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Border Carbon Adjustment and International Trade: A Literature Review

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Border Carbon Adjustment and International Trade

A LITERATURE REVIEW

Madison Condon, Ada Ignaciuk

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Abstract

Border Carbon Adjustment and International Trade
A Literature Review

Madison Condon and Ada Ignaciuk

An important source of political opposition to measures aimed at reducing emissions of greenhouse gases (GHGs) arises from concerns over their negative effects on the competitiveness of domestic firms, especially those that are energy-intensive and exposed to competition from foreign producers. Politicians and industry representatives alike fear that imports from countries without similar regulations can gain cost-of-production advantages over domestic goods. With many of the major economies of the world contemplating unilateral action to restrict their carbon emissions (while continuing to pursue co-ordinated multilateral action), the parallel concern of carbon leakage — whereby domestic reductions in emissions are partially or wholly counterbalanced by increased emissions elsewhere in the world — has also arisen. Various adjustments have been proposed, both in the academic literature and in draft climate legislation, including levying a border tax or requiring importers to surrender a quantity of carbon permits. Collectively, these kinds of adjustments are often referred to as border carbon adjustments, or BCAs. This note reviews the existing literature on BCAs and alternatives to BCAs and discusses what various researchers have concluded about the efficacy of BCAs from both a trade and an environmental perspective.

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Boxes

Border Carbon Adjustment and International Trade A Literature Review

Madison Condon[1] and Ada Ignaciuk[2]

Introduction

An important source of political opposition to measures aimed at reducing emissions of greenhouse gases (GHGs) arises from concerns over their negative effects on the competitiveness of domestic firms. Politicians and industry representatives alike fear that imports from countries without similar regulations can gain cost-of-production advantages over domestic goods. With many of the major economies of the world contemplating unilateral action to restrict their carbon emissions (while continuing to pursue co-ordinated multilateral action), a parallel concern that arises is that of carbon leakage, whereby domestic reductions in emissions are partially or wholly counterbalanced by increased emissions elsewhere in the world. Various adjustments have been proposed, both in the academic literature and in draft climate legislation, including levying a border tax or requiring importers to surrender a quantity of carbon permits. Collectively, these kinds of adjustments are often referred to as border carbon adjustments, or BCAs.

The dual issues of carbon leakage and competitiveness (energy-intensive domestic industries facing stiffer competition because of cost increases) have been central considerations in the design of flanking policies. Among the most common types are unilateral measures applied to imports — generally, either import taxes or requirements that importers surrender carbon permits. In recent years, other ideas have emerged on ways in which such measures could be designed to minimise adverse trade effects, and some commentators have proposed alternatives to measures applied on imports, such as voluntary export restraints.

This note reviews the existing literature on BCAs and alternatives to BCAs and discusses what various researchers have concluded about the efficacy of BCAs from both a trade and an environmental perspective. In addition, it explores some alternatives to BCAs that have been proposed in the literature.

Empirical evidence of the effects of BCAs on leakage and competitiveness is limited. This is mainly due to *(i)* the overall maturity level of climate policies in developed countries being rather low, and *(ii)* that, to date, no BCAs have actually been implemented (Stephenson and Upton, 2009; Zhang, 2012; Withmore, 2013). Therefore, most of the examples discussed in this report are primarily of a theoretical nature.

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Background

A preliminary review of the literature reveals that the desirability of competitiveness adjustment policies remains an open question, with many arguments both for and against. The primary rationale against the use of tools such as BCAs is that unilateral strategies to combat climate change are second-best options, the first-best policy being universally applied emissions taxes (or cap-and-trade mechanisms) (Markusen, 1975). Houser (2008) and Dröge et al. (2009) argue that unilateral border carbon adjustments could impede future co-operation on multinational climate agreements and spark protectionist trade wars. However, in light of the lack of progress at recent conferences of the United Nations Framework Convention on Climate Change (UNFCCC), some argue that some individual action is far better than no action at all.

BCAs, competitiveness and leakage

Many OECD economies have already begun regulating domestic GHGs regulation, some in response to commitments they made through the UNFCCC and the Kyoto Protocol. In light of this, the three most commonly cited arguments for the use of border carbon measures are: (1) to address domestic constituencies' concerns about the loss of competitiveness, (2) to reduce carbon leakage, and (3) to leverage other countries' participation in climate agreements.

Competitiveness

Most studies indicate that there will be some loss of production by domestic industry if carbon emissions are made costly at home but not abroad. This argument is mainly based on the assumption that the industries complying with the domestic policies to reduce GHGs emissions will move their production to non-complying countries, reducing the employment opportunities and the economic output within the acting country.

Leakage

Carbon leakage is defined as the ratio of an increase in emissions outside of the country or countries with domestic climate polices to the reduction in emissions that occurs within these countries (Felder and Rutherford, 1993; IPCC, 2007). Leakage occurs when emissions in non-acting countries increase as a result of the climate policies in acting countries. The OECD (2012) proposes to broaden this definition to account also for domestic emission increases towards non-priced emission sources in acting countries.

Leverage

Another motivation discussed in the literature for BCAs is an assumption that they could spur other countries towards reaching a more comprehensive global regime (Helm et al., 2012; Stiglitz, 2006). The assumption behind this argument is that acting countries may induce a change in the national policies of non-acting countries. Non-acting countries may choose to adjust their domestic climate policies rather than being subjected to BCAs on their exports.

Assessing the effects of BCAs

Many authors have employed a global dynamic computable general equilibrium (CGE) model to study the trade effects and carbon-leakage impacts of carbon regulation, *ex ante*. The models provide a range of estimates on competitiveness and leakage,

depending on the assumptions made on factors such as price elasticity of demand, elasticity of trade substitution, returns to scale, and the technological response of individual industries (Babiker, 2005; Babiker and Rutherford, 2005; Reinaud, 2008; Monjon and Quirion, 2011; Böhringer et al., 2012).

Competitiveness

Babiker (2005) uses a model with increasing returns to scale and finds competitiveness effects resulting from an emissions cap in OECD countries. Veenendaal and Manders (2008), based on their IMPASSE scenario, find that, were the European Union to act unilaterally to reduce emissions, it would experience a 0.7% decline in national income; and the rest of the Annex I countries would experience a 0.3% decline. Non-Annex I countries would experience a decline in national income of 0.1% as a result of slower growth in OECD countries. They find only modest competitiveness effects for the European Union when its climate policy is accompanied by a BCA.

Several analyses using CGE models have shown that significant output losses occur in energy-intensive sectors when a cap-and-trade or carbon-tax regime is implemented, and that BCAs are insufficient to counteract all of the loss (Burniaux et al., 2010; Mattoo et al., 2009, Winchester et al., 2011). Burniaux et al. (2010) attributes this to the fact that energy-intensive industries are affected primarily by the contraction of the overall market size that comes from carbon pricing, rather than by general international competitiveness losses. Aldy and Pizer (2009) argue similarly that most domestic production loss stems from energy-price increases and reduced overall consumption rather than the loss of competitiveness in its product markets. Monjon and Quirion (2011) analyzed European climate policy and found that a decrease in EU production of energy-intensive products can be expected, but mainly due to a reduction in European demand rather than a shrinking global market share.

