BCA – simply put, a CO_2 tariff on imported goods. For example, imported steel from countries without a domestic carbon tax would face a tax based on direct emissions (those due to the use of fossil fuels in steel production) as well as indirect emissions (such as emissions created by electricity generation for use in steel production). Such a tariff would level the playing field in the European market for foreign and domestic producers, but it would not correct the disadvantage that European exporters would have in markets outside the EU. Full border adjustments must therefore combine an import tariff with export rebates for European exporters. However, in practice, most of the policy debate focuses on the use of import tariffs, because it is feared that export rebates would constitute a prohibited export subsidy under the WTO's Agreement on Subsidies and Countervailing Measures.[27]

Principles for calculating CO_2 tariffs

A carbon duty should, in principle, apply a carbon tax on an imported good so that the cost of emissions become the same for foreign and domestic producers selling the good in the domestic EU market. To calculate the appropriate duty requires knowledge about foreign carbon taxes and the emissions generated in foreign production. However, the latter is very difficult to establish in practice. There are several reasons for this. The foreign production technology may involve different levels of emissions than the domestic technology, and local measurement and verification would be needed to establish how large the foreign emissions are. Furthermore, it

27 Cosbey et al. (2012) "A Guide for the Concerned: Guidance on the Elaboration and Implementation of Border Carbon Adjustment" and Mehling et al. (2019) "Designing border carbon adjustments for enhanced climate action".

is by no means certain that foreign authorities have the incentives to perform these emission measures or to report emissions in a non-biased fashion. Finally, the rise of global-production networks and global value chains (GVCs) exacerbates the problem of calculating foreign emissions. Final goods consist of components from many countries that have crossed back and forth between production facilities in different countries. This probably makes it close to impossible, or at least impractical, to calculate the emissions embodied in imported goods.

A solution to this problem is to assume that imported goods embody the same level of emissions as if they were produced in Europe (where technology is known). Different benchmarks are possible, such as the average emission intensity in the respective sector in the EU or the emission intensity from the best-available technology. The latter benchmark being less efficient in preventing leakage, since it implies lower carbon duties.

A serious drawback of any benchmark is that the border tax in this case gives no incentives for foreign firms to use cleaner technology, unless a firm could be exempted from the tax by providing documentation showing that its emissions are below the benchmark. Without the possibility of exemptions at the firm level, they will continue to pay the same duty irrespective of how much they reduce emissions or invest in clean technology.

An alternative to firm-level exemptions that may be easier to administer would be to implement exemptions at the national level based on the stringency of the carbon policy in the exporting country in question.[28] This would mean that foreign governments would have incentives to increase the cost of CO_2 emissions to the European level. The strength of these incentives would hinge on how important the European market is for the foreign countries or the firms in question.

Thus, there is a strong economic argument for taking domestic carbon policies in the exporting country into account when deciding the level of the border carbon tax in the EU, since this incentivises foreign countries to apply carbon levies. The crux is that such a country-specific levy could create problems with regard to the very central most-favoured-nation clause in the WTO's General Agreement on Tariffs and Trade (GATT). Article XX in the GATT treaty does specify a number of exceptions where discrimination is allowed, and climate-change protection is notably one of the likely exceptions in the article.[29]

28 This policy is very like the formation of a carbon club, which is discussed later in the paper.
29 Mehling et al. (2019). "Designing border carbon adjustments for enhanced climate action".

Leakage will not occur when two trading countries both have emission caps, since the total emission level from these countries is fixed by the cap. It is possible that emissions leak in a particular sector, but that must be paired by an equal negative leakage in another sector keeping aggregate emissions constant. These offsetting cross-sectorial leakages will not occur if the emission caps are defined at sector level.

Sectors

A uniform marginal cost of emissions for all firms in equilibrium would be optimal (first best) in a closed economy since the externality associated with CO_2 emissions is the same irrespectively of the sector that generates the emission. However, in an open market such as the European Union there is the problem of leakage to countries with laxer environmental standards. Theory suggests that border measures, such as import tariffs and export subsidies on the carbon embodied in trade can be used as a second-best instrument to improve the economic efficiency of unilateral emissions-pricing policies.[30] Since the degree of leakage differs among sectors, the policy would mean sector-specific import duties

30 Markusen (1975), "International externalities and optimal tax structures", and Hoel (1996) "Should a Carbon Tax Be Differentiated across Sectors?".

as well as sector-specific export subsidies.

