

Thinking Ahead on International Trade (TAIT) – 2nd Conference
Climate Change, Trade and Competitiveness: Issues for the WTO

Climate Change and International Trade: Lessons on their Linkage from International Environmental Agreements¹

Scott Barrett²

Thinking Ahead on International Trade (TAIT)

The Thinking Ahead on International Trade (TAIT) programme, run by the Centre for Trade and Economic Integration (CTEI) at the Graduate Institute, Geneva, is a 4-year research programme devoted to the analyses of medium-term challenges facing the international trade system in general and the WTO in particular. www.graduateinstitute.ch/ctei

¹ This is a background paper written for Round Table 6 on **Lessons from other International Environmental Agreements**, at the business-government-academic conference **Climate Change, Trade and Competitiveness: Issues for the WTO**. The conference is organised by the (CTEI) as part of its TAIT programme, in collaboration with the Economic Research and Statistics Division of the Secretariat of the World Trade Organization and The World Bank, and held at the headquarters of the World Trade Organization on 16th, 17th and 18th June, 2010.

² Columbia University

1. Introduction

Climate Change mitigation and international trade are collective action challenges. In the case of climate change, international agreement is needed to internalize the externality caused by greenhouse gas emissions. In the case of international trade, international agreement is needed to internalize the terms of trade externality.¹

But here the similarity stops, for climate change mitigation and trade liberalization are *different* collective action challenges. Climate change mitigation is a global public good. International trade is a bilateral activity. Because the challenges are different, the agreements seeking to address them must be designed differently.

The agreements of World Trade Organization have been relatively successful in reducing trade barriers. This is largely because, as trade is a bilateral activity, trade agreements can be enforced by a strategy of reciprocity. Through rebalancing, punishments for deviating from the trade rules can be targeted to harm the countries that violate the rules without injuring innocent countries. By contrast, for a global public good like climate change mitigation, reciprocity is a very weak tool for enforcement. If countries reduce their own abatement efforts to punish a country for not cooperating, they harm themselves in the process. This limits their incentive to punish; and because the incentive to punish is weak, the ability of an agreement to sustain substantial emission cuts is compromised.

We can get a better sense of the difficulty by looking into the way in which the parties to the Kyoto Protocol thought they could enforce that agreement.² Kyoto's basic architecture was agreed in late 1997. However, an enforcement mechanism was not agreed until 2001 and remains non-binding today.³

Even if the mechanism were binding, it would have no effect. The main component of the mechanism is a 30 percent penalty. A country that emits, say, 100 tons more than the treaty allows in the first "commitment period" (2008-2012) must make up for this by reducing its emissions by an additional 130 tons in the next period. This reduction is "additional" relative to this country's next-period cap. This cap, however, is subject to the approval of the country having to pay the penalty. Hence, the country that failed to comply in the first commitment period can insist on a generous cap as a condition for participating in the next commitment period, and so get away with paying a "phantom" penalty. Alternatively, this country could ratify

¹ See Bagwell and Staiger (2003). There are, of course, other theories that explain the need for trade agreements.

² See Barrett (2005) and (2008).

³ According to Article 18 of the Kyoto Protocol, any compliance mechanism "entailing binding consequences" must be approved by amendment. An amendment is akin to a new agreement. It would only be binding on the parties that ratified it, provided three-quarters or more of the parties to the Kyoto Protocol also ratified it. While an enforcement mechanism was agreed in 2001, an amendment to make it binding was never adopted. The mechanism agreed in 2001 is thus non-binding.

the new treaty and then fail to comply again—the current arrangement essentially carries forward the penalty indefinitely. The problem is that the punishments must be self-inflicted. This is to be contrasted with the WTO enforcement mechanism described previously. The WTO compliance mechanism works by enabling an injured party to impose rebalancing tariffs against a party found to have violated the rules. The injured party can choose its punishment so that causes maximal harm to the target country and little or no harm to itself and third parties.

Kyoto offers one more weapon for enforcement. It permits other parties to the Kyoto Protocol to suspend the emissions trading privileges of a country found to be in non-compliance. Would other countries impose this punishment? There is reason to believe they would not, at least in some important cases (Kallbekken and Hovi 2007). If a large seller of permits were in non-compliance, withdrawal of its trading privileges would push up international permit prices, harming net importers; the latter countries may therefore be unwilling to impose the punishment. If a large buyer of permits were punished in this same way, international permit prices would fall, harming net exporters; *these* countries may therefore also be unwilling to impose the punishment. In short, the threat to punish may not be credible. Of course, in each of the cases I just mentioned, some countries would gain by imposing the punishments (net exporters in the first instance, net importers in the second). But with some countries gaining and some losing, activation of the sanction could spark conflict among the countries that had complied with the agreement.⁴ This is in contrast to the WTO punishment mentioned previously in which the retaliatory trade restriction harms only the target country.

It is also important to stress that this punishment mechanism described above applies only to compliance. It does not extend to participation. A country may withdraw from the WTO, and so no longer be bound by its rules. But such a party would also lose the benefits of being a party to the WTO. By contrast, a country that withdraws from Kyoto, or that fails to accede in the first place, would still benefit from the mitigation achieved by the agreement.

Given these failings, it is natural for the parties to a climate agreement to want to look elsewhere for a possible means of enforcement. If trade measures can enforce trade agreements, why not use trade measures to enforce climate agreements?

Strengthening but also complicating this possibility is the fact that international trade and climate change mitigation are already linked. That is, they are linked automatically. Efforts to reduce emissions will alter market prices of traded goods, causing comparative advantage in the greenhouse-gas-intensive industries to shift towards other countries. Such efforts will also lower the market prices of traded fossil fuels, leading other countries to increase their consumption of these fuels.

⁴ The Euro's Stability and Growth Pact had a similar design, and collapsed when put to the test; see the afterword to Barrett (2005).

Both effects will increase the emissions of countries that are not limiting their emissions—a phenomenon known as “leakage.”

Because of leakage, free trade is generally taken to be injurious to unilateral and multilateral efforts to reduce emissions. However, trade liberalization can also play a supportive role, by helping to diffuse new energy technologies. Indeed, this kind of leakage can be negative.

There are thus two different rationales for linking climate policy and trade policy. The first is to discourage free riding. The second is to reduce, neutralize, or even make negative the leakage rate.

Linking climate and trade policy holds the promise of improving the prospects for mitigating climate change. But it also poses a risk to the trade system. Depending on how the linkage is done, the world could be made better off or worse off. Either way, the stakes are great.

The world faced a similar challenge before, when seeking to protect the ozone layer. In this case, linkage of trade and environmental policy was a spectacular success. The ozone layer was protected, and trade was not restricted.

In this paper, I shall tell the story of how this was done, and why this favorable outcome emerged. I shall also explain that the same approach cannot be adopted to address climate change.

2. How related concerns were addressed by the Montreal Protocol

The Montreal Protocol was negotiated and subsequently developed to supply a global public good—protection of the stratospheric ozone layer. The Kyoto Protocol was intended to supply another global public good—climate change mitigation. But whereas Montreal was extended and strengthened over time, Kyoto’s future is precarious. It ends in 2012. A successor agreement was to be negotiated in Copenhagen in December 2009, but those talks did not advance the process. The Copenhagen Accord is not a treaty, and it does not address the fundamental weaknesses in the Kyoto Protocol. So far, the world’s climate regime has failed to take a form that countries can expect will persist. Montreal created certainty, and so stimulated investment and transformation. The climate regime, so far, has been unable to replicate that success.

2.1 Design of the agreement

Although my focus in this paper is on the trade restrictions in the Montreal Protocol, these were not “tacked on,” as it were, to a treaty seeking to supply a global public good. They formed an integral part of the agreement. To understand why the trade restrictions were incorporated in the agreement, it is thus essential to understand

other features of this treaty's design. Three features are especially important, and I discuss these below.

2.1.1 Limits on production and consumption

Unlike Kyoto, Montreal does not limit emissions directly. Instead, it limits the production and consumption of ODSs (ozone depleting substances; Montreal also incorporates provisions for the destruction of ODSs). Montreal defines consumption as production plus imports minus exports. Montreal's most basic obligations thus relate directly to trade.

Why did Montreal limit the production and consumption of ODSs rather than, say, production alone or the emission of ODSs? As explained by Richard Benedick (1998: 80-81), the chief U.S. negotiator of the treaty, the reason was concern about expected effects on "competitiveness." If consumption, and not production, were reduced, the U.S. market would shrink, and U.S. manufacturers would likely respond by increasing their exports, taking business away from European manufacturers. European negotiators thus "pushed hard for the production concept" (Benedick 1998: 79). Limits on production only, however, would "essentially lock in the Europeans' foreign markets," giving Europe "a monopoly reinforced by treaty obligations" (Benedick 1998: 80). This was a concern of importing states. The U.S., on the other hand, was worried that a limit on production only might make importing countries less inclined to participate in the treaty, so as to keep open the option of developing their own production capability, to substitute for the loss of European product. In the end, a compromise was agreed: the treaty would reduce both production and consumption.