Bao et al. (2012) employ a multi-sector dynamic CGE model to estimate the impacts of a hypothetical BCA regime implemented by the United States and the European Union on China's carbon emissions. They note the presence of the energy-substitution effect, whereby global energy prices are reduced, thus increasing demand in the domestic market, finding that the emissions reduction impacts of BCAs "are relatively small in China." They advocate the use of technology-transfer agreements and other incentive mechanisms as more effective alternatives to BCAs.

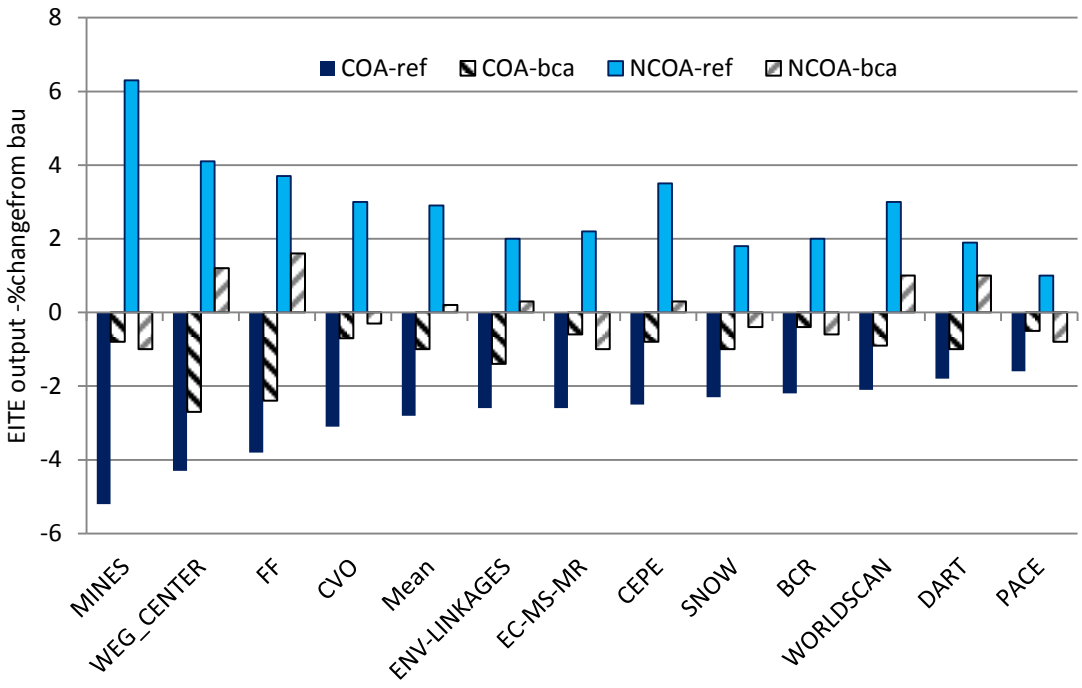
A recent study comparing different models, performed under the umbrella of the Energy Modelling Forum (Böhringer et al., 2012), shows that BCAs can be effective in reducing the negative effects that the climate policies can have on competitiveness in acting countries (Figure 1). Emission pricing of Energy Intensive Trade Exposed (EITE) industries may put these sectors at a disadvantage with international competitors. For the scenario in which climate policy is *not* supported by BCAs (labelled as "ref" in Figure 1), all models indicated output losses of EITE industries in the coalition of acting countries (COA) and increase of output from EITE industries in the coalition of non-acting countries (NCOA).When BCAs are applied (the COA-bca and NCOA-bca scenarios in Figure 1) the loss of EITE production in acting countries falls on average from 2.8% to roughly 1% (Böhringer et al., 2012).

Böhringer et al. (2012) point out that the overall costs of achieving an approximately 10% emission reduction by the coalition countries are relatively modest, up to 0.6% GDP loss. Additionally, when calculating the global cost-effectiveness of the BCAs, in terms of global changes of GDP, it appears that BCAs improve slightly on global cost-

effectiveness. With uniform emissions pricing only, acting countries carry a substantially higher burden, as opposed to non-acting countries. However, when BCAs are applied the burden sharing is almost equal between acting and non-acting countries, in terms of their GDP losses.

In general, the overall welfare loss due to climate policies is lower when more GHGs are targeted by climate policies and more sectors participate in the emission reductions scheme. For instance, Ghosh et al. (2012) find that including methane, nitrous oxides and fluorinated gases significantly reduces the potential welfare loss. BCAs strengthen this effect at the global scale, however, similarly to the findings of Bohringer et al. (2012) there is strong positive welfare effect (compared with a climate-policy scenario without BCAs) for acting countries but, for non-acting countries, the effects are negative.

Figure 1. Output of EITE industries in coalitions of acting (COA) and non-acting (NCOA) countries (% change from *Business as usual*)



Source: Böhringer et al., 2012.

Ex post econometric studies of competitiveness loss have found differing results in response to climate-related measures, though generally they find less of an impact than predicted by the *ex-ante* models (Jaffe et al., 1995; Levinson and Taylor, 2008; Kellenberg, 2009).

