Institute for International Economic Policy Working Paper Series
Elliott School of International Affairs
The George Washington University

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IIEP-WP-2010-2

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June 2010

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Implementing Carbon Tariffs: A Fool's Errand?

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Abstract: Some governments are considering taxes on imports based on carbon content from countries that have not introduced climate change policies. Such carbon border taxes appeal to domestic industries facing higher charges for their own carbon emissions. This research demonstrates that there are enormous practical difficulties surrounding such plans. Various policies are evaluated according to World Trade Organization compliance, administrative plausibility, help in meeting environmental goals, and ability to deal with domestic pressures. The steel industry is used as a case study in this analysis. All considered policies arguably fail to meet at least one of these constraints, bringing into question the plausibility that a carbon border tax can be practical policy.

JEL Codes: F13, F18, H23

Keywords: carbon tariffs, climate change, environmental policy

Acknowledgements: Thanks to Petros Mavroidis, Tom Prusa, Patrick Messerlin, Maurizio Zanardi, Joost Pauwelyn and Robert Teh for helpful comments and discussion. Special thanks go to Todd Friedbacher for his hospitality and his insights during the Geneva research visit. I would like to thank the GW Center for International Business Education and Research for their financial support for this work. This paper also appears as World Bank Research Policy Paper No. 5359.

I. Introduction

This research examines the practicality of border measures that impose restrictions on imports originating in countries that do not have a carbon emission reduction program in place. This is an extremely complicated issue because of the simultaneous needs to: 1) satisfy international trade rules; 2) meet environmental goals; 3) garner support from critical stakeholders; and 4) create an administratively tractable system. This paper will make clear that designing a policy that meets all of these constraints will be extremely difficult. The steel industry will provide a useful case study to illuminate these difficulties.

Concern about human-induced climate change has induced a number of developed countries, most notably in the EU, Japan, and Canada, to introduce regimes to reduce "greenhouse gas" (GHG) emissions. In various ways, these systems are designed to increase the private cost of GHGs such as carbon dioxide (CO2) and thereby reduce the emission of these gases. At the same time, other important trading countries such as the U.S., China, and India, have hesitated to institute analogous policies.

This policy variation and consequent differential costs of GHG across borders raise the possibility that production and investment in carbon-intensive industries might migrate to those countries that either do not introduce a GHG emission reduction regime or implement one that results in lower GHG prices than in other more restrictive countries. Industries in countries that have imposed GHG reduction regimes are obviously concerned about "competitiveness" when other countries do not implement similar policies, especially as the carbon[1] costs on these industries begin to rise in the near future. There are also concerns about the possibility of "carbon leakage," whereby reduction in GHG in one jurisdiction would be matched, or even surpassed, by the movement of production to non-GHG reducing jurisdictions.

Some have suggested introducing border adjustments based on imports' carbon content to deal with what they deem to be "unfair trade" from countries that have not introduced GHG reduction schemes. French President Sarkozy,[2] economist Joseph Stiglitz,[3] and U.S. Energy Secretary Steven Chu [4] are just a few of those who have expressed possible support for some type of trade action against countries that do not put a sufficiently high price on carbon. U.S. legislative proposals in both houses of Congress have included a plan to require importers to buy emission permits that reflect the products' carbon content.[5]

Even as some have called for such an approach, others have noted the importance of designing a measure that also is consistent with World Trade Organization (WTO) commitments and does not lead to a trade war. In July 2009, President Barack Obama praised a House climate

[1] I will refer to "carbon" as shorthand for carbon dioxide. However, other gases are also covered GHG reduction measures, such as methane. All of the issues raised below would apply equally to those other GHG emissions.

[2] Frankel (2009, p. 73.)

[3] Stiglitz (2006).

[4] Wall Street Journal, March 18, 2009.

[5] These include the Waxman-Markey Bill on Climate Change (i.e., the American Clean Energy and Security Act of 2009) and the Kerry-Lieberman Bill (i.e., American Power Act) under consideration by the Senate in the summer of 2010.

change bill but cautioned against "sending protectionist signals" through a carbon tariff. Even an April 2010 letter from nine Democratic Senators urging some sort of border adjustment for carbon-intensive imports noted the need to take into account obligations under WTO trade rules.[6]

These two goals of "leveling the playing field" through differential taxation of some countries' exports and adhering to WTO rules significantly complicate the design of the measures. Hufbauer et al. (2009), Pauwelyn (2007), and Houser et al. (2009) have focused on how such carbon border adjustments might be made consistent with WTO commitments. Horn and Mavroidis (2010) look at similar issues but also focus on how a dispute based on carbon border tax adjustments might be adjudicated by the WTO. Many of those same authors as well as others (e.g. Jensen (2009), Messerlin (2010) and WTO (2009)) have noted the practical difficulties of determining the carbon content of imports necessary to put such WTO-consistent policies in place.[7]

This research will focus in more detail on the practical implementation of such border adjustments within existing WTO rules. I will demonstrate that the principal policies that have been proposed for carbon border tax adjustments (CBTA) all have very problematic features.[8] Three essential points arise out of the discussion.