A related concern was whether consumption should be calculated by deducting exports to non-parties. European industry objected to this proposal. The U.S., however, believed that this provision was essential to create "an added incentive for importing countries to join the protocol." Here again a compromise was negotiated. Article 3 says that exports to non-parties can only be deducted from consumption only through 1992. After that, exports to non-parties could not be deducted from consumption, reducing the incentive for parties to serve these markets.

2.1.2 Amendments and adjustments

Trade restrictions applying to these basic obligations are incorporated in Article 4. Appendix 1 to this paper contains the original article. It also includes the changes adopted subsequently in four amendments.

The amendments are binding on all the countries that ratify them. Countries that ratify Montreal after the amendments enter into force are also bound by these amendments. Not every country that is a party to the Montreal Protocol is a party to every amendment (see Appendix 2). A country that is a party to the Montreal Protocol but that has not ratified the Beijing Amendment, for example, would be

considered a non-party to the Beijing agreement. Such a country would therefore be subject to trade restrictions in bromochloromethane, which is controlled under Beijing but not under the Montreal Protocol. To avoid the trade restrictions pertaining to a particular ODS, a country must consent to be bound by the production and consumption restrictions applying to that ODS.

Montreal has also been “adjusted” many times. Unlike amendments, adjustments are binding on all parties to the agreement being adjusted, provided the adjustments are approved by a two-thirds majority of these parties, representing at least 50 percent of global consumption of the relevant ODSs. Adjustments tighten up on the controls that were agreed previously. Amendments extend the treaty in more fundamental ways. The trade restrictions embodied in the Montreal Protocol apply to the adjustments and amendments alike.

All of the ozone treaties, including the adjustments and amendments, together with the number of parties to each agreement, are summarized in Appendix 2. A reading of Appendix 1 shows that the trade restrictions incorporated in the original agreement were extended and strengthened over time. Appendix 2 shows that the obligations of the treaty were also extended and strengthened over time. All these changes were developed in lock step.

2.1.3 Financial assistance

The original Montreal Protocol, unlike Kyoto, established obligations for all countries, rich and poor alike. These were differentiated but reflected countries’ common responsibilities. And, yet, the incentives for developing countries not to participate, even given the prospect of trade restrictions, were powerful. There was a risk that the trade restrictions in Montreal might divide rather than unite the world. As Richard Benedick (1998: 151) explains:

“...CFC technology was inexpensive and uncomplicated; plants could be small in scale and rapidly constructed and could achieve a relatively fast payback. Therefore, some developing nations could be tempted to build their own CFC facilities if the only alternative was to purchase more-expensive substitute technology or products from Europe, Japan, or the United States. The treaty’s trade restrictions became irrelevant against the sheer size of potential domestic markets in some countries. Furthermore, to the extent that populous nations stayed outside the protocol and were therefore not bound by the trade restrictions, new producers in developing countries might try to supply CFCs and CFC products to Africa, Asia, and Latin America even as industrialized-country manufacturers were phasing down.”

Essentially, developed countries recognized that, to induce developing countries to participate, they would need to offer more than differentiated obligations and the stick of trade restrictions. They would also need to offer the carrot of financial and technical assistance.

This is why the London amendment incorporates a financial mechanism in which developed countries agree to pay the “incremental costs” of compliance by Article 5 countries (developing countries whose annual consumption of controlled substances is less than 0.3 kilograms per capita). Rather remarkably, funding for Montreal has been effective. In the latest report on the Montreal Fund, pledged contributions from 1991-2009 total \$2,547,708,280, while actual contributions sum to \$2,562,622,684.ⁱ By any standard, this is an impressive outcome.

These payments were important not only in creating a positive incentive for developing countries to accede to the agreement, but also in making the obligations of the treaty, including the trade restrictions, seem fair and therefore legitimate.

2.1.4 The trade restrictions

The trade restrictions in these agreements are easily summarized. They require that parties⁵

1. ban imports of controlled substances from non-parties (this ban took effect within one year of the treaty entering into force);
2. ban exports of controlled substances to non-parties (this ban took effect in 1993; see below);
3. draw up a list of products *containing* controlled substances and (for the countries that do not object to the list) ban imports of those products from non-parties (exports by parties to non-parties were *not* banned);
4. determine the feasibility of banning or restricting the import of products *produced with, but not containing*, controlled substances from non-parties (such as electronics circuitry cleaned with CFC-113);
5. discourage the export to non-parties of technology for producing and utilizing controlled substances; and
6. refrain from providing “new subsidies, aid, credits, guarantees or insurance programmes” for the export to non-parties of products, equipment, plants or technology that would facilitate the production of controlled substances.

The process of deciding where and how to apply trade restrictions was highly managed. The original export ban was restricted to developing country parties. As explained previously, developed country parties were constrained only by having to count exports to non-parties against their consumption limits. However, the amendments passed subsequently prohibited exports to non-parties by *all* parties (see the amendments in Annex A). Similarly, while HCFCs (a “transitional” group of

⁵ For completeness, let me mention two other aspects of Article 4. The first is that the restrictions do not apply to technologies that can recycle controlled substances. The second is that the restrictions would not be applied to non-parties that fulfill the obligations of the treaty. This last provision was a way to deal with a country like Taiwan, which due to its unusual status could not become a party to the treaty. However, the provision was also applied to other countries, which were able to become parties to the treaty only after a delay; see Andersen and Sarma (2002: 141).

chemicals) were controlled by the Copenhagen Amendment (1992), trade in HCFCs was restricted only by the Beijing Amendment (1999).

A new annex (Annex D) of products containing controlled substances was adopted in 1991. For the substances controlled under the original Montreal Protocol (specifically, Annex A), these included automobile and truck air conditioning units, whether incorporated in vehicles or not, refrigerators, freezers, air conditioning units, aerosols, fire extinguishers, and insulation board.⁶ These restrictions would not apply to parties choosing to object to them, but as a practical matter countries did not object.⁷ The restrictions applied to imports from non-parties, but not exports. Restrictions on imports would reduce leakage. No restrictions were placed on exports of these products, since production and consumption of the bulk substances was already controlled.

If the category of products made using but not containing ODSs were defined very broadly, the range of products involved could potentially include “almost every traded product” (Brack 1996: 48). A trade ban would thus entail a total ban on all trade. The category of products made using ODSs could be defined more narrowly, of course, but according to Duncan Brack (1996), “Even if a more restrictive definition, involving only direct input of ODS, were adopted, the list of products which would need to be drawn up would be very large—and..., given the very small quantities of ODS involved in the production of each product, the costs in lost trade would vastly exceed the benefits to the ozone layer.” He also notes that the Technology and Economic Assessment Panel recommended that trade restrictions *not* be applied to products made with but not containing HCFCs. The decisions to restrict trade under this agreement have thus been based on a very careful consideration of the full consequences, for the environment and for trade.

Interestingly, even in cases where trade was not restricted, the possibility that this decision might be reversed in the future has affected behavior. Since the treaty allows trade to be restricted in goods made with but not containing ODSs, the “players” in this “game” can never be sure that trade in these goods will not be restricted.⁸

2.2 How trade restrictions came to be incorporated in the agreement

How did the trade restrictions come to be incorporated in the agreement? According to the chief U.S. negotiator at the ozone talks, Richard Benedick (1998: 91),

6

http://ozone.unep.org/Publications/MP_Handbook/Section_1.1_The_Montreal_Protocol/Annex_D.shtml.

⁷ Singapore did object originally, but subsequently withdrew its objection; see Brack (1996: 47).

⁸ See Brack (1996: 49).

“At the first session in Geneva in December 1986, the United States offered specific proposals to restrict trade in controlled substances with nonparties. *The objective of such restrictions was to stimulate as many nations as possible to participate in the protocol, by preventing nonparticipating countries from enjoying competitive advantages and by discouraging the movement of CFC production facilities to such countries. These provisions were critical, since they constituted in effect the only enforcement mechanism in the protocol* (emphasis added). Yet the trade issue also proved to be a complex and contentious subject, and trade working groups debated exhaustively at each negotiating session.”

I shall return to this motivation for including trade restrictions in the agreement, but let us first consider in more detail the mechanics of how the decision emerged.