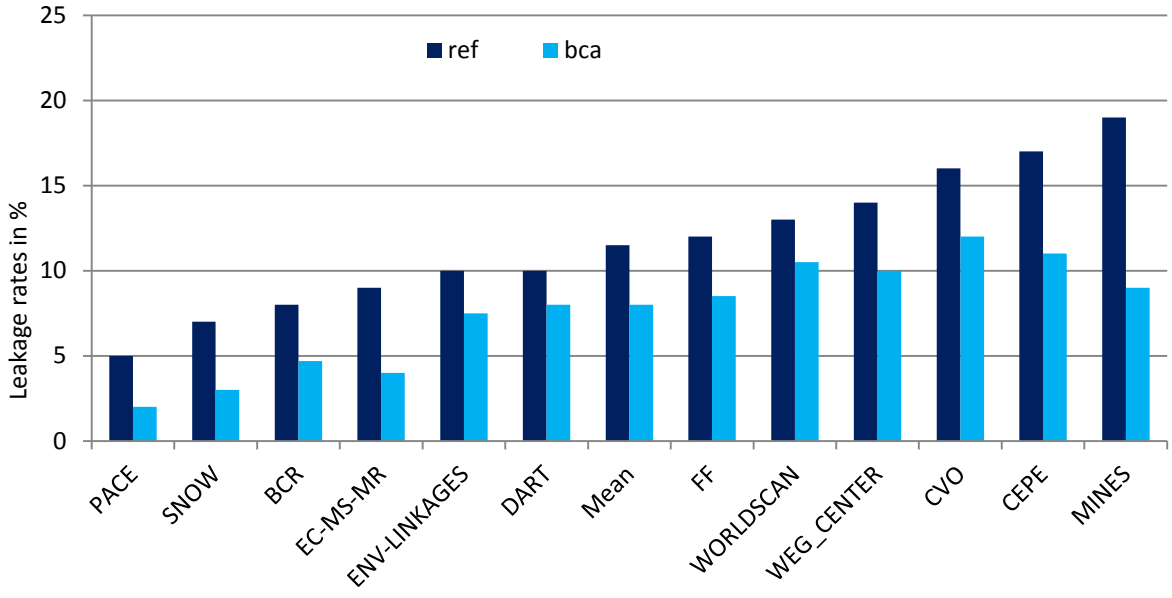
Leakage

Ex ante studies that focus on heavy industry in the European Union predict rather high leakage rates: 55% in the iron and steel sector, and between 40% and 70% in the cement sector (Reinaud, 2008). These predictions have not been borne out by *ex post* studies on the first phase of the ETS (Ellerman and Buchner, 2008; Reinaud, 2008). However, emissions prices were set notoriously low during this period and leakage rates

are likely to be much higher as the price of carbon climbs. Zhang (2012) provides a comparison of *ex ante* and *ex post* leakage calculations. There are two possible explanations for the discrepancy between the predicted and observed amounts of leakage. The first is that the models used for the *ex ante* studies are stylised and therefore do not accurately model the EU ETS. The second is that the *ex ante* studies omit certain positive implications of unilateral climate policy, such as induced technological innovation. Zhang (2012) makes two additional points: first, that high commodity prices during the period 2005-2007 make it difficult to observe the impacts on certain sectors; and second, that European product standards and specifications help insulate European manufacturers from foreign competition (Reinaud, 2008; Convery et al., 2008).

Most studies find a significant amount of economy-wide carbon leakage that typically ranges from 5% to 20% (Elliott et al., 2010; Altamirano-Cabrera et al., 2010; Monjon and Quirion, 2010). Elliott et al. (2010), using a three-region model, investigate trade in virtual carbon[3] and find substantial carbon leakage, ranging from 15% at low tax rates to over 25% for the highest tax rate. Monjon and Quirion (2010) point out that most general-equilibrium models predict the majority of carbon leakage occurring, not through shifts in GHG-intensive industry locations, but through the energy prices channel — i.e. that as a consequence of tighter climate policies, the world prices of fossil fuels would fall, leading to an increase in consumption of these fuels in countries without carbon regulation. Nearly all of the models that incorporate both the competitiveness channel and the fossil-fuel-pricing channel demonstrate that most leakage occurs via the latter (Böhringer et al., 2010; Fischer and Fox, 2009). Of course, the greater the number of countries that agree to emissions reduction commitments, the less the resulting carbon leakage (Reinaud, 2008; Böhringer et al., 2011).

Figure 2. Leakage rate in (%), in the climate policy scenario (ref) and the same scenario with full BCAs (bca)



3. Defined by the authors (p. 467) as "Virtual carbon is the CO_2 emissions associated with the production of a good".

Source: Böhringer et al., 2012.

The aforementioned comparative study by the Energy Modeling Forum shows that BCAs can be effective in reducing leakage. In that exercise, Annex I countries together agree to reduce emissions by around 20%. Only the EITE sectors were included under the climate policy and BCAs were imposed as the carbon-based import tariffs and export rebates. As a result of this scenario, leakage rates under BCA range between 2% and 12% with a mean value of 8% (Figure 2). Thus, full BCAs reduce the leakage rate on average by one third compared with the reference scenario (Böhringer et al., 2012). Note that this is a global level of emission reductions; some of the reductions take place in the non-acting countries and contribute to the overall goal set by the acting countries.

Ghosh et al. (2012) analysed the effectiveness of BCAs in reducing leakage not only in EITE sectors but also when the agriculture sector is included in the analysis and climate policies target, beside CO_2, other GHGs. They concluded that when the set of gases is broader, under the assumption that only EITE sectors are included, the leakage rate drops significantly to around 1%. Interestingly, when agriculture is included, the overall emissions are reduced, which means that a part of the acting countries' target was met by the emissions reduction in non-acting countries.

When climate policies are imposed on a selection of sectors there may be a potential increase of consumption in domestic, non-traded sectors such as construction, electricity generation and local and regional transport, against which BCAs are ineffective (McKibbin et al., 2010). Wiener (1999) emphasizes that this kind of leakage is worse than what occurs around most other environmental pollutants because the regulating country loses the economic benefits from an emitting industry while still suffering the same environmental harm. Some authors (e.g. Coglianese and D'Ambrosio, 2008) have gone so far as to argue that incremental schemes short of a global agreement are worse than no action at all because of these leakage effects.

Another approach to predicting leakage is to look at the impacts on one sector or industry. Mathiesen and Maestad (2004) examined the steel industry and project a leakage rate of 26% when a USD 25/tCO_2 tax is imposed on Annex I countries of the Kyoto Protocol. Demailly and Quirion (2008) find that a USD 15/tCO_2 tax in Annex I countries would result in a 20% leakage rate in the cement industry. Lanz et al. (2013) use a plant-level representation of industrial geography, which allows them to reflect complex trading patterns, including transportation costs, and regional heterogeneity in the production process. In applying this method to the copper industry, they conclude that the copper industry is unresponsive to sub-global climate policies. They attribute this to the low price responsiveness of both producers and consumers, owing to the fact that adjustments in the copper industry are constrained by infrastructure requirements and institutional factors.

Many studies have incorporated various BCA adjustment proposals into their models. An OECD report completed for EPOC's Working Party on Climate, Investment and Development used a CGE model called ENV-linkages to investigate the interactions between economic activities across sectors and regions, with an emphasis on energy-related economic activities (OECD, 2012). The report investigates BCAs, direct linking, and indirect offset-based linking of carbon markets as policies to address sectoral competitiveness and carbon leakage impacts. One of the findings of the report is that direct and indirect linking may be preferable to BCAs because they ensure that all least-cost emission reduction measures are adopted globally. The authors suggest that this may be preferable from a global welfare perspective.

Winchester et al. (2011) find that a BCA results in minimal reduction in total emissions and significantly reduces global welfare. Kuik and Hofkes (2010) find that while BCAs have some success in reducing leakage in certain sectors, the overall reduction is modest — from 11% leakage without a BCA to between 8% and 10% with a BCA. Monjon and Quirion (2011) use a partial-equilibrium model, CASE II, to evaluate the impacts on four energy-intensive industries by various hypothetical BCA schemes for the EU ETS. When the BCA emissions benchmarks are based on best available technologies, carbon leakage is significantly reduced in the cement, aluminum, steel, and electricity sectors.