The criteria for defining sectors that are subject to leakage would firstly be related to how important the cost of the environmental regulation is in relation to total costs. Secondly, it is related to the degree to which cost increases would lead to a substitution to products sourced from abroad. This second criterion is not easily established. Note that a drop in EU consumption or firm profits does not necessarily indicate leakage. It may instead indicate that consumers are changing their behaviour by consuming less or by using cleaner substitutes, which are both desirable. In practice, a sector's trade exposure (trade share), is often used as a proxy for the second criterion.

However, BCAs are not the only instruments available to correct for the externality associated with leakage. In fact, the EU already has a policy in place for this. To safeguard the competitiveness of industries covered by the EU ETS, the production from sectors and sub-sectors deemed to be exposed to a significant risk of carbon leakage receives a higher share of free allowances compared to the other industrial installations.

The criteria for free allocation in the EU ETS during the present third trading period has been that a sector or sub-sector is considered to be at significant risk of carbon leakage, and thereby qualifies for free emission rights, if:

- direct and indirect costs induced by the implementation of the directive would increase production cost, calculated as a proportion of the gross value added, by at least 5%; *and*
- the sector's trade intensity with non-EU countries (imports and exports) is above 10%[31]

A large number of European sectors qualify according to these criteria. The policy will continue in phase 4 (2021-2030) but based on more-stringent criteria and improved data.[32]

General examples of production sectors that are sensitive to leakage are cement, ceramics and lime, iron and steel, pulp and paper, aluminium (if the indirect costs of increased electricity prices are included), and basic inorganic chemicals and nitrogenous fertilisers. In total, 43% of all emissions allowances have been allocated for free during phase 3 (2013-2020).[33]

31 European commission. (n.d.-c) "Emissions trading system (EU ETS): Carbon leakage".
32 Rules have been set to better align the level of free allocation with *actual production levels*: 1) Allocations to individual installations may be adjusted annually to reflect relevant increases and decreases in production. 2) The list of installations covered by the Directive and eligible for free allocation will be updated every 5 years. 3) The 54 benchmark values determining the level of free allocation to each installation will be updated twice in phase 4 to avoid windfall profits and reflect technological progress since 2008. See e.g. European Commission (n.d.-d) "Free allocation".
33 European Commission (n.d) "Free allocation"

A question then, is whether it is better to handle the risk for leakage in certain sectors by sector-specific BCAs or if this should be handled by purely domestic policies such as a higher allocation of free emission rights.

Export rebates

Carbon duties, if properly applied, would level the playing field for domestic and foreign producers in the EU market. However, it will still be the case that European producers that bear the cost of European carbon allowances will face a cost disadvantage in foreign markets. The question then arises if exports by European firms should be subsidised. While there are theoretical arguments for export subsidies, there are several legal problems, as the WTO prohibits exports subsidies except for some less-developed countries. Export rebates or subsidies could therefore make the BCA system (or parts of it) incompatible with GATT rules. A simpler solution would be to keep the allocation-free emission allowances, but to reduce it to encompass production for export only.

Developing countries

A BCA shifts the economic burden of emissions reduction to non-abating countries through implicit changes in international prices. One effect is therefore to shift part of the burden of EU climate policy to the developing world as the EU extracts a surplus from non-EU exporters of emission-intensive goods. The redistributive effects are particularly strong when carbon tariffs are based on the full embodied carbon content, so that also indirect emissions are taxed. The CO_2 tariffs thereby create incentives for countries outside the EU to apply domestic carbon taxes or other measures that make CO_2 emissions costly, provided that this is accounted for when exporting to the EU. However, a CO_2 tax or an emissions-trading scheme may not be appropriate for the poorest countries, and it is therefore reasonable to exclude these from the BCAs.

Value chains

Globalisation has led to the development of highly complex production patterns often called global value chains. The production process of individual firms in these networks is geographically fragmented, and each production stage or task is performed in the country most suited for this task. This means that parts and components travel back and forth over national borders in very complex patterns before they are finally assembled to a final product. As a result, it is becoming increasingly difficult to establish the origin of a product or to the direct and indirect CO_2 emissions embodied in a product.

This has led policymakers to suggest that BCAs should be applied only to a limited number of industries with small value chains.[34] This would also limit the environmental levy on imported components used by exporting domestic downstream producers. However, this may imply that some industries with high emissions that are sensitive to leakage are excluded from the BCA. A better alternative is therefore to apply the BCA broadly (to all sectors in the EU ETS), and to apply a known industry benchmark, based on industry emissions in the EU, for emissions.