Benedick’s account of the negotiations suggests that the European Commission was unenthusiastic about the use of trade restrictions. Brack (1996: 53) confirms this, saying that “The European Community, at the time the biggest producer and exporter of CFCs, was suspicious of US motives, believing [the trade restrictions] were aimed at creating a competitive advantage for American industry, which was believed to be further advanced in the development of CFC substitutes and also possessed or controlled more production facilities based in developing countries.” According to Andersen and Sarma (2002: 76) however, “There was unanimity that imports from non-parties should be restricted, and movement of capital and facilities outside the protocol areas should be discouraged.”⁹ Whether there was agreement on this or not at this point, the decision to incorporate trade restrictions in the agreement was sealed at the April 1987 negotiating session in Geneva. According to Benedick (1998: 91),

“the EC Commission and U.K. representatives blocked further discussion of trade until a legal expert from the General Agreement on Tariffs and Trade (GATT) secretariat could advise on the permissibility of such measures under existing international law. The tactic backfired when the expert affirmed that trade restrictions were allowable, under article XX of GATT, as they could be considered ‘necessary to protect human, animal, or plant life or health’ and ‘relating to conservation or exhaustion of exhaustible natural resources.’

⁹ There are other areas where the accounts of this history diverge. According to Andersen and Sarma (2002: 82), the United States argued not that exports to non-parties should be banned, but that they should be subtracted from consumption calculations, since “a total ban on exports would induce the non-parties to build their own production capacity” (Andersen and Sarma 2002: 82). Benedick (1998: 91), however, says that “the United States initially proposed an outright ban on CFC exports to nonparties.” This was to create “a strong incentive for countries to ratify the protocol.” The EC, according to Benedick, disapproved of a complete ban. As a compromise, they agreed to let exports to non-parties be subtracted from consumption. According to Benedick (1998: 91), “if EC nations wanted to continue exporting to any customers that had not joined the protocol... they would have to reduce their own domestic consumption to do so. Since such a move was unlikely, there would be pressure on importing countries to join the protocol in order to maintain their supply.”

From this point on, a consensus inexorably grew that such measures were indispensable to the protocol's effectiveness."

Writing about the same meeting, Andersen and Sarma (2002: 79-80), note that the representative of the GATT qualified his recommendation:

"the judgment as to whether the action proposed satisfied Article XX rested with the GATT contracting parties, normally in the context of a complain brought by one GATT party against another. He also mentioned that the greater the number of commodities controlled, the larger the chances would be of a challenge from some GATT members; he stressed that his view was based on practical rather than legal considerations. There was a consensus on banning imports and exports of controlled substances from non-parties, and determining the feasibility of restricting or banning imports of products produced with the ozone depleting substances. There was also consensus that the parties should discourage exports of CFC technologies except for recycling."

The desire to incorporate trade restrictions came from the perceived need to reduce leakage, promote participation, and enforce the agreement—issues I shall address in the subsection below. Compatibility with trade law seems to have been important to the decision mainly by removing an obstacle to incorporating trade restrictions. We will never know whether trade restrictions would have been left out of this agreement had the GATT representative been less encouraging in his assessment.

2.3 Why a trade ban rather than border tax adjustments?

The Montreal Protocol has not banned all trade in all ODSs, products containing ODSs, or products made using ODSs. The application of a trade ban has been selective. But a ban on trade is a very blunt instrument. Why not use a subtler instrument like a border tax adjustment?

One reason is that ODSs are not controlled under the Montreal Protocol using fiscal measures. They are controlled by quantity limits, and normally border tax adjustments are used to correct for tax differentials. Of course, countries could seek to implement the obligations of the treaty by means of taxes. Alternatively, they could have negotiated a coordinated tax instead of quantity controls. But a tax on ODS consumption, coupled with a rebate on exports, would only have neutralized leakage; it would not have encouraged non-parties to participate in the agreement—a primary motive of the agreement. Of course, preventing leakage was another motive. But if participation is full, leakage by definition is zero. The trade restrictions, by achieving the goal of full participation, eliminate leakage indirectly. Indeed, it is probably because the trade restrictions succeed in meeting both of these goals that there can be disagreement about the importance of the two goals (to reduce leakage and to deter free riding), and yet all the negotiators could agree

that trade restrictions were needed to meet them, individually or jointly (Brack 1996: 52).

Another reason for not using border tax adjustments is that the aim of the Montreal Protocol was to phase out these substances. A trade ban is equivalent to a very high tariff. Zero production/consumption can be achieved using a very high tax. From this perspective, a trade ban would work as well as a tax.

2.4 Were the trade restrictions successful in achieving these aims?

It is difficult to know if the trade restrictions were successful in reducing leakage or promoting participation. Indeed, it is difficult to know if the Montreal Protocol was successful in protecting the ozone layer. A fully convincing investigation would require counterfactuals.

And, yet, forensics point to the conclusion that Montreal was astonishingly successful. Theory strongly suggests this (Barrett 2005). So does a close reading of the history. While some countries took steps to reduce their production and consumption of CFCs beginning in the 1970s, they concluded that unilateralism would fail to address this challenge, and so initiated the negotiation process that led to Montreal's adoption. As the treaty entered into force, and developed over time, more and more countries took action, and every country took progressively more action. Looking back from today's perspective, Montreal obligated countries to do almost as much as it was technically possible to do to protect the ozone layer. Because of these actions, scientists predict that the ozone layer will be restored to its 1980 level by the middle of this century. This is a truly remarkable achievement.

For the purposes of this paper what matters is whether the trade restrictions were instrumental in making Montreal a success. Again, the evidence suggests that they were. Theory shows how the trade restrictions transformed the "game," from one of getting countries to cooperate to reduce their production and consumption of ODSs into one of getting countries to coordinate their participation in an agreement obligating parties to control ODSs, and to block trade in ODSs with non-parties (Barrett 2005). Without the trade restrictions, Montreal confronts the usual free riding problem. With the trade restrictions, participation is assured provided (1) non-participants lose more from being outside the agreement (the loss in the gains from trade due to the trade restrictions) than they gain from being outside (the gain due to free riding), and (2) participants gain more by imposing the trade restrictions against non-participants than by not imposing them. Normally, countries cannot gain by restricting trade. In this case, however, they can, because the trade restrictions limit leakage. Ironically, though leakage undermines unilateral and unilateral efforts to protect the ozone layer, it strengthens multilateral efforts to do so.

Anecdotal evidence also points in this direction. South Korea's decision to join the Montreal Protocol was strongly influenced by the trade restrictions. As Richard

Benedick (1998: 244) explains, "Although it attended the Montreal Protocol negotiations and followed them with interest, South Korea had long hesitated to ratify" the agreement. This is because South Korea had developed the capacity to produce CFCs domestically, just as Montreal was being negotiated. And its consumption was so great, that it would not qualify for financial assistance under the Montreal Fund. So South Korea faced a dilemma. It could become self-sufficient in ODSs, and remain outside the agreement, or it could accede to the agreement and trade with other parties. Benedick (1998: 244) continues:

"After the London trade decisions, the Korean ambassador in Washington sought my advice on this dilemma. I underscored both the seriousness of the trade restrictions should Korea remain a nonparty, and the possibility of its qualifying under article 5 [for financial assistance] if it could act quickly to bring consumption below the threshold. Not long thereafter, Korea initiated its internal ratification process. The trade threat to its current and future exports of electronics and appliances proved intolerable."

Other countries were also influenced by the restrictions, including Taiwan and Mexico (Brack 1996: 56). India and China were both "expanding domestic production capacity and seeking new foreign markets; indeed, in 1988 India purchased an entire second-hand CFC-12 plant from Allied Chemical, after the Protocol had been agreed." But they also joined the treaty. Brack (1996: 56) adds:

"While...it is impossible to disentangle individual developing countries' motivations for joining, most observers accept that the combination of financial assistance and technology transfer plus the fear of trade discrimination created a powerful incentive. When Myanmar, for example, announced its adherence to the Protocol in 1994, its officials stated that one of their major motivations was the desire to avoid trade restrictions. The more countries joined, of course, the greater the incentive for the rest to join too, particularly if there were no significant producers left outside; the trade provisions would then shut off consumers from any legal source of supply and producers from export markets."

Again, this explanation is consistent with the theory, which suggests that trade restrictions create a tipping effect. Once enough countries participate in a treaty incorporating trade restrictions, it becomes irresistible for the rest to participate.

My discussion to this point has emphasized the use of trade restrictions for encouraging participation. But trade restrictions can also be used to enforce compliance. Indeed, the United States initially argued that, "a new article should be added stipulating that the parties not in compliance should be treated as non-parties and therefore subject to trade restrictions" (Andersen and Sarma 2002: 83). Although such an article was not included in Montreal, trade restrictions were threatened when some countries announced that they would have difficulty complying with the agreement, several years after the treaty entered into force.

Theory suggests that, if an enforcement mechanism can deter non-participation, then it should also be able to deter non-compliance (Barrett 2005). Experience with the Montreal Protocol confirms this.