Aichele and Felbermayr (2011 and 2012) study leakage effects using a derived gravity equation for the carbon content of trade. They find that that Kyoto commitments lead to increased imports of embedded carbon in committed countries, resulting in leakage. Their recent follow-up paper finds that exports of countries that are bound by the Kyoto Protocol are reduced by 13-14% (Aichele and Felbermayr, 2013). Paltsev (2001) also found that high rates of leakage occur in these industries as well as in the mining industry.

Motivated by the acknowledgement that border adjustments are complex to administer and could face possible legal challenges, Elliott et al. (2012) used a CGE model to simulate the effects of several "imperfect" border adjustment mechanisms.[4] Using this model, they simulated imperfect system that results in double the amount of leakage arising from "perfect" border taxes. This result is explained by the fact that foreign producers have less of an incentive to reduce emissions under an imperfect border adjustment mechanism.

BCA Proposals

In January 2010, France proposed an EU-wide border carbon tax on goods. This proposal came out of a broader Environmental Round Table, the *Grenelle de l'Environnement.* Box 1 lists two examples of border carbon adjustments that have at some point been considered.

Concerns around BCAs

Several authors, including Babiker and Rutherford (2005), have argued against the use of BCAs, because they predict that the costs of emissions reductions would be shifted from developed to developing countries via terms-of-trade effects. The UN Framework Convention on Climate Change (UNFCCC), ratified by 194 countries, calls for "common but differentiated responsibilities and respective capabilities" based on a country's level of development. Given this, many authors argue that it may be undesirable to penalise

4. In their study, Elliott et al. (2012) consider that a "perfect" border-adjustment mechanism would require that the importing country determine the emissions from the production of each good produced abroad. Imperfect border adjustment mechanisms are more likely, because knowledge of the particular and constantly changing production processes and energy sources of other countries may not be available. The imperfect BCA mechanisms the authors consider are: (1) "border tax adjustment based on the average emissions from production of a good in the importing country"; (2) "a global system of border tax adjustments where the border tax and the rebate on export are based on a schedule set by a global entity such as the WTO or the UN"; the schedule they model, for each category of goods, is equal to the global average emissions from the production of those goods; and (3) "perfectly calculated border taxes … imposed only on imports without the corresponding rebate on export."

developing countries via trade mechanisms. Eckersley (2010) takes this view, arguing that penalizing developing nations through BCAs, rather than using payment incentives to regulate, is inherently unfair.

Among many others, Holmes et al. (2011), warn that BCAs have the potential to be used as a cover for protectionist measures. Taxes at the border could be employed to make foreign products more expensive relative to domestic ones, especially if they are coupled with the exemption or grandfathering of emissions from existing domestic firms or the subsidisation of domestic carbon-abatement technologies. India has already announced its intention to challenge at the WTO of any BCA implemented by a developed country (IIFT, 2010). Evenett and Whalley (2009) give an overview of their concerns about "green protectionism," arguing that the use of BCAs by Western policymakers would undermine efforts to get emerging economies to make binding reduction commitments in emissions.

Box 1. Examples of border carbon adjustments that have at some point been considered

European Union

Criterion 11 of Annex III of the EU Emission Trading System (ETS) Directive states that the national allocation plans (NAPs) "may contain information on the manner in which the existence of competition from countries or entities outside the Union will be taken into account." In the first stage of the implementation of the ETS, however, no Member State took advantage of this criterion. The 2009 revision to the ETS (Directive 2009/29/EC) added new provisions to address the problem of carbon leakage. In addition to allowing the free allocation of permits to sectors that were particularly vulnerable to leakage, the Directive also states that "by 30 June 2010, the Commission shall … submit to the European Parliament and to the Council … any appropriate proposals, which may include … inclusion in the Community scheme of importers of products which are produced by the sectors or subsectors [at risk for carbon leakage]". While this provision explicitly opens the door for border adjustment mechanisms for imports, it also goes on to add that: Any action taken would need to be in conformity with the principles of the United Nations Framework Convention on Climate Change (UNFCCC), in particular the principle of common but differentiated responsibilities and respective capabilities, taking into account the particular situation of least-developed countries (LDCs). It would also need to be in conformity with the international obligations of the Community, including the obligations under the WTO agreement. (Recital 25) Despite these provisions, no "carbon equalization system[s]" have been proposed. EU Member States have instead tackled possible competitiveness loss of EU industries by granting free allowances to energy-intensive industries.

United States

The American Clean Energy and Security Act (ACES), also known as the Waxman-Markey bill, was passed by the House of Representatives in 2009 but eventually died in the Senate. It aimed to establish an emissions trading scheme similar to the EU-ETS. The bill provided that, if no international agreement on climate change had been reached by 1 January 2018, the President would be required to establish a border adjustment mechanism. This mechanism would have involved requiring importers to obtain emissions credits from an "international reserve allowance program". The details of how to calculate emissions embodied in various imports were not addressed in the bill.

The Waxman-Markey bill held that these border adjustments would only apply to imports originating from certain countries. Countries that had imposed economy-wide restrictions on carbon emissions that were "at least as stringent" as those in the United States would be exempted, in addition to those that had signed a bilateral agreement with the United States with respect to the carbon emissions of specific sectors. The least developed counties (LDCs) and those countries who are responsible for less than 0.5% of total GHG emissions and less than 5% of US imports in relevant sectors would also have been exempted (van Asselt and Brewer, 2010; Monjon and Quirion, 2010).

More problematic is the potential for developing countries to retaliate against BCAs in ways that circumvent the Dispute Settlement Body, as for instance China has pledged to do in response to BCAs via a "retaliatory regime based on per capita emissions" (Groser, 2009). In 2009 Groser, while New Zealand's Associate Minister of Climate Change issues, called for a moratorium on unilateral border carbon adjustments, which he claimed were likely to spark a trade war (Deuchrass, 2009). According to Bartels (2012) China may have used some trade-linked retaliations in response to the inclusion of aviation in the EU ETS.

There are several criticisms of the various approaches to combating losses of competitiveness, whether in the form of free allotments or industry tax relief (Quirion, 2009; Wooders et al., 2009). If polluters are simply paid for the full cost of regulations, then they have no incentive to reduce their emissions. Wood and Etis (2011), in discussing Australia's assistance to vulnerable industries, acknowledge that such assistance may be necessary to protect jobs from going overseas, but argue that the compliance exemptions must be "tightly targeted" because exemptions increase the cost of the emissions-abatement programme to the entire country. Others note that there is a risk that polluters have every incentive to exaggerate the cost of regulation and will be slow to undertake technological innovation (Dröge et al., 2009). Additionally, they point out, it is typically far easier to grant economic support measures than to remove them: governments should therefore be cautious before providing support measures that can be locked in as entitlements.