Risk of protectionism

One of the main concerns related to carbon duties or BCAs is that they will be overtaken by protectionist interests. BCAs are in many ways similar to anti-dumping measures that are applied against foreign

34 The National Board of Trade Sweden (2019). "Gränsjusteringsåtgärder för koldioxidutsläpp".

firms. These measures are generally viewed as one of the main instruments for protectionism within the WTO system. The fact that BCAs will be hard to calculate in practice makes it more likely that protectionism creeps into the system. This is a reason for keeping the system simple and transparent, and it is also an argument for applying a clearly stated and transparent benchmark for industry emissions. The benchmark could, for instance, be based on average EU emissions. Protectionism can also be minimised by avoiding exceptions, and to consistently apply the BCA on a wide spectrum of sectors.[35]

Legality

Border tax adjustments, like any other domestic instrument, must respect the conditions reflected in Art. III.2 GATT: this provision requests WTO Members to respect the national treatment (NT) principle whenever they regulate conditions of competition regarding goods in their national market and to this effect impose fiscal measures. The principle implies that imported goods should be treated no worse than "like" domestic goods.

35 Horn and Sapir (2019). "Border Carbon Tariffs: Giving up on Trade to Save the Climate?".

However, Article XX in GATT specifies general exceptions under which discrimination can be allowed. In particular, environmental concerns can come under both (b) and (g) of Art. XX GATT, and legal experts argue that carefully designed BCAs are likely to be allowed under the GATT.[36] For instance, Horn and Mavroidis believe that "[...] it has never been a better time in the GATT=WTO history for regulators to defend similar measures. Foreign will have an Everest to climb when challenging BTAs aimed to address climate change by Home."[37]

Welfare effects

The welfare effects of European BCAs are the combination of the effects of the border tariffs on consumers and producers, on tariff revenues and on the welfare effects of reduced emissions. The tariff by itself would be negative for welfare if we disregard the environmental effects, and take world market price as given, but the effect is not dramatic. For example, a 5% tariff on half of all EU imports would result in a static loss below 1% of the EU's GDP.[38] The

36 Cosbey et al. (2012). "A Guide for the Concerned: Guidance on the Elaboration and Implementation of Border Carbon Adjustment".
37 Horn and Mavroidis (2011). "To B (TA) or Not to B (TA)? On the legality and desirability of border tax adjustments from a trade perspective".
38 A back-of-the-envelope formula in a neoclassical model with given world market prices is the import share*trade elasticity2*percentage tariff change. The import share of the EU was around 13 percent in 2018 and a typical value for the trade elasticity is -4.

welfare effects incorporating the environmental effects and the general-equilibrium effects on prices are best assessed in a fully fledged CGE model. Nordhaus, for instance, used a model of this type to numerically calculate (simulate) the effects of a club with a uniform import tariff. It is shown that all major regions gain from the club relative to the non-cooperative outcome.[39] These simulations take into account the fact that large countries can gain from employing a small import tariff because this turns the terms of trade in their favour (by reducing the world market price of their imports).

Conclusion on BCAs

The theoretical argument for BCAs is clear and intuitive. It is about levelling the playing field for EU producers by imposing the same cost of emissions for all producers. BCAs could therefore preserve the competitiveness of European manufacturers and prevent leakage. They may also incentivise foreign countries and producers to reduce emissions.

However, the practical application is not so simple. First, it is very difficult to establish the emis-

39 Nordhaus (2015). “Climate clubs: Overcoming free-riding in international climate policy”.

sions levels embodied in foreign products. This is particularly difficult if indirect emissions (those embodied in the inputs of a good such as electricity) must be accounted for. This probably means that some sort of benchmark must be used, such as, for instance, the average emission intensity by EU firms in a specific sector.

The disadvantage of using a benchmark for foreign emissions is that it removes incentives for foreign countries and producers to reduce emissions. It is therefore important to allow individual firms to present their own data on emissions to challenge the benchmark. It is likewise important to allow exemptions to individual countries based on their policies for making emissions costly, such as CO_2 taxes.

Second, care must be taken to make the BCA compatible with the GATT. Allowing exemptions for firms and individual countries may incidentally make it more likely that a BCA is compatible with GATT rules under Article XX.

Third, a complete BCA would involve export rebates to EU producers to level the playing field outside the EU market. However, it is not likely that export rebates would pass GATT regulation, and a BCA should therefore focus on imports. Free allocation of permits could instead be kept for compensating exporters.