The first is that all CBTAs that arguably are consistent with WTO rules will have such onerous informational needs that importing countries will find implementation nearly impossible. The essential problem is that planned domestic GHG reduction plans involve variable burdens based on individual *domestic* firms' carbon emissions. WTO national treatment rules require similar flexibility for foreign firms and likely will result in extremely difficult cross border data collection requirements. This raises trade frictions if there is resistance from those foreign firms about cooperating in such an intrusive investigation. This is particularly problematic since, as recent trade theory and empirical work suggests, exporting firms have very strong aspects of firm- and even plant-level-heterogeneity.

Secondly, such WTO-consistent rules for CBTAs will have problems and complications that mirror those of antidumping, another procedure designed to deal with what some believe to be "unfair trade." The carbon intensive sectors that are likely to be at the center of the issue (i.e., steel, chemicals, paper, cement, and aluminum) are already intensive users of antidumping and are likely to be aggressive in their attempts to use CBTAs as a means of limiting international competition. Moreover, CBTAs would likely cover more trade, involve more firms, be more controversial politically, and more likely to result in significant trade disputes adjudicated at the WTO. There will be a myriad of problems associated with properly collecting and analyzing information, how to treat firms that do not cooperate in investigations, and arguments about non-

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[6] The letter stated that "[t]o avoid undermining the environmental objective of the climate legislation, *a WTO-consistent border adjustment measure*, which the WTO has recognized as a usable tool in combating climate change, should apply to imports from countries that do not have in place comparable greenhouse gas emissions reduction requirements to those adopted by the United States." [Emphasis added.] *Inside U.S. Trade* April 15, 2010.

[7] Gros and Egenhofer (2009) take a more sanguine view and argue that an external carbon evaluation scheme such as the ISO 14067 carbon footprint procedures could be used to assess the level of the emissions burden. However, the ISO standards are used with self-reported data by individual firms. Thus all of the potential issues of verifying the underlying data would remain with this approach.

[8] In the discussion that follows, the focus will be on a carbon-content-based border adjustment tax on imports. This has similar economic effects as other measures like carbon tariffs but, for technical legal reasons, is more likely to be deemed WTO consistent.

discrimination. In fact, one might come to think of WTO-consistent carbon border adjustment plans as "antidumping on steroids," which already takes up a disproportionate amount of WTO dispute settlements.

The third concern is that CBTAs that are simpler and implementable are not only likely to be inconsistent with WTO rules but also result in perverse incentives for foreign industries to become *more* rather than less carbon-intensive. This would undercut one of the principal environmental goals of the program.[9]

The rest of the paper is organized in the following way. Section II outlines the set of domestic and international constraints that face those trying to implement a carbon tax regime on imports. Section III includes an analysis of those constraints using the steel industry as a concrete example. Section IV contains some concluding remarks.

II. Constraints on Carbon Border Tax Adjustment Implementation

Policymakers may want to impose some sort of border adjustment on imports originating in countries that are not participating in a GHG emission reduction scheme. But the desire and ability to do so with acceptable costs given policy constraints may be two very different things.

Various proposals will be evaluated below based on the following political, economic, environmental, legal, and administrative constraints.

<u>Constraint 1</u>: The policy must be supported (or at least not strongly opposed) by
a. Domestic firms and
b. Foreign firms

<u>Constraint 2</u>: The policy should provide incentives for foreign firms to adopt less carbon-intensive technologies.

<u>Constraint 3</u>: The policy must adhere enough to WTO rules so that governments and firms believe that it would withstand a trade dispute case.

<u>Constraint 4</u>: The policy must be administratively tractable.

Constraints 1.a and 1.b: Domestic and Foreign Firms Support

A government will obviously prefer to get "buy-in" from affected domestic firms with any implemented policy. Governments can ignore complaints from domestic firms that bear burdens of a policy but it obviously complicates the long-term viability of a program. One aspect that will play a critical role in this analysis is whether domestic firms might feel that they are being treated worse than their foreign counterparts. This is particularly important in the CBTA context, as the energy intensive industries that will be involved have also been very active in aggressively

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[9] This analysis in this paper is not predicated on carbon emissions actually imposing cross-border negative externalities. Instead, I presume that policymakers in the importing country believe that carbon emissions are an environmental hazard and are looking for efficient and plausible ways to deal with such emissions.

pursuing trade remedies against foreign competitors; they are unlikely to be shy in the carbon border tax adjustment debates.