Design considerations

Beyond the issues of comparability with existing legislation, there are also issues of determining the set of goods and sectors to be covered. First, such a determination involves deciding which goods are at risk. The main argument for a broad coverage of goods and sectors is the potential reduction of leakage, but including more sectors may impose larger transaction costs and additional methodological burden. And it may be the case that, including only a limited number of relevant sectors, e.g. EITE industries, may deliver almost all the potential benefits in terms of reducing leakage, since the value of embodied carbon in EITE products, as a percentage of value added, tends to be relatively high as compared with manufactured products (Cosbey et al., 2012). Second, it involves proper accounting for emissions attributed to traded products.

An additional argument often made against the use of BCAs is their complexity and their potentially high cost of implementation. Most of the existing literature assumes that BCAs would take the form of taxes on GHGs used in the production of a product, levied at the border. A tax would be levied on imports from countries without equivalent domestic climate-change-mitigation regulations. Products exported to these countries could benefit from a tax exemption, or a rebate. While an export rebate would limit the loss of competitiveness to domestic firms, it might actually work against decreasing global GHG emissions because it would weaken the incentive for domestic exporters to make their own production processes less carbon-intensive (Monjon and Quirion, 2010). Pauwelyn (2007) points out that such an adjustment could also take the form of permitting and allowances, pre-approving amounts of carbon in imports rather than taxing at the border. This method might be more desirable for countries that employ cap-and-trade mechanisms at home because it would allow for easier integration into their domestic systems. Monjon and Quirion (2010) note that, "given the volatility of the EU allowances price, determining the appropriate tax level applied to importers would be delicate".

Evaluating the amount of emissions attributed to the product

Presumably, the issue of calculating the amount of emissions imputed to exports produced within a country would have already been resolved under the domestic carbon tax or cap-and-trade system. EU production installations, for example, have an obligation to monitor and declare their emissions. Trouble arises when determining the carbon intensity of imports coming from foreign installations that do not monitor, and may not already know, their GHG emissions. One option that has been proposed would be to impose the same monitoring and reporting requirements on importers. Pauwelyn (2009) asserts that WTO rules would favour a carbon assessment and tax on a "product-specific" basis, "allowing an importer to demonstrate the actual carbon footprint of a specific batch of imports." The downsides of such an approach are obvious. For one, the administrative burden of monitoring and reporting could be quite high for the exporting country. In addition, certifying the accuracy of the data would be a monumental undertaking, requiring much international co-ordination and bureaucracy. There is also the potential for disputes if the parties could not agree on the appropriate measurement method, as is in the case of current disagreements over the life-cycle carbon emissions of biofuels (Laborde and Msangi, 2011; WTO, 2013).

An alternative option that has been proposed would be to use an industry-wide average emission baseline from the origin country and apply it to each product (Monjon and Quirion, 2011). Again, this could entail high administrative costs, and the exporting country might not co-operate fully. A further disadvantage of this approach is that it discourages individual producers from cutting emissions because its import tax would be determined by the industry average regardless of its efforts (Cosbey et al., 2012). Pauwelyn (2009) argues, conversely, that this approach could encourage foreign governments to enact sectorally focused emission-reduction regulations. Such an approach, however, does not result in an optimal emissions-reduction strategy.

Godard (2007) and Ismer and Neuhoff (2007) propose that emissions should be based on those characteristics of the best available technology (BAT) being used throughout the world. However, taxing each producer as if it were emitting the same GHG as its cleanest competitor, although it would narrow the price gap between foreign and domestic producers, seems to offer almost no incentive for improvement at all. Indeed, argue Monjon and Quirion (2010), it makes little sense to use aluminium produced from, say, hydropower in Canada as the industry benchmark. There are possible modifications to the BAT standard, such as using "a technology that is commercialized, perhaps by requiring a certain market share" (Ismer and Neuhoff, 2007).

Monjon and Quirion (2011) propose that, instead of a world average BAT, which would be difficult to determine, the BAT standard could be based on the recently defined EU product-specific benchmarks. These benchmarks were established by the European Commission in order to determine the appropriate amount of free allowances in the EU ETS. They are based on a value reflecting the average GHGs emissions performance of the 10% best-performing installations in the European Union. Wiers (2008) discusses several proposals from France; one of which advances the idea that the BCA level could be determined using country-wide metrics rather than carbon content, such as overall GHG emissions per capita or per unit of GDP.

Calculating the equivalency of carbon-reduction policies

Most proposals assume that BCAs would only be levelled on those countries that were deemed to have an insufficient domestic climate-change policy of their own, or

which were found to be non-acting with international carbon-reduction agreements. However, the core problem, writes Groser (2009), is how to distinguish between acting and non-acting countries. The Kyoto Protocol itself holds that compliance cannot be evaluated until the end of the emissions-reduction commitment period. By what means would domestic policy makers determine, in real-time, the extent to which foreign regulations are limiting emissions in order to evaluate the appropriate level of carbon levy to level on imports? Countries are currently employing a wide range of carbon-reduction policies including energy-efficiency standards and afforestation programmes. Evaluating the equivalency of these programmes against a carbon trading scheme would be a complicated economic feat, leaving ample room for subjectivity.

A BCA scheme that attempted to distinguish among various countries' GHG-mitigation programmes would also be at an increased risk of failing a challenge in the WTO under the most favoured nation (MFN) principle (Godard, 2007; Pauwelyn, 2007). See the Annex to this paper.

Alternative instruments to BCAs

Several widely ranging alternatives (or supplements) to border carbon adjustments have been proposed by both governments and academics. Bhagwati and Mavroidis (2007) discuss the possibility of imposing an import ban or punitive tariffs on imports from countries that do not have sufficient domestic carbon regulations. Stiglitz (2006) has labelled unregulated carbon an implicit subsidy, meaning that products from countries that do not tax or cap their emissions are not bearing the full costs of their production. He thus claims that governments ought to impose anti-dumping or countervailing (anti-subsidy) duties on imports from countries without GHG regulations.

A more institutional approach has been proposed by Mattoo and Subramanian (2013). They suggest that more active participation by the emerging economies in reducing their own emissions and contributing to the international funds that have been established by the developed countries might unblock the current impasse in the climate negotiations. Technology transfers and, when necessary, a modest use of BCA, they argue, could strengthen the co-operation of countries to combat climate change.

Various regulatory standards have been proposed relating to the carbon footprint of imported products (Fischer and Fox, 2009). The biofuel standards employed by the European Union, Switzerland, the United States and the US State of California are current examples of this approach (Moïsé and Steenblik, 2011). In addition to standards for fuels like the ones mentioned above, Moïsé and Steenblik note the existence of product-specific carbon footprint labels and government procurement guidelines for green goods. Holland (2009) argues that emissions-intensity standards are a better method for regulating carbon and can yield higher welfare in the face of "incomplete regulation" or leakage because, under his modelling conditions, the standard led to higher social welfare, defined as the sum of consumer and producer surplus. Wooders et al. (2009) discuss a further method of differentiation: the embedded-carbon standard. Rather than requiring an import payment or permit purchase to be made on the basis of carbon content of the product, these standards would sort goods into two or more categories. Certain categories would then be barred from import altogether.