Finally, given the administrative difficulties in the implementation of BCAs in Europe, the question arises if this is the best policy to achieve its aims. There is already a system in place that handles the leakage problem – namely free allocation of emission rights to vulnerable industries. This means that incentivising foreign firms and/or countries to reduce carbon emissions is the only really novel effect of a BCA, and it is therefore important that the BCA is designed so as to create these incentives.

In summary, this suggests a policy where a European BCA is based on a benchmark, but where exemptions to individual firms and countries based on actual data are allowed. It also suggests that the system of free allocation of emission allowances is maintained to compensate exporters.

Chapter 4
Climate clubs

One way of handling the carbon-leakage problem is the formation of climate clubs, where the participating countries agree to undertake harmonised actions to reduce carbon emissions.[40] Existing agreements within the United Nations Framework Convention on Climate Change (UNFCCC) have to date had a limited success in reducing global CO_2 emissions. A particular problem is that the US has signalled its intention to withdraw from the Paris agreement. Absent a working global agreement, many countries have resorted to national policies or policies among limited groups of countries, such as the EU ETS, for reducing carbon emissions. A weakness of this approach is the incentive of free riding. Clubs have been used in several cases to handle international free riding. Successful examples are agreements on international trade and finance.[41]

40 Nordhaus (2015). "Climate clubs: Overcoming free-riding in international climate policy".
41 For instance, international agreements to promote financial stability have been reached by the 95 countries that are part (shareholders) of the Bank for International Settlements.

Basic club theory

The theory of clubs is a small field in economics with a long tradition.[42] The basic club formulation deals with how a club can be used to optimally provide and utilise a rival public good such as a swimming pool, or a park. New members will contribute to the financing of the public good but they will also increase crowding in the pool or the park. Club theory can be used to determine the optimal size of a club as well as the optimal membership fee. A successful club generally has the following characteristics:[43] (i) that there is a public good such as a golf course that can be shared; (ii) that the club arrangement, including the fees, is beneficial for each of the members; (iii) that non-members can be excluded or penalised at relatively low cost to members; and (iv) that no one wants to leave the club (that the club is stable).

Climate clubs in practice

A climate club is an arrangement where the participating countries agree to undertake harmonised actions to reduce carbon emissions. It has a couple

42 Buchanan (1965). "An economic theory of clubs", and surveys by Sandler and Tschirhart (1980, 1997).
43 Buchanan (1965). "An economic theory of clubs".

of particular characteristics. First, CO_2 abatement is a public good that is non-rival. That is, contrary to a swimming pool where each new member increases the congestion in the pool, there are no adverse effects of more countries joining a climate club. There is consequently no reason to limit membership in the club. Second, the only benefit of the club cannot be the enjoyment of a cleaner (with less CO_2) atmosphere, since this non-rival global public good can be enjoyed by all countries – members or not. A climate club must therefore have something else that makes membership worth the cost, typically sanctions on non-members.[44] One often-mentioned proposition is to have tariffs on imports from non-members, which is a low-cost method for penalising non-members.

William Nordhaus suggests a climate club where countries agree to policies that produce a given minimum domestic carbon price.[45] Countries in the club are free to choose whichever policy they prefer to achieve this target price – carbon tax, cap-and-trade, or hybrid systems. Non-participants are penalised by a uniform tariff on all imports to the club coun-

44 It is, of course, possible to think of other benefits. One suggestion in the literature is transfers of clean technology (see e.g. Paroussos et al. 2019). However, such a benefit has the disadvantage of being hard to value beforehand. Moreover, only publicly owned technology can easily be transferred.

45 E.g. 25 USD per ton of CO_2 (Nordhaus 2015).

tries, and this is what motivates membership in the club. Properly designed this creates a situation in which countries enter and remain in the club based on their self-interest. That is, the club is stable.

A question is what type of tariff that should best be used to penalise non-members. One possibility is to tax the carbon content of imports. That is, to implement BCAs. However, as discussed earlier in this paper, there are several technical difficulties in calculating the appropriate tariff rate. Nordhaus therefore suggests a uniform tax rate on all imports. This is much simpler to implement, and simulations reveal that an appropriate uniform tariff can be remarkably well-calibrated to the CO_2 externality.[46]

Legality

An important problem with a climate club that imposes a uniform import tariff on non-members is that this is likely not allowed under the GATT. This type of carbon club would likely require amendments to existing trade law. This probably means that industry tariffs, based on industry-level emission benchmarks, must be used in the shorter perspective.