2.5 Are the trade restrictions compatible with the trade rules?

The advice given to the parties by the representative of the GATT Secretariat may give the impression that the trade restrictions in the Montreal Protocol were compatible with the trade rules, but this was far from obvious. Indeed, the GATT Secretariat was hardly supportive. Among other criticisms, the GATT (1992: 25) said that the trade restrictions were unnecessary:

“...the parties to the Montreal Protocol...could have structured the Protocol in such a way that it reduced consumption of CFCs in the participating countries by the target amount, without the necessity of including provisions for special restrictions on trade with non-parties. Since, however, the drafters had other goals as well, including that of providing compensation to CFC producers in the participating countries (by allowing them to receive extra profits from selling the diminishing quantity of CFCs), trade provisions which discriminate against non-participants were included in the Protocol.”

The main problem with this critique is that it does not explain how leakage and free riding could be prevented by other means. The argument that the trade restrictions were intended to shift rents to manufacturers in developed countries is misguided. As noted previously, the United States proposed the use of trade restrictions, and the U.S. adopted a “windfall profits tax” to ensure that producers did not profit from the policy (Barrett 2005: 322).

At the same, Montreal and the WTO are hardly harmonious. One problem is with the possibility of restricting trade based on the method of production. Another is with the non-discrimination provisions. A third is with the obligations being expressed as quantitative restrictions. Article XX may allow for deviations from these rules. And the fact that Montreal is a multilateral agreement is hugely important. There are 196 parties to this agreement, 153 to the World Trade Organization. Finally, and most importantly of all, no country has brought a complaint to the WTO. So, countries have voted with their feet, as it were; they have supported the trade restrictions in the Montreal Protocol, whether or not these are in conflict with the WTO.

However, this support for Montreal’s use of trade restrictions is probably due to the extraordinary fact that the trade restrictions in the Montreal Protocol have not needed to be applied. It is the credible threat to apply them that has changed behavior.

2.6 Relevance of the Montreal Protocol to climate change

The Montreal Protocol is not just an example of an international environmental agreement that has incorporated trade restrictions. It is a treaty that has used those restrictions, among other devices, to reduce greenhouse gas emissions.

Ozone in the stratosphere is a greenhouse gas (protecting the ozone layer will thus add to climate change), as are the chemicals that deplete stratospheric ozone (reducing these emissions will thus help mitigate climate change) and many of their substitutes (use of these will thus add to climate change). What is the net effect of the Montreal Protocol on the climate? Calculations by Velders *et al.* (2007) conclude that the Montreal Protocol reduced greenhouse gas emissions four times as much as the Kyoto Protocol intended (and Kyoto will achieve much less than intended).

In late 2007, the parties to the Montreal Protocol negotiated a new adjustment, agreeing to accelerate and expand the phase out of HCFCs, an ozone-depleting substance that happens also to be a greenhouse gas (HCFCs are controlled under the London amendment; they are not controlled under the Kyoto Protocol). Manufacture of these compounds produces hydrofluorocarbons (HFCs) as a by-product. HFCs do not deplete the ozone layer, and so are not regulated by the Montreal Protocol; but HFCs are a very potent greenhouse gas, controlled by the Kyoto Protocol. By one estimate (Kaniaru *et al.* 2007: 4), the Montreal adjustment, agreed in September 2007 will have about the same impact on the climate as the Kyoto Protocol was designed to achieve.

Because of Montreal's relevance to climate change mitigation, the Kyoto Protocol's emission limits apply to greenhouse gases not controlled by the Montreal Protocol. So Montreal is relevant for two reasons. It incorporates trade restrictions, and it helps mitigate climate change.

2.7 Relevance of other agreements

Other agreements incorporate trade restrictions, but they are not as relevant to the design of a climate treaty. Examples include the Convention on International Trade in Endangered Species and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. In contrast to Montreal, the *purpose* of these agreements is to restrict trade. The trade restrictions in the Montreal Protocol were not intended to restrict trade (indeed, and as mentioned before, trade has not actually been restricted). They were intended to limit leakage and to promote participation. Trade restrictions in a climate agreement, if every adopted, would be used for similar purposes.

There are, however, two other agreements that are relevant to climate change. These agreements restrict trade by establishing technical standards. Like Montreal, these agreements are also mentioned in the Kyoto Protocol because of their relevance for climate mitigation. As directed by Article 2 of the Kyoto Protocol,

“The Parties included in Annex I shall pursue limitation or reduction of

emissions of greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organization and the International Maritime Organization, respectively.”

Kyoto does not limit the emissions controlled by the Montreal Protocol because Montreal is already reducing these emissions. Kyoto excludes the emissions associated with ocean shipping and international air transport for different reasons. Recall that Kyoto’s basic obligations limit the total emissions of individual countries. To include these sectors within the Kyoto framework, it is thus essential to assign a ship’s or a plane’s emissions to individual countries. It isn’t obvious how this can be done. For example, in the case of ocean shipping, should the state from which a ship departs be responsible? Should the state of final destination be responsible? How about the state in which the vessel is registered? Another difficulty is that these sectors are strongly prone to leakage. Indeed, it is because of this that these organizations establish standards for these sectors.

The International Convention for the Prevention of Marine Pollution from Ships, known as MARPOL 73/78, was adopted in 1978 and entered into force in 1983. Today, this agreement has 149 parties, making up over 99 percent of world tonnage. The agreement does not incorporate trade restrictions directly. But it does establish technical standards for tankers, and obligates member states to prevent ships not complying with the standards from entering their ports. From this perspective, MARPOL 73/78 is a trade-restricting agreement.

The International Civil Aviation Organization (ICAO) sets standards for international air travel in areas like safety and the operation of aircraft. It also establishes aircraft engine emission standards for pollutants such as nitrogen oxides and carbon monoxide. A state can adopt these standards in its national laws, preventing aircraft that violate the standards from landing within its territory. The commercial aircraft industry is highly concentrated, making international standards particularly easy to implement.

So far, neither the International Maritime Organization nor ICAO has been effective in limiting the emissions of these sectors. Frustrated with this lack of progress, the European Union has proposed incorporating international air transport emissions within its Emissions Trading Scheme. This would be a unilateral action, and other countries, including the United States, have protested. At the same time, the American Clean Energy and Security Act of 2009, which was approved by the U.S. House of Representatives in 2009, would regulate fuel supplies upstream, raising the price of jet fuel. This would also be a unilateral action. Obviously, there is a need for such actions to be coordinated. More specifically, there is a need for them to be agreed multilaterally.

3. Why have trade restrictions not (yet) been incorporated in a climate treaty?

A key insight of the previous discussion of the Montreal Protocol is that the trade restrictions were not just tacked onto the treaty. They were an integral part of the treaty. To understand why trade restrictions have not been incorporated in a climate treaty (yet), it will therefore help to consider the other design features of the Kyoto Protocol.

I shall focus here on Kyoto because it is the only binding agreement for mitigation. The Copenhagen Accord is not a real agreement. It is not a treaty subject to ratification; it is non-binding. Copenhagen points towards a general, collective goal, making a little more specific the goal already expressed in the Framework Convention. It departs from Kyoto in one important way, by indicating that developing countries should undertake mitigation actions (implying, among other things, that emissions may not fall in absolute terms, though they should fall relative to “business as usual”). The obligations of rich and poor countries to reduce emissions are expressed in an appendix to the Accord. These are not negotiated obligations. These are obligations established independently. Rather awkwardly, however, many if not most of these pledges are expressed in conditional terms. Copenhagen creates a collective obligation for industrialized countries to contribute \$10 billion a year through 2012, and \$100 billion a year by 2020 for “balanced allocation between adaptation and mitigation.” However, individual countries cannot be made accountable should these collective goals not be reached. Copenhagen makes no reference to the use of trade restrictions.

3.1 Emissions rather than production and consumption

By seeking to control production and consumption, with the latter being defined as production plus imports minus exports, Montreal practically invited consideration of trade restrictions. (Or perhaps the treaty controlled production and consumption because of the desire to employ trade restrictions.) The focus of climate treaties has been very different. Kyoto focuses on emissions of greenhouse gases—a basket of six gases. Montreal also limits clusters of chemicals, with weights being attached to different compounds depending on their ozone-destroying potential. But as explained above, separation was created by the different amendments (different appendices to the treaty), and the application of trade restrictions was selective. Because Kyoto aggregates up over all the six gases, it is more difficult for trade restrictions to be applied selectively. The design of the Kyoto Protocol emphasizes cost-effectiveness above enforcement, just the opposite of Montreal.

3.2 Caps for rich but not for poor countries

Montreal limited the production and consumption of ozone-depleting substances everywhere, whereas Kyoto limits only the emissions of industrialized countries. Moreover, among the industrialized countries, Kyoto allocates “hot air” to the economies in transition. This design feature does nothing to limit the leakage associated with emission reductions by the countries actually subject to emission

caps. Montreal, by contrast, created a clear distinction between parties and non-parties, a crucial feature if trade restrictions are to be applied only to non-parties. Kyoto did not create the same distinction. If Kyoto were to apply trade restrictions to non-parties, it would be restricting trade only with the United States.