One way to influence another country's domestic policy is regulatory co-operation that commits participating countries to maintain regulations of comparable stringency. For instance, the United States and Canada have collaborated on the former's most recent auto emissions standards (Paris, 2012). International forums, like the Clean Energy

Ministerial, attempt to co-ordinate otherwise unilateral regulatory efforts among interested governments. Sixteen countries currently work together on appliance and electronic standards through the forum (Clean Energy Ministerial, 2012). However, apart from lowering the cost of command-and-control regulations by allowing for compliance economies of scale, these co-ordinated efforts do not offer much more additional incentive to enact comparable regulations. In some cases they may give rise to the standard free-riding problem.

Australia has recently implemented a carbon tax for the 500 largest emitters (excluding the agricultural sector), which will be replaced by an emissions trading scheme on 1 July 2015. Under the plan, AUD 8.6 billion is to be allocated over the first three years of the tax for industry assistance. After the permitting system is in place, the most exposed industries, such as steel, aluminum, zinc, and paper makers will get free permits representing 94.5% of industry average carbon costs (Australian Government, 2013). In addition to the AUD 8.6 billion of assistance provided through Australia's *Jobs and Competitiveness Program*, the federal government is also granting additional subsidies for clean-tech investments in manufacturing (AUD 1.2 billion), the steel industry (AUD 300 million), and the coal sector (AUD 1.3 billion).

One alternative that has garnered increasing attention in the BCA debate is that of an export tax or VAT rebate on carbon-intensive goods from countries that otherwise lack GHG regulation (Babiker and Rutherford, 2005; Copeland, 2012). Since the 1990s, China has placed export taxes on certain goods in order to limit the export of strategic resources. In 2007 and 2008 these taxes were substantially increased on metals, chemical products, fertilisers, coal, steel, and aluminium. At the same time, the standard value-added tax (VAT) rebate was reduced on certain polluting products. Dröge (2009) investigates the effects on exports from these policies and concludes that they had a significant trade-reducing effect. Monjon and Quirion (2011) evaluated the efficiency of various border adjustment designs in limiting carbon leakage. They examined four sectors, cement, aluminium, steel, and electricity within the EU ETS, and concluded that a full border adjustment, including both exports and imports, was the most economically efficient and reduced total global emissions.

Voituriez and Wang (2009) claim that measures targeting GHG-intensive industries can be re-interpreted as an indirect carbon-pricing system. They converted these border-adjustment measures into carbon-based rates for export tariffs in 2006-08 and found that the calculated carbon price varied widely depending on the industry. They found also that, for high-value products, like steel and aluminium, the carbon price equivalent was similar to what was found in the EU-ETS at the time. However, for products like cement and clinker, CO_2 was being underpriced. From this discrepancy, Dröge (2009) concludes that China's export-tax policy is far from equivalent to the carbon regulation measures present in the European Union.

Babiker and Rutherford (2005) performed a comparative analysis of various adjustment measures, looking at their effects on terms of trade, comparative advantage, and competitiveness. Import tariffs, export rebates, exemption of energy-intensive industries, and voluntary export restraints were each examined. Exemptions were found to produce the least net carbon leakage, but resulted in a much higher price of carbon compared with the other analysed instruments. Import tariffs (akin to BCAs) were found to be the most welfare-maximising policy. Fischer and Fox (2009) compare several anti-leakage policies, including a tax on imports, a border rebate for exports, and full border adjustment (a combination of the two). They find that all three policies raise domestic

output and reduce foreign output compared with a world with no adjustment mechanism. However, they could draw no conclusions about the overall response of global emissions because it is dependent on "relative elasticities of substitution, size, and emissions rates".

A more radical and longer-term approach, proposed by Horn and Mavroidis (2011), is to handle the question of carbon adjustment and associated reduced trade flows at the level of trade negotiations themselves. They argue that, especially if a BCA scheme is broadly applied, rather than targeted at specific sectors, one should expect "the imposition of BTAs to affect trade negotiations, and negotiated trade agreements to affect the use of BTAs." With this in mind, they argue that the product classification system used in trade negotiations, the World Custom Organization's Harmonized Commodity Description and Coding System (HS), needs to be modified in order to account for distinctions based on the environmental properties of how (imported) products are produced and processed. This, they argue, would allow for these processes to be accounted for in the tariff schedules of importing countries.

Several authors maintain that export duties or VAT refund reduction policies ought to be considered as tools for integrating developing countries into a post-Kyoto global carbon-reduction scheme (Muller and Sharma, 2005). Wei et al. (2011) analyse various recent BCA proposals from the European Union and the United States, and find that they would affect only 6% of the total exports coming from China. They doubt the effectiveness of unilateral BCAs alone to incentivise Chinese CO_2 emission reductions. Wang et al. (2010) argue that export taxation should be utilised as a transitional step toward more comprehensive domestic carbon regulation in China.

Muller and Sharma (2005) and Copeland (2012) both point to the 1996 US-Canadian Softwood Lumber Agreement as a success story of voluntary export restraints that could be applied to the BCA context. The dispute arose when the United States claimed that Canada was unfairly subsidising its lumber industry. Following the negotiations between the two parties, Canada agreed to impose substantial duties on its lumber exports to the United States rather than having the United States applying import duties. Kinnucan and Zhang (2004) showed that, from Canada's perspective, an export limit was clearly preferable because an "import duty harms Canada's producers, with no offset to the Canadian treasury or overall economy." Export duties, however, extract rent from foreign consumers.

Yet another trade-related measure that has been discussed is the co-ordinated lowering of tariffs for low-carbon intensive products among all WTO Members. The Doha Round was mandated to lower barriers to trade on environmental goods attempted to create such a list of "green products" but has so far been unable to reach consensus (Balineau and de Melo, 2011).

Annex

WTO Compatibility

Much has been written on the topic of whether various proposed BCA designs could be designed in a way that conform to WTO rules. Article 3, Para 5 of UNFCCC Convention explicitly states that measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade. This section seeks to summarize some key opinions of legal scholars rather than provide an exhaustive discussion. Lengthy reviews on the topic have been produced by Pauwelyn (2009 and 2013), Brewer (2008), Ashiabor (2006), Low et al. (2011), and de Cendra (2006). Hufbauer and Kim (2009) and Cosbey (2009) are just a few more of the authors that, while not drawing conclusions on legality aspects, consider that measures that attempt to correct for carbon leakage, such as BCAs, are likely to be challenged by WTO members with export-oriented economies and relatively lax carbon regulation.