46 Nordhaus (2015). "Climate clubs: Overcoming free-riding in international climate policy".

Empirical results on the effects of climate clubs

The empirical evaluation of climate clubs is based on *ex ante* simulations. Nordhaus simulates the effect of a climate club when the world is divided into 15 regions. The club is assumed to require members to implement policies to achieve a given target price of carbon, and import tariffs are applied on all non-members. It is first shown that no country joins the climate club without trade sanctions. However, for low target carbon prices, all or most countries join even for very low tariff rates. The four target carbon prices (USD 12.5, USD 25, USD 50, and USD 100) correspond to reductions in CO_2 emissions by 9%, 18%, 36%, and 72% compared to baseline emissions in 2011. For instance, a 3% tariff on non-members' imports is enough to incentivise all countries to participate in a club that requires an 18% reduction in CO_2 emissions compared to baseline emissions. It is more difficult to make regions join the club when the target price rises, meaning that import tariffs have to rise to provide sufficient incentives for countries to join the club. For instance, import tariffs need to rise to 7% to incentivise 13 out of 15 regions to participate when the target carbon price is USD 50, which would imply a 36% reduction in global emissions (if all countries participate).[47]

47 Ibid.

How to form a successful climate club: starting small or large?

In order for a climate club to have a significant effect on world emissions, it is important to have many of the large emitters as members. Only 10 countries account for about 75% of world emissions, and China, the US and EU28 alone account for more than 50%.[48]

The incentives for joining vary among countries depending on their vulnerability to climate change, their sensitivity to penalties for not being a member, as well as political factors in the country. A challenge therefore is how to get the reluctant countries to join.

It has been suggested that it is easier to start with a small club of enthusiastic members, and that it is better to get started on complex deal-making by working in smaller groups. It is thought that lessons about best practices learned and technologies demonstrated in these small groups might then diffuse more widely and facilitate broader cooperation.[49] This strategy may work if the club benefits are things like international reputation. However, size

48 Crippa et al. (2019). "Fossil CO2 and GHG emissions of all world countries".
49 See e.g. Falkner (2015), Hovi et al. (2019), Sælen, H. (2016) and Victor (2015).

is likely to be a crucial factor for most climate clubs, at least if the club applies some form of import tariffs on non-members since the size of the club-countries' market determines how costly such a tariff is for non-members. If the club countries have a large market, the tariff becomes costly for non-members.

The reason for the importance of club size is that the cost of joining a climate club only depends on the agreed carbon price. It is unrelated to the size of the club. The benefits of being a member, on the other hand, increase from the size of the club. This implies that the net benefit of the club increases in its size. It also means that countries that export a lot to club countries will have stronger incentives to join. This implies that a club must be of sufficient size to succeed (to be stable).

Membership of the US or the EU greatly increases a club's prospects. The risk of tariffs when selling in the large EU market alone would have the potential to constitute a strong incentive to join a climate club for the EU's trade partners.

Interestingly, the club design discussed here creates a domino mechanism that has been observed in the case of regional integration.[50] Exporters to the climate club in non-member countries will consti-

50 Baldwin (1993) "A domino theory of regionalism", and Baldwin and Rieder (2008) "A test of endogenous trade bloc formation theory on EU data".

tute a powerful pro-membership constituency. If, for any reason, a new country joins the climate club, this harms the profits of non-member exporters, which stimulates them to boost their pro-membership political activity. The extra activity may tilt the balance and cause another country to join the club. This new enlargement further harms non-member exporters since they now face a disadvantage in a greater market. This second-round effect brings forth more pro-membership political activity and a further enlargement of the club and so on. Thus, we have an instance of circular causality, implying that a climate club has the potential to grow very large as more and more countries join-in in a domino-like fashion.

Concluding discussion

This paper has discussed climate clubs and border carbon adjustments in the context of the EU's emissions trading system, as policies to overcome CO_2 leakage, whereby pollution activity simply moves to jurisdictions with laxer environmental standards. The introduction of BCAs would, if properly applied, also give incentives for other countries to implement climate policies of their own.

Club theory suggests that non-members, or in this case countries that do not impose policies that make carbon emissions as costly as in Europe, will have to be penalised. Ideally this could be done with a BCA that corrects for the carbon embodied in imported goods, which would level the playing field in the European market. Such an ideal BCA would also imply giving rebates to European exporters that levels the playing field also outside Europe.