3.3 No financial assistance for compliance

The offer of financial compensation for compliance by developing countries was a strong inducement for their participation to the Montreal Protocol. As noted before, by the design of this treaty, developing countries could not be made worse off for participating; and the trade restrictions would make them worse off for not participating. Just as important, the trade restrictions were agreed, not imposed.

If the same approach were applied to a climate treaty, there would need to be agreement about what different parties would be required to do, and about how the costs of fulfilling those obligations would be distributed. Kyoto, as noted before, does not limit the emissions of developing countries. One reason may seem to be that it would be inequitable to expect developing countries to limit their emissions. But this would be true only if compensating payments could not be offered for compliance.¹⁰ Another reason may seem to be that it is not essential for developing countries to reduce their emissions in order for climate change risks to be addressed. This is also untrue.

As noted before, Copenhagen allows developing countries to pledge mitigation actions. It also promises financial assistance “with balanced allocation between adaptation and mitigation” (whatever that means). But Copenhagen does not make any connection between these actions and finance. Montreal offers to finance compliance by developing countries with their individual production and consumption obligations subject to the principle of incremental costs. That is, the financing arrangement in Montreal is related to the agreed obligations. In Copenhagen, by contrast, financing is determined by a budget, with no connection made to individual country obligations.

3.4 A different enforcement mechanism

As noted before, Kyoto pays more attention to cost-effectiveness than enforcement. An enforcement mechanism was developed after the basic architecture of the treaty had already been agreed, but it was never adopted. As suggested earlier, this may be because the agreed mechanism would not work.

¹⁰ The Clean Development Mechanism allows industrialized countries to pay developing countries to limit their emissions on a project-by-project basis. However, these transactions are deeply problematic, not least because of the difficulty of establishing the baseline level of emissions in the absence of the transaction.

Indeed, while the enforcement capabilities of Montreal were strengthened over time, enforcement of an emerging climate regime has grown weaker. It is apparent that some parties to the Kyoto Protocol will not comply with their obligations, and will face no consequences for not complying (which probably explains why they are not complying). Meanwhile, the Copenhagen Accord lacks an enforcement mechanism and is non-binding in any event.

The need for enforcement is essential, and so the search for a mechanism that can work will continue. So far, countries have avoided serious discussion of the use of trade restrictions. But trade restrictions are the most obvious way of enforcing a future agreement, and it seems inevitable that they will be discussed in future negotiations. A central theme of this paper is that trade restrictions, if they are to be used, or credibly threatened to be used, must form an integral part of a well-designed treaty. This means that, as trade restrictions are discussed, other aspects of the Kyoto design will also need to change. I shall return to this point later in this paper.

4. Trade restrictions that have been contemplated and their implications

As noted before, trade restrictions have not been incorporated within a climate treaty. But as treaty negotiations founder, the incentive for states to act unilaterally will increase. Unfortunately, unilateral or minilateral efforts to reduce emissions are particularly prone to leakage. States will not want to do much on their own without trade restrictions. This is perhaps the main reason why trade restrictions have been discussed mainly in the context of unilateral and minilateral policies.

4.1 International air travel: a first test case

Europe is already planning to impose a border measure. Beginning in 2012, airlines landing in or departing from European airports will need to obtain emission permits.¹¹ In the first year, airlines will be allocated 97 percent of historical emissions. Thereafter, the allocation will be held at 95 percent. Initially 15 percent of these permits will be auctioned, the rest given away. Failure to comply will be subject to enforcement, including the possibility that non-complying airlines will be banned from operating within the European Union. The United States has said that it will impose trade sanctions should the EU force U.S. carriers to comply with the new directive (McCarthy 2010: 8).

Ideally, rules for international air travel would be agreed multilaterally through the International Civil Aviation Organization. However, the EU only acted because ICAO has so far failed to act.

4.2 Compensating producers at home

¹¹ Amendment to Council Directive 96/61/EC; see <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2003L0087:20090625:EN:PDF>.

In the next phase of the Emissions Trading Scheme, a distinction will be made for sectors “deemed to be exposed to a significant risk of carbon leakage.”¹² Such sectors will receive relatively more free allowances than other sectors, with the most efficient plants receiving proportionally more free allowances than other plants. It should be noted that allocations of emissions permits are lump sum transfers. They will affect profits. They will not affect “competitiveness.” That is, they will not affect pricing. This means that they will not affect leakage.

The bill passed by the United States House of Representatives (but not the Senate) in June 2009 (known as H.R. 2454) includes a similar provision. It would allocate allowances for free based on a facility’s output and emissions per unit of output for the sector. Like the EU allocation proposal, more efficient facilities would be rewarded. Unlike the EU arrangement, however, H.R. 2454’s approach affects a facility’s production decision. The overall effect on emissions is difficult to determine, with one incentive favoring emission reductions and another rewarding greater output. Another reason to question the merits of this approach is that this policy does not depend on the actions taken by other countries, the most important of which are these firms’ international competitors. This is also a feature of the EU plan for the next phase of the Emissions Trading Scheme.

4.3 Addressing “competitiveness” effects

H.R. 2454 also allows the president, from 2020, to require importers to obtain emission permits, provided there is no international agreement to ensure global coordination in reducing greenhouse gas emissions. The requirement would not apply to imports from countries meeting the same emissions criteria as the United States, but determining a standard for “comparability” will clearly be important. The president can seek to waive this requirement, but his decision would need to be approved by both houses of Congress—a most unusual restraint on presidential authority.

Some European states have proposed a different remedy for the same problem. President Nicolas Sarkozy of France and Prime Minister Silvio Berlusconi of Italy have both said they would like the EU to impose a tariff to address carbon leakage. Other EU member states oppose such a policy, believing that it would likely trigger a trade war.

4.4 Acting alone or with others

The European Parliament has asked the Commission to re-examine the new rules noted above “in the light of the outcome of the international negotiations and the

¹² These are sectors for which costs increase by at least 5% of gross value added and with a trade intensity exceeding 10%. Sectors having a value exceeding 30% for just one of these categories would also be included.

extent to which these lead to global greenhouse gas emission reductions....”¹³ This underscores two important points. The first is that, whether trade restrictions are needed depends on whether other countries are undertaking “comparable action.” The second is that, whether a country will find it in its interests to impose trade restrictions may depend on which countries will join it and which will oppose it.

From Europe’s perspective, the possible reaction of the United States is paramount. As expressed by a representative of a European industry group, “In a theoretical world where Japan, the U.S. and Europe could move together, then it might work. But if Europe imposed tariffs alone it would not.”¹⁴ A broadening of support for trade measures has two advantages. First, it reduces the costs of imposing trade restrictions (including the threat of retaliation by the U.S.). Second, by increasing the size of the market being subject to trade measures, a “tipping” effect may be created. As more countries seek to create a new playing field, as it were, supported by trade restrictions, the incentive for other countries to join them, by adopting “comparable” climate policies, would strengthen.

4.5 Eco-imperialism

It is ironic that the U.S. has opposed Europe’s efforts to impose trade restrictions, as the U.S. has embraced the same approach as regards other countries. The first full paragraph of H.R. 2454, approved by the House of Representatives in June 2009, says:

“The Administrator, in consultation with the Department of State and the United States Trade Representative, shall annually prepare and certify a report to the Congress regarding whether China and India have adopted greenhouse gas emissions standards at least as strict as those standards required under this Act. If the Administrator determines that China and India have not adopted greenhouse gas emissions standards at least as stringent as those set forth in this Act, the Administrator shall notify each Member of Congress of his determination, and shall release his determination to the media.”

The EU may be worried about imposing tariffs on the U.S., but even if the U.S. adopted climate legislation, and so did Japan, and all these countries then agreed to impose tariffs or similar measures on third parties, the same problem of “eco-imperialism” would apply. In the run up to Copenhagen, a draft “Copenhagen Accord” developed by the so-called “BASIC” group of countries (Brazil, South Africa, India, and China) contained a warning: “Parties shall not resort to any form of unilateral measures, including fiscal and non-fiscal border measures, against goods and services imported from other Parties, in particular from developing country Parties, on grounds of stabilization and mitigation of climate change.” This language

¹³ Article 10b of <http://register.consilium.europa.eu/pdf/en/08/st03/st03737.en08.pdf>.

¹⁴ <http://www.reuters.com/article/idUSTRE63T1LE20100430>.

seems to be saying that these countries would not countenance trade restrictions even if they were allowed under Article XX of the GATT. The key issue here is not whether the trade restrictions are necessary to mitigate climate change. The key issue is whether they would be applied to countries being treated unfairly. That is, the issue is whether the arrangement establishing trade restrictions has international legitimacy.