A WTO member may not unilaterally determine that a certain measure is illegal. Instead, a member may contest another member's domestic measures as a violation of WTO law by bringing a challenge to the Dispute Settlement Body (DSB). Following consultations, and at the request of the complaining Member, the DSB establishes a panel of experts to adjudicate the merits of the case. If a panel were to find that a BCA measure was indeed a violation of WTO law and this finding was not successfully appealed to the Appellate Body, the country in violation would have to bring the measure into conformity with its WTO obligations, for example, by changing its legislation. If the losing party does not bring the measure into conformity within a reasonable period of time, then the challenger may seek compensation, often in the form of tariff reductions or the lifting of import quotas. If the two parties are unable to reach an agreement on the appropriate level of compensation, the winning party may seek authorization from the DSB to suspend trade concessions or other WTO obligations against the member in violation pending removal of the WTO inconsistent domestic measure or the agreement of a mutually satisfactory solution between the parties.

A threshold issue when considering the WTO legality of adjustment schemes in the form of a monetary charge at the border is to determine whether or not the measures at issue can truly be considered taxes (Cosbey et al., 2012). If the measures are held not to be taxes in fact, but rather something more akin to import duties, then the measures could be in violation of Article II of the General Agreement on Tariffs and Trade (GATT) to the extent that they exceed a WTO member's tariff bindings (Wiers, 2008). For *tax* adjustments on imports there are two relevant principles established under the GATT that must be adhered to. The first, under Article III of the GATT, is the national treatment obligation, which requires that imported goods be treated no less favourably than "like" domestic products. Article I of the GATT establishes the second principle, "most-favoured-nation treatment". This holds that a border tax must not discriminate among imports from different WTO member economies.

The term "like product," is not defined anywhere in the text of the GATT and its ambiguity has given rise to several important WTO cases over the years. Its interpretation may differ depending on the provision the terms are used. In 1970, the GATT Working Party on Border Tax Adjustments reported suggestions from the Contracting Parties regarding the relevant factors in evaluating, on a case-by-case basis, whether two products were like or not. Those factors included "the product's end uses in a given market; consumers' tastes and habits, which change from country to country; [and] the product's properties, nature and quality" (GATT, 1970). In *EC-Asbestos* the WTO's Appellate Body (AB) implied that likeness under Article III:4 of GATT is determined by, among other factors, the competitive relationship between imported and domestic products: a determination of "likeness" under Article III:4 is, fundamentally, a determination about the nature and extent of a competitive relationship between and among products. This case implies that it may matter if one can prove that consumers have a significant preference for goods produced in a less carbon-intensive fashion. However, some authors argue that market studies most often will show that consumers generally ignore the processes and production methods (PPMs) of products (Low et al., 2011).

In 1987 a GATT panel determined that the United States was allowed to impose an import tax "on certain imported substances produced or manufactured from taxable feedstock chemicals" so long as the tax also applied to domestic products in the same manner (1987). Pauwelyn (2013) points out that importantly, in this *US-Superfund* case, the panel did not explicitly require that the chemicals be physically present in the product at the time it entered the domestic market. A similar tax on ozone-depleting chemicals used in production processes was never challenged at the WTO (Bierman and Brohm, 2005). More recent WTO cases have considered whether to take PPMs into account in likeness determinations and may also be relevant to this question. For example, in US-Tuna II the Panel found that Mexican tuna products were "like" US tuna products despite them being caught in a different manner and perhaps as a result perceived differently by consumers. The United States did not appeal these findings.[5] The panel did not exclude the possibility that PPMs could be relevant to the determination of likeness in other circumstances (see para 7.249). This may mean that the WTO might allow for differences in product "likeness" even if they are physically identical at the time of import. Production processes, i.e. whether or not the product was produced using renewable energy, might be accepted as something that may be taken into account when determining likeness.

Whether or not production processes may be taken into account to determine product likeness is crucial for BCA measures. Under some proposed schemes, cement made in China using power generated by coal-fired plants would be subject to a higher tax burden, than, for example, cement produced domestically using natural gas. So, while a certain regulation on its face could seem neutral with respect to national origin, as applied it could still systematically tax imports from a particular country more heavily. While the WTO distinguishes between *de facto* and *de jure* discrimination, both are illegal unless justified (Pauwelyn, 2013).

Practical problems on how to evaluate carbon emissions embodied in imports also have a bearing on the discussion of WTO legality. How are border officials to determine

5. See Panel Report para 7.251 and AB report para 230. This finding relates to Art 2.1 of the TBT Agreement.

if imported steel was made with power from a coal plant or a hydropower plant? The method employed in the *US-Superfund* case was to ask for voluntary disclosures from foreign manufacturers. If the importer failed to comply with the reporting standards, then it was assumed that the production had used the same amount of chemicals as it would have had it been produced using the "predominant method of production" in the United States (Pauwelyn, 2013). Another WTO case that may also be relevant is *US-Gasoline*, in which the Panel found that the measure treated imported gasoline "less favourably" than domestic gasoline, in violation of Art. III: 4, as imported gasoline effectively experienced less favourable sales conditions than those afforded to domestic gasoline. In particular, under the regulation, importers had to adapt to an average standard, i.e. a "statutory baseline" that had no connection to the particular gasoline imported, while refiners of domestic gasoline had only to meet a standard linked to their own product in 1990, i.e. an individual refinery baseline. The system has obvious drawbacks in the carbon-reduction context. As discussed above, there would be little incentive for Indian exporters to switch to cleaner technology if they are being taxed according to methods used in the United States. The alternative, using the predominant method of production in the *foreign* market, would likely raise allegations of *de facto* discrimination based on national origin (Pauwelyn, 2013).

Environmental exception under Article XX

Countries wishing to defend their BCA schemes in the WTO could seek to justify their measure under Article XX. There are two provisions that could potentially offer a safe haven for trade measures that would otherwise violate the GATT. Article XX(b) makes exceptions for measures that are *necessary* to protect human, animal or plant life, or health. Article XX(g) allows exceptions for trade measures that are *related to* the conservation of exhaustible natural resources and are made effective in conjunction with restrictions on domestic production or consumption. The environmental objectives sought by the implementing country must be "important and legitimate in character" (*US-Shrimp*) and must also fulfil the conditions in the chapeau of Article XX.