The logic of a club implies that countries that do implement carbon policies that correspond to the European policies should be invited as members of the climate club. That is, they should be exempt from border carbon duties.

The EU already has a policy in place to handle leakage. Free emission allowances are given to producers in industries that are sensitive to leakage. This subsidises the firms to maintain production within the EU, but it does not remove their incentives to reduce CO_2. The marginal cost of emitting CO_2 is still the same, since firms receiving a free allocation have the right to sell their emission allowances. However, a shortcoming of the system of free allowances is that it does not incentivise other countries to put a price on carbon emissions. BCAs, on the contrary, do provide incentives for CO_2 abatement by other countries, provided that exemptions from the BCA are allowed based on verifiable documentation of the costs of emitting carbon.

In practice, it is not easy to implement an ideal BCA. First, it is almost impossible to verify the direct and indirect emissions embodied in foreign products. This is particularly true for products that are produced in complex global production networks. Therefore, some type of benchmark must be used. It could, for instance, be based on emissions of corresponding production in the EU. An alternative solution, proposed by Nordhaus in 2015, is to apply a uniform import tariff on all goods from countries that do not apply appropriate CO_2 policies. This alternative solution is less directly targeted to the leakage, but has the advantage of being easily applied and highly transparent.

An important issue is whether BCAs or uniform import tariffs are compatible with trade law or GATT. Herein lies a large uncertainty, as such a system has not previously been tested under the GATT. It seems clear, however, that a uniform import tariff is much less likely to pass under the GATT than a BCA designed to level the playing field in Europe.

Finally, directly subsidising exporters to level the playing field outside Europe is difficult to implement within existing trade law. The disadvantage of EU exporters could however be addressed by using free allowances for emissions related to production of goods that will be exported.

This suggests the following design of BCAs in Europe: i) Apply carbon adjustments on imports based on a transparent benchmark. ii) Allow for exemptions for countries with policies that imply carbon prices corresponding to the EU level. iii) Allow for partial exemptions for firms based on documented emissions. iv) Use the method of free emission allowances to correct for disadvantages of EU producers in export markets.

Conclusions and policy recommendations

- **Even though** the scientific literature has found little sign of leakage from the EU during the period with an exceptionally low price of emission allowances, leakage becomes much more likely after the price has increased sharply. The usefulness of BCAs can therefore not be discounted on the basis of empirical results from the period 2011-2017, when the price of emission allowances was very low.
- The fact that BCAs will be hard to calculate in practice makes it more likely that protectionism creeps into the system. This is a reason for keeping the system simple and transparent, for instance by applying a benchmark based on the tech-

nology used by EU firms. Protectionism can also be minimised by avoiding exceptions, and to consistently apply the BCA to a wide spectrum of sectors.

- Export rebates to level the playing field for EU producers in foreign markets will be a hard sell both in the GATT and among EU trading partners. It is therefore advisable to keep the allocation of free emission allowances, but to reduce it to encompass production for export only.
- It is important that countries that implement carbon policies that lead to carbon prices corresponding to the EU level are exempted from BCAs. Firms should likewise be exempted if they can document carbon emissions below the benchmark. The exemptions are necessary to incentivise other countries to adopt climate policies, and to incentivise foreign firms to reduce emissions.
- Border carbon adjustments shift the economic burden of emissions reduction to non-abating countries. It is therefore reasonable to exclude the poorest countries from BCAs.

- The benefits of free access to the market as a member of a climate club crucially depends on the size of the market. The EU is the second-largest consumer market in the world, and it is therefore likely to be suitable for a climate club.

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Border Carbon Adjustments and Climate Clubs

in the EU context

Global warming poses a major policy challenge for politicians around the globe. Regional and national policies, such as the EU ETS, have been put into place to fight climate change by making emissions more costly. However, since there is no global environmental policy in place, these systems are systematically exposed to both the risk of carbon leakage and free-riding. Carbon leakage means that emissions move to countries or regions with less strict climate regulations, and free-riding refers to the lack of incentives for countries to cut their emissions, given that other countries do. The purpose of this text is thus to discuss two policies, border carbon adjustments (BCAs) and climate clubs, and how these may help overcome the risk of carbon leakage and free-riding. After the discussion, policy suggestions regarding BCAs and climate clubs are provided in more detail.

ISBN: 978-91-87379-78-9

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