5. How trade restrictions might feature in a future climate treaty system

In section 3 I explained why trade restrictions have not been incorporated in a climate treaty. The Kyoto Protocol was designed as if enforcement was not needed, or could be “tacked on” later. Both views were wrong. Enforcement is needed, but it needs to be integrated into an agreement. This is one of the important lessons of the Montreal Protocol discussed in section 2.

Because of the failure of the climate negotiations, countries have once again focused on taking unilateral action. As I explained in section 4, the need for trade restrictions is particularly acute when countries act unilaterally. It is also in such a setting that the risks of using trade restrictions is greatest. A close reading of the experience with the Montreal Protocol shows that, whether trade restrictions are legal (WTO-compatible) is not that important—the WTO, after all, was not designed to address the use of trade restrictions in such a context. What is more important is whether the possible use of trade restrictions is “fair” and “legitimate” and supported by a very large number of countries. A strong case can be made that the trade restrictions in the Montreal Protocol violated the GATT rules, at least as they were interpreted up until that time. But no country complained to the GATT about the Montreal restrictions. Another key insight of the history of the Montreal negotiations is that trade restrictions may be particularly effective when the threat to impose them is credible, and when the consequences of them being imposed are so great for the target countries that they would prefer to avoid them by joining the international agreement and complying with its rules. The most remarkable thing about the Montreal Protocol is that the trade restrictions were essential to enforcing the agreement, but that they never needed to be used. The credible threat to use them was enough.

5.1 Together or separate?

A key design issue for future climate treaties is whether to continue to focus on economy-wide emission ceilings for a basket of gases or whether to break the problem up into smaller pieces. In the former case, the use of trade restrictions is problematic. If the restrictions were general, all trade would need to be restricted. If the restrictions were selective, they wouldn’t affect the aggregate measure of greenhouse gases. In the latter case, by contrast, the use of trade restrictions is more natural and less risky. Indeed, and as explained in Section 2, trade restrictions have already been used indirectly—by helping to reduce the greenhouse gases being controlled by the Montreal Protocol.

This approach may soon be extended. As I was writing this paper, the United States, Canada, and Mexico proposed expanding the Montreal Protocol to control HFCs. This is a significant departure from the approach taken so far, and any new amendment to the Montreal Protocol may well make use of the trade restrictions for purposes of enforcement. I want to stress that HFCs are not an ozone-destroying chemical but a greenhouse gas. There is thus the very real prospect that trade restrictions will be used to limit a greenhouse gas—and yet, in my view, this would be entirely appropriate.

Perfluorocarbons (PFCs), another greenhouse gas controlled by the Kyoto Protocol, also resembles the ODSs in these other respects. These gases could also be controlled as by the Montreal Protocol, using trade restrictions. Alternatively, HFCs and PFCs could be controlled under new agreements, negotiated under the Framework Convention, that limited just these gases.

The main challenge is to limit carbon dioxide emissions. How to extend this approach to limiting this important greenhouse gas? One approach may be to control emissions by sector.

5.2 Energy-intensive sectors

The aluminium sector is a prime candidate.¹⁵ It is a concentrated industry: twelve countries account for 82 percent of global production; ten companies produce more than half of world output. The industry employs just two smelting technologies, and emissions can be reduced substantially by re-melting aluminium scrap (the former is 95 percent less greenhouse-gas-intensive than primary aluminium production). Finally, twenty-six companies, making up 80 percent of world output, belong to the International Aluminium Institute, which has already adopted voluntary intensity targets. There exists a basis here for negotiating new global standards for the industry, supported by financial assistance, and backed by the threat of trade restrictions.

Trade restrictions are more likely to be effective, as a deterrent, for this sector since the leakage rate for this sector is significant.

The precise nature of such an agreement would need to be worked out by the parties, in association with the industry. One possibility is to require that all smelters employ the more efficient Prebake smelting technology (some facilities in developing countries still rely on the less efficient Söderberg technology). Another possibility is to require that the carbon-dioxide-intensity of production be limited.

¹⁵ It may also be possible to develop separate agreements for other sectors, such as steel, cement, paper, and chemicals. My discussion here of the aluminum sector draws from the excellent study by Bradley *et al.* (2007), especially pp. 37-38.

If trade restrictions were to be applied to such an agreement, they would have to be based on the production and process method, not the product itself. Perhaps the closest analogy would be to the Kimberly Process and trade in diamonds.

5.3 Transport

Transport is a key sector. An agreement on automobile standards would be easy to enforce using trade restrictions. For example, a requirement that all new vehicles be equipped with plug-in hybrid engines or run exclusively on battery power would entail automatic trade restrictions. Investment in a complementary infrastructure for recharging would help spread, much in the same way as for MARPOL, due to network externalities. Economies of scale in car production, and domestic environmental benefits (reduced emissions of local pollutants) will also help spread.

5.4 Electricity

Ultimately, reductions in the emission of energy-intensive industries and in the adoption of electric cars will only reduce emissions if the power sector can be transformed. Power is not highly traded. Leakage from this sector is low. Trade restrictions, therefore, would not play a role in reducing emissions. There may be an indirect role for trade restrictions. As mentioned before, trade restrictions could be applied to “level the playing field” for the energy-intensive industries, taking into account the emissions associated with the electricity input. However, as a general matter, it seems that reductions in emissions from the power sector will need to be achieved by other means.

To illustrate, one simple approach would be to require that all new coal-fired power plants employ carbon capture and storage (a prerequisite condition would be that RD&D be undertaken in an earlier stage) by 2020, and that all coal-fired power plants employ carbon capture and storage by 2050. This approach would not necessarily constitute a cost-effective solution, but it has other advantages. For example, rich countries could offer to compensate poor countries for the incremental costs of adopting this new technology.

5.5 Radically different approaches

There are other ways to address the threat of climate change than by reducing emissions. One of these, of course, is adaptation, and it is a sign of how the world has failed to reduce emissions that the climate negotiations have already evolved to include adaptation—a key focus of the Copenhagen talks. Continued failure to reduce global emissions will shift discussions to yet other possibilities.

One of these is to remove CO₂ directly from the air, and to store it permanently underground. This approach has much to commend it as a “technological fix” (Sarewitz and Nelson 2008). In addition, it would not have any competitiveness effects, and would alleviate the free rider problem somewhat (Barrett 2010). The

downside to this technology is that it would be very costly to deploy. It is likely to be used only if the damages from climate change appear to be very great. Use of this approach would not involve trade restrictions.

Another approach is “geoengineering” (Barrett 2007). This would seek to offset the warming effect of rising concentrations of greenhouse gases by reflecting sunlight. The approach discussed most frequently is to engineer a kind of volcanic eruption, throwing reflective particles into the stratosphere. This approach would not address climate change fundamentally, and will involve new risks. However, it would be inexpensive in financial terms, and would be fast-acting. It may be the only way to avoid “abrupt and catastrophic” climate change. Like “air capture,” this technology can be deployed by a “coalition of the willing.” It is much less vulnerable to free riding, and would not involve leakage. Trade restrictions would not be needed.

The main challenge for both of these approaches is governance. Who gets to decide what the concentration level ought to be? Who gets to decide what the temperature ought to be?

6. Conclusions

Efforts to cooperate in reducing greenhouse gas emissions have so far avoided the use of trade restrictions. However, these efforts have also failed to reduce global emissions.

In the talks leading to Copenhagen, the industrialized countries continued to avoid mention of trade restrictions in their draft treaties. By contrast, the largest developing countries warned against their use. The Copenhagen Accord, like the Kyoto Protocol before it, does not mention trade restrictions. Like Kyoto, Copenhagen also will do nothing or next-to-nothing to reduce global emissions.

How will this system evolve? As international negotiations fail to reduce emissions, some countries will seek to take matters into their own hands. Since unilateral and minilateral efforts are particularly vulnerable to leakage and free riding, stepped up efforts at this level will inevitably come to include trade restrictions of some variety.

The first area in which this issue may flare up concerns international air travel. It is not obvious how this will play out. One possibility is that the EU will back down. Another is that the EU will impose the planned restrictions and the US will not respond. A third possibility is that the EU will impose the planned restrictions and the US will retaliate in some fashion. A fourth possibility is that the main parties will avoid conflict by striking a compromise through ICAO. Note that, while air travel may become a flashpoint, there is little that can be done in the short term to limit emissions in this sector except by reducing the volume of air travel—a step that may lack political support.

Trade restrictions may also feature in future U.S. legislation. The target of U.S. measures is likely to be the major developing economies, especially China. Implementation of such restrictions may take some time to develop, but its effects are difficult to predict. Again, there are several possibilities. One is that the U.S. will impose restrictions against countries like China, and these countries will adjust their policies to avoid the restrictions. Another possibility is that these countries will not make adjustments, and the U.S. will therefore restrict trade with these countries. A third possibility is that these countries will not make adjustments, and the U.S. will not impose the restrictions. This last possibility seems likely to me, since the U.S. would be harming itself by restricting trade with China.