"Necessary" under Article XX

There is no exhaustive single test for determining what qualifies as "necessary" under GATT Article XX (a), (b) and (d). In *Korea–Various Measures on Beef*, the AB considered that a person assessing necessity could consider the "relative importance of the common interests or values that the law […] is intended to protect," the "contribution of the measure to the realization of the end pursued" and the impact of the measure on trade. It added that "[t]he more vital or important those common interests or values are, the easier it would be to accept as "necessary" a measure designed as an enforcement instrument." Bown and Trachtman (2009) suggest that this decision should be taken to mean that "if a measure contains exceptions or discrimination that cannot be justified by reference to the purpose that formed the basis for provisional justification under one of the paragraphs of Article XX, then it will fail the test of the chapeau." In *Brazil-Tyres* the AB employed what Bown and Trachtman characterise as a "suitability test"[6] to determine whether the measure was apt to make a "material contribution" to achieve the relevant objective. The suggest that this decision should be taken to mean that "if a measure

6. Bown and Trachtman (2009, p. 3) define a suitability test as a " 'simple means-ends rationality test' [that] asks simply whether the national measure seems reasonably designed to achieve the purported legitimate goal."

contains exceptions or discrimination that cannot be justified by reference to the purpose that formed the basis for provisional justification under one of the paragraphs of Article XX, then it will fail the test of the chapeau."

US-Gambling established that the burden for proving that a measure falls under an Article XX exception first falls on the party invoking the defense. Once a *prima facie* case of necessity has been established, the burden then shifts to the complaining party to show that a less-trade-restrictive option is available. If the complainant is able to show that there are other options available to achieve the same means, then the burden shifts once again to the defending party to demonstrate that this proposed option is not reasonably available (Mavroidis et al., 2010). This means that a party asserting the illegality of a BCA against an Article XX defense would have to prove to a WTO Panel that there were other less-trade-restricting options to combating the carbon-leakage dilemma, or, for example, that the threat of carbon leakage did not justify the associated restrictions on trade.

"Relating to" under Article XX(g)

Article XX(g) allows for exceptions "relating to the conservation of exhaustible natural resources." There has been some debate as to what can and cannot fall under the "natural resources" category. The DSB panel found in *US-Gasoline* that clean air could be "depleted" by pollutants, and thus the regulation of pollutant emitting gasoline combustion was justifiable under this exception. Wiers (2008) extends this finding, arguing that "air not 'depleted' by excessive greenhouse gas concentration caused by human-induced CO_2 emissions may also qualify as an exhaustible natural resource." The loss of biodiversity due to climate change may also qualify as an exhaustible natural resource (Wiers, 2008).

The legal test for compliance as regards the "relating to" requirement has evolved over many AB decisions (Mavroidis and Horn, 2010). In *US-Shrimp*, the United States had banned shrimp imports that had been fished in a manner that lead to the accidental death of sea turtles. The AB reversed a panel decision that had required a territorial nexus between the protected natural resources and the WTO Member implementing the trade measure. "Horn and Mavroidis (2010) have argued that the AB, in its report on *US-Shrimp*, held that the phrase "relating to" implies a rational connection between a measure and the conservation of exhaustible natural resources. The import ban on shrimp in this case was "narrowly focused," "not disproportionately wide in its scope and reach in relation to the policy objective." Crucially, the means employed by the measure was closely related to the end of conserving an exhaustible natural resource (WTO, 1997; 1998).

Wiers (2008) highlights this decision and argues that for any proposed BCA measure to fall under an Article XX(g) exception, it must be found to contribute to its stated goal of reducing the impacts of climate change. The main purpose of the BCA must be defined for its impact in reducing global emissions rather than for its role in reducing competitiveness concerns for domestic industry. For this same reason, several authors have argued that a BCA that rebates the cost of a carbon tax on exports headed to countries without climate regulation would not pass the XX(g) "smell test" (Ruiz-Fabri and Reynier, 2010). Ismer and Neuhoff (2007) argue, to the contrary, that a "symmetry argument" could be made in order to justify an export rebate. They propose that a Panel might agree with a nation that argues its BCA tax on imports could not exist without a matching rebate on exports that further "level the playing field."

Chapeau

These exception provisions must be interpreted alongside the *Chapeau* of Article XX, which additionally requires that measure hold up to two standards. The first holds that the excepted trade measure must not be "applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail." Pauwelyn (2013) applies this to the BTA context by arguing that the implementing nation would still have to justify that its adjustment scheme is applied in such a way that it takes into account "the situation and history of each exporting nation, e.g. do they have an adequate climate change policy of their own, [and] what is their level of development" (Pauwelyn, 2012). The second standard from the *Chapeau* is that the measure must not be a "disguised restriction on international trade." Low et al. (2011) report that this part of the test considers how it is applied rather than considering its objectives. The measure must be implemented in good faith and in a reasonable and consistent manner.

Wiers (2008) expects that this good-faith standard would require that the implementing country demonstrate its serious efforts to "seek international agreement on climate change before enacting a carbon tax."[7] In the context of an agreement like the Kyoto Protocol, which sets emissions-reduction targets for certain dates, it will only be clear whether parties have met their goals at the end of the evaluation period. Would it be considered arbitrary or unjustified discrimination, or otherwise disguised restrictions on trade to levy a carbon tax against certain countries and not others during this period, when those in compliance have yet to be determined?

Carbon credit considerations

If, instead of a tax, the border adjustment measure took the form of an obligation for importers to buy carbon credits, other parts of the GATT might apply in addition. Article XI of the GATT (General Elimination of Quantitative Restrictions) prohibits import restrictions "other than duties, taxes or other charges", for example import restrictions such as quotas and licenses, from being imposed at the border on products from other countries."[8] On the other hand, Monjon and Quirion (2011) argue that an obligation to buy allowances would be *more* in line with WTO rules than one based on a tax because the pure environmental purpose might be easier to prove.

7 The Appellate Body's (AB) findings on the US-Shrimp dispute looked at the question of good faith in relation to international efforts to address the environmental objective at issue (turtle conservation) in the context of the chapeau reference to 'unjustifiable discrimination'. (See paragraph 168 of the AB report, WT/DS58/AB/RW of 22 October 2001.)

8 However, it is unlikely that a country would impose a requirement to buy credits only on imported goods (which for administrative reasons it might make sense to apply the measure at the border). Rather, it would likely apply equivalent climate-change measures also to domestic goods as part of a broader regulatory scheme. In that case, the first paragraph of Annex I, Ad Article III, would apply: "Any internal tax or other internal charge, or any law, regulation or requirement of the kind referred to in paragraph 1 [of Ad Article III] which applies to an imported product and to the like domestic product and is collected or enforced in the case of the imported product at the time or point of importation, is nevertheless to be regarded as an internal tax or other internal charge, or a law, regulation or requirement of the kind referred to in paragraph 1, and is accordingly subject to the provisions of Article III."

WTO law in the broader context

Several authors have advanced the arguments that nations contemplating border adjustment schemes to combat global warming simply should not be concerned about violating WTO law. Brewster (2010) argues that a multilateral carbon tariff imposed by the world's largest importing economies would be nearly as good as a comprehensive carbon-reduction agreement, pointing out that the European Union and the United States together consume approximately 40% of the world's total exports. The WTO can only authorize retaliatory trade measures.

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