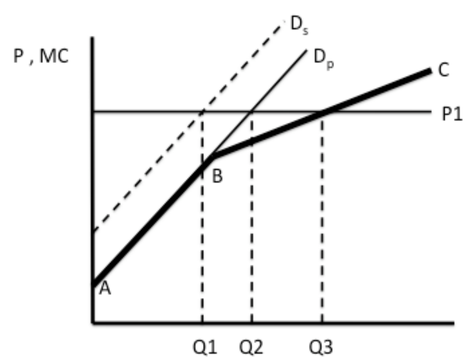
Foreign company support is clearly less important directly to the domestic government. The main concerns that will be analyzed below are whether foreign firms feel that a domestic policy is both detrimental to their interests and inconsistent with the domestic government's WTO obligations. If so, they will exert pressure on their own government to file a WTO dispute. The most sustainable policy would avoid intense foreign firm opposition.

Constraint 2: Incentives for Foreign Firms to Emit Less Carbon

Any implemented policy should achieve a reduction in foreign emissions of GHGs but preferably in an efficient way. There are therefore strong theoretical reasons in the presence of heterogeneous negative externalities to differentiate CBTAs both across sectors and across firms within a sector so that an efficient policy will take account of that. A simple partial equilibrium model will make the essential points.

Assume that a homogeneous good is produced in a country that initially does not have a carbon emissions reduction program in place. For simplicity, we will keep the demand side in the background by assuming a fixed price for the good, given by P1.

Figure 1



One firm uses the "dirty" technology and is assumed initially to be the only operating enterprise in the market. The private marginal cost curve (assumed linear) is given by D_p in Figure 1. The production of the good creates negative externalities (assumed constant) for the world so that the full marginal social cost of production is give by D_S in Figure 1, where the vertical distance between the cost curves reflects the marginal social cost of the carbon emissions. At price P1 the firm produces Q2 units while the social optimum production level is Q1. With only one firm type, the domestic government can set a tax equal to (D_S – D_P) to reach the social optimum production.

Suppose there is another domestic firm that produces the same good using a "clean" technology without carbon emissions. Assume that the first unit costs more than the dirty technology. Marginal costs for the clean firm, however, rise more slowly than the dirty firm so that at high enough prices, it can compete in the market place.

In Figure 1, the economy-wide supply curve is given by ABC, which reflects the additional output from the clean technology firm. At price P1 and no intervention, total production is Q3; the dirty firm produces Q2 and the clean firm produces (Q3-Q2).

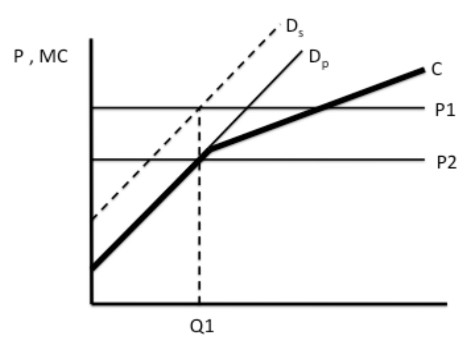
The optimal policy must distinguish between the two types of firms. Such a policy would impose costs on the dirty firm so it reduces its output to Q1 and allows the clean technology firm to increase production by (Q2-Q1). Examples of such a policy would be a domestic production tax solely on the dirty firm or an emissions permit program that does not impose a burden on the clean firm.

Note that the implementation of such a strategy requires that the domestic government be able to audit the firms in order to make sure that the dirty firm is obtaining the proper number of permits or paying the correct tax.

We now reinterpret the figures as pertaining to a mirror image of the domestic economy abroad with the same distribution of firms and technology types. Assume that the foreign firm only produces for export to the domestic market and the foreign government does not intervene. The foreign country is small in international markets.

If foreign production only came from a carbon intensive technology, then the domestic government could impose a border tax equal to the foreign externality to reduce marginal revenue enough so that Q1 is produced and exported. If the domestic and foreign dirty technologies have the same negative externality, then the per unit charges imposed on domestic and foreign production would be identical.

Figure 2



But with the additional presence of a clean technology firm abroad, the domestic government must also try to distinguish between the two foreign firm types.

A uniform border tax on both producers is problematic. In Figure 2, suppose that the marginal revenue from sales abroad falls to P2 as a result of the tax. In the particular case depicted, total foreign production falls to