If trade restrictions are to feature in climate policy, they should be adopted *by agreement*. This is an essential lesson of the Montreal Protocol. Issues of fairness and legitimacy are crucial to the success of such measures in changing behavior.

Another key insight from experience with the Montreal Protocol is that the use of trade restrictions needs to be considered in the broader context of the design of an international agreement. The dominant approach taken so far of limiting economy-wide greenhouse gas emissions is not conducive to the application of trade restrictions. If trade restrictions are to be used, and if their use is to be effective, then the design of international agreements will need to be very different.

A proposal has already been made to control HFCs through the Montreal Protocol. Doing so would be an admission that the Kyoto approach has failed. It is very likely that controls on HFCs through an amendment to the Montreal Protocol would involve trade restrictions. In this case, the threat to restrict trade would likely suffice to change behavior.

A further breaking up of the problem would enable trade restrictions to be used in other areas, such as for product standards and controls for the energy-intensive industries. Again, provided these restrictions were negotiated, and had the support of key parties, they would likely not trigger a trade war.

As countries search for ways to limit greenhouse gas emissions collectively by means of trade restrictions, they should consider the best and worst case scenarios. The best-case scenario is one in which trade is not restricted but the credible threat to restrict trade causes emissions to be cut substantially, just as in the Montreal Protocol. The worst-case scenario is one in which trade is restricted because countries do not take steps to avoid the restrictions by cutting their emissions. Currently, countries are doing little if anything to reduce their emissions, but trade is not being restricted. As bad as this situation is, it could be even worse.

References

Andersen, Stephen O. and K. Madhava Sarma (2002). *Protecting the Ozone Layer: The United Nations History*. London: Earthscan.

Bagwell, Kyle and Robert W. Staiger (2003). *The Economics of the World Trading System*. Cambridge, MA: MIT Press.

Barrett, Scott (2005). *Environment and Statecraft: The Strategy of Environmental Treaty-Making*, Oxford: Oxford University Press (paperback edition).

Barrett, Scott (2007). *Why Cooperate?: The Incentive to Supply Global Public Goods*. Oxford: Oxford University Press.

Barrett, Scott (2008). "Climate Treaties and the Imperative of Enforcement," *Oxford Review of Economic Policy*, **24**(2): 239-258, 2008.

Barrett, Scott (2009). "The Coming Global Climate-Technology Revolution," *Journal of Economic Perspectives*, **23**(2): 53-75.

Barrett, Scott (2010). "Climate Treaties and Backstop Technologies," CESifo Working Paper.

Benedick, Richard Elliot (1998). *Ozone Diplomacy: New Directions in Safeguarding the Planet*. Cambridge, MA: Harvard University Press, 2nd edition.

Brack, Duncan (1996). *International Trade and the Montreal Protocol*. London: Royal Institute of International Affairs and Earthscan.

Bradley, R., K.A. Baumert, B. Childs, T. Herzog, J. Pershing (2007). *Slicing the Pie: Sector-Based Approaches to International Climate Agreements*. Washington, DC: World Resources Institute.

General Agreement on Tariffs and Trade (1992). "Trade and the Environment," in *International Trade 1990-1991*. Geneva: GATT.

Kallbekken, S. and J. Hovi (2007). "The Price of Non-Compliance with the Kyoto Protocol: The Remarkable Case of Norway," *International Environmental Agreements*, **7**: 1-15.

Kaniaru, D., R. Shende, S. Stone, and D. Zaelke (2007). "Strengthening the Montreal Protocol: Insurance Against Abrupt Climate Change," *Sustainable Development Law & Policy*, **3**.

McCarthy, James E. (2010). "Aviation and Climate Change." Congressional Research Service; http://assets.opencrs.com/rpts/R40090_20100127.pdf.

Sarewitz, Daniel and Richard Nelson (2008). "Three Rules for Technological Fixes." *Nature*, December 18: 871-872.

Velders, G.J.M., S.O. Anderson, J.S. Daniel, D.W. Fahey, and M. McFarland (2007). "The Importance of the Montreal Protocol in Protecting Climate." *Proceedings of the National Academy of Sciences*, 104(12): 4814-4819.

Appendix A: Text of the Montreal Protocol concerning trade restrictions

Montreal Protocol (1987)

Article 4: Control of trade with non-Parties

1. Within one year of the entry into force of this Protocol, each Party shall ban the import of controlled substances from any State not party to this Protocol.
2. Beginning on 1 January 1993, no Party operating under paragraph 1 of Article 5 may export any controlled substance to any State not party to this Protocol.
3. Within three years of the date of entry into force of this Protocol, the Parties shall, following the procedure in Article 10 of the Convention, elaborate in an annex a list of products containing controlled substances. Parties that have not objected to the annex in accordance with those procedures shall ban, within one year of the annex having become effective, the import of those products from any State not party to this Protocol.
4. Within five years of the entry into force of this Protocol, the Parties shall determine the feasibility of banning or restricting, from States not party to this Protocol, the import of products produced with, but not containing, controlled substances. If determined feasible, the Parties shall, following the procedures in Article 10 of the Convention, elaborate in an annex a list of such products. Parties that have not objected to it in accordance with those procedures shall ban or restrict, within one year of the annex having become effective, the import of those products from any State not party to this Protocol.
5. Each Party shall discourage the export, to any State not party to this Protocol, of technology for producing and for utilizing controlled substances.
6. Each Party shall refrain from providing new subsidies, aid, credits, guarantees or insurance programmes for the export to States not party to this Protocol of products, equipment, plants or technology that would facilitate the production of controlled substances.
7. Paragraphs 5 and 6 shall not apply to products, equipment, plants or technology that improve the containment, recovery, recycling or destruction of controlled substances, promote the development of alternative substances, or otherwise contribute to the reduction of emissions of controlled substances.
8. Notwithstanding the provisions of this Article, imports referred to in paragraphs 1, 3 and 4 may be permitted from any State not party to this Protocol, if that State is determined, by a meeting of the Parties, to be in full compliance with Article 2 and this Article, and has submitted data to that effect as specified in Article 7.

London Amendment 1990

O. Article 4: Control of trade with non-Parties

1. Paragraphs 1 to 5 of Article 4 shall be replaced by the following paragraphs:

1. As of 1 January 1990, each Party shall ban the import of the controlled substances in Annex A from any State not party to this Protocol.

1 bis Within one year of the date of the entry into force of this paragraph, each Party shall ban the import of the controlled substances in Annex B from any State not party to this Protocol.

2. As of 1 January 1993, each Party shall ban the export of any controlled substances in Annex A to any State not party to this Protocol.

2 bis Commencing one year after the date of entry into force of this paragraph, each Party shall ban the export of any controlled substances in Annex B to any State not party to this Protocol.

3. By 1 January 1992, the Parties shall, following the procedures in Article 10 of the Convention, elaborate in an annex a list of products containing controlled substances in Annex A. Parties that have not objected to the annex in accordance with those procedures shall ban, within one year of the annex having become effective, the import of those products from any State not party to this Protocol.

3 bis Within three years of the date of the entry into force of this paragraph, the Parties shall, following the procedures in Article 10 of the Convention, elaborate in an annex a list of products containing controlled substances in Annex B. Parties that have not objected to the annex in accordance with those procedures shall ban, within one year of the annex having become effective, the import of those products from any State not party to this Protocol.

4. By 1 January 1994, the Parties shall determine the feasibility of banning or restricting, from States not party to this Protocol, the import of products produced with, but not containing, controlled substances in Annex A. If determined feasible, the Parties shall, following the procedures in Article 10 of the Convention, elaborate in an annex a list of such products. Parties that have not objected to the annex in accordance with those procedures shall ban, within one year of the annex having become effective, the import of those products from any State not party to this Protocol.

4 bis Within five years of the date of the entry into force of this paragraph, the Parties shall determine the feasibility of banning or restricting, from States not party to this Protocol, the import of products produced with, but not containing, controlled substances in Annex B. If determined feasible, the Parties shall, following the procedures in Article 10 of the Convention, elaborate in an annex a list of such products. Parties that have not objected to the annex in accordance with those

procedures shall ban or restrict, within one year of the annex having become effective, the import of those products from any State not party to this Protocol.

5. Each Party undertakes to the fullest practicable extent to discourage the export to any State not party to this Protocol of technology for producing and for utilizing controlled substances.

2. Paragraph 8 of Article 4 of the Protocol shall be replaced by the following paragraph:

8. Notwithstanding the provisions of this Article, imports referred to in paragraphs 1, 1 *bis*, 3, 3 *bis*, 4 and 4 *bis*, and exports referred to in paragraphs 2 and 2 *bis*, may be permitted from, or to, any State not party to this Protocol, if that State is determined by a meeting of the Parties to be in full compliance with Article 2, Articles 2A to 2E, and this Article and have submitted data to that effect as specified in Article 7.

3. The following paragraph shall be added to Article 4 of the Protocol as paragraph 9:

9. For the purposes of this Article, the term "State not party to this Protocol" shall include, with respect to a particular controlled substance, a State or regional economic integration organization that has not agreed to be bound by the control measures in effect for that substance.

Copenhagen Amendment 1992

K. Article 4, paragraph 1 ter

The following paragraph shall be inserted after paragraph 1 *bis* of Article 4 of the Protocol:

1 ter Within one year of the date of entry into force of this paragraph, each Party shall ban the import of any controlled substances in Group II of Annex C from any State not party to this Protocol.

L. Article 4, paragraph 2 ter

The following paragraph shall be inserted after paragraph 2 *bis* of Article 4 of the Protocol:

2 ter Commencing one year after the date of entry into force of this paragraph, each Party shall ban the export of any controlled substances in Group II of Annex C to any State not party to this Protocol.

M. Article 4, paragraph 3 ter

The following paragraph shall be inserted after paragraph 3 *bis* of Article 4 of the Protocol:

3 ter. Within three years of the date of entry into force of this paragraph, the Parties shall, following the procedures in Article 10 of the Convention, elaborate in an annex a list of products containing controlled substances in Group II of Annex C. Parties that have not objected to the annex in accordance with those procedures shall ban, within one year of the annex having become effective, the import of those products from any State not party to this Protocol.

N. Article 4, paragraph 4 ter

The following paragraph shall be inserted after paragraph 4 *bis* of Article 4 of the Protocol:

4 ter Within five years of the date of entry into force of this paragraph, the Parties shall determine the feasibility of banning or restricting, from States not party to this Protocol, the import of products produced with, but not containing, controlled substances in Group II of Annex C. If determined feasible, the Parties shall, following the procedures in Article 10 of the Convention, elaborate in an annex a list of such products. Parties that have not objected to the annex in accordance with those procedures shall ban or restrict, within one year of the annex having become effective, the import of those products from any State not party to this Protocol.

O. Article 4, paragraphs 5, 6 and 7

In paragraphs 5, 6 and 7 of Article 4 of the Protocol, for the words:

controlled substances

there shall be substituted:

controlled substances in Annexes A and B and Group II of Annex C

P. Article 4, paragraph 8

In paragraph 8 of Article 4 of the Protocol, for the words:

referred to in paragraphs 1, 1 *bis*, 3, 3 *bis*, 4 and 4 *bis* and exports referred to in paragraphs 2 and 2 *bis*

there shall be substituted:

and exports referred to in paragraphs 1 to 4 *ter* of this Article

and after the words:

Articles 2A to 2E

there shall be added:

, Article 2G

Q. Article 4, paragraph 10

The following paragraph shall be inserted after paragraph 9 of Article 4 of the Protocol:

10. By 1 January 1996, the Parties shall consider whether to amend this Protocol in order to extend the measures in this Article to trade in controlled substances in Group I of Annex C and in Annex E with States not party to the Protocol.

Montreal Amendment (1997)

A. Article 4, paragraph 1 qua.

The following paragraph shall be inserted after paragraph 1 *ter* of Article 4 of the Protocol:

1qua. Within one year of the date of entry into force of this paragraph, each Party shall ban the import of the controlled substance in Annex E from any State not party to this Protocol.

B. Article 4, paragraph 2 qua.

The following paragraph shall be inserted after paragraph 2 *ter* of Article 4 of the Protocol:

2qua. Commencing one year after the date of entry into force of this paragraph, each Party shall ban the export of the controlled substance in Annex E to any State not party to this Protocol.

C. Article 4, paragraphs 5, 6 and 7

In paragraphs 5, 6 and 7 of Article 4 of the Protocol, for the words:

and Group II of Annex C

there shall be substituted:

Group II of Annex C and Annex E

D. Article 4, paragraph 8

In paragraph 8 of Article 4 of the Protocol, for the words:

Article 2G

there shall be substituted:

Articles 2G and 2H

E. Article 4A: Control of trade with Parties

The following Article shall be added to the Protocol as Article 4A:

1. Where, after the phase-out date applicable to it for a controlled substance, a Party is unable, despite having taken all practicable steps to comply with its obligation under the Protocol, to cease production of that substance for domestic consumption, other than for uses agreed by the Parties to be essential, it shall ban the export of used, recycled and reclaimed quantities of that substance, other than for the purpose of destruction.

2. Paragraph 1 of this Article shall apply without prejudice to the operation of Article 11 of the Convention and the non-compliance procedure developed under Article 8 of the Protocol.

F. Article 4B: Licensing

The following Article shall be added to the Protocol as Article 4B:

1. Each Party shall, by 1 January 2000 or within three months of the date of entry into force of this Article for it, whichever is the later, establish and implement a system for licensing the import and export of new, used, recycled and reclaimed controlled substances in Annexes A, B, C and E.

2. Notwithstanding paragraph 1 of this Article, any Party operating under paragraph 1 of Article 5 which decides it is not in a position to establish and implement a system for licensing the import and export of controlled substances in Annexes C and E, may delay taking those actions until 1 January 2005 and 1 January 2002, respectively.

3. Each Party shall, within three months of the date of introducing its licensing system, report to the Secretariat on the establishment and operation of that system.

4. The Secretariat shall periodically prepare and circulate to all Parties a list of the Parties that have reported to it on their licensing systems and shall forward this information to the Implementation Committee for consideration and appropriate recommendations to the Parties.

Beijing Amendment (1999)

F. Article 4, paragraphs 1 quin. and 1 sex.

The following paragraphs shall be added to Article 4 of the Protocol after paragraph 1 *qua*:

1 *quin.* As of 1 January 2004, each Party shall ban the import of the controlled substances in Group I of Annex C from any State not party to this Protocol.

1 *sex.* Within one year of the date of entry into force of this paragraph, each Party shall ban the import of the controlled substance in Group III of Annex C from any State not party to this Protocol.

G. Article 4, paragraphs 2 quin. and 2 sex.

The following paragraphs shall be added to Article 4 of the Protocol after paragraph 2 *qua*:

2 *quin.* As of 1 January 2004, each Party shall ban the export of the controlled substances in Group I of Annex C to any State not party to this Protocol.

2 *sex.* Within one year of the date of entry into force of this paragraph, each Party shall ban the export of the controlled substance in Group III of Annex C to any State not party to this Protocol.

H. Article 4, paragraphs 5 to 7

In paragraphs 5 to 7 of Article 4 of the Protocol, for the words:

Annexes A and B, Group II of Annex C and Annex E

there shall be substituted:

Annexes A, B, C and E

I. Article 4, paragraph 8

In paragraph 8 of Article 4 of the Protocol, for the words:

Articles 2A to 2E, Articles 2G and 2H

there shall be substituted:

Articles 2A to 2I

Appendix B

The Ozone Treaties

Year adopted	Treaty	Year entered into force	No. parties	What the treaty/adjustment/amendment does
1985	Vienna Convention for the Protection of the Ozone Layer	1988	196	Countries agree to take “appropriate measures...to protect human health and the environment against the adverse effects resulting or likely to result from human activities which modify or are likely to modify the Ozone Layer.”
1987	Montreal Protocol on Substances that Deplete the Ozone Layer	1989	196	Requires that production and consumption of 5 of CFCs be cut in half and that of 3 halons be stabilized.
1990	London Adjustment	1991		Reduction schedules agreed previously in Montreal were accelerated and tightened.
1990	London Amendment	1992	195	Number of controlled substances increased from 8 to 20. Industrial country parties agreed to pay for the “incremental costs” of compliance by developing country parties. Adjustment accelerated reductions in Montreal Protocol.
1992	Copenhagen Adjustment	1993		Further tightened earlier controls.
1992	Copenhagen Amendment	1994	192	Number of controlled substances increased from 20 to 94.
1995	Vienna Adjustment	1996		Tightened earlier controls.
1997	Montreal Adjustment	1998		Tightened earlier controls.
1997	Montreal Amendment	1999	180	Added requirement for a licensing system to allow control and monitoring of trade in controlled substances.
1999	Beijing Adjustment	2000		Revised allowances for meeting “basic domestic needs” of developing country parties.
1999	Beijing Amendment	2002	162	Adds one more substance, bringing the total number of controlled substances to 95.
2007	Montreal Adjustment	2008		Increased cuts in HCFCs.

Source : Ratifications from http://ozone.unep.org/Ratification_status/.

ⁱ Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol, “Status of Contributions and Disbursements,” UNEP/OzL.Pro/ExCom/59/3; at <http://www.multilateralfund.org/files/59/5903.pdf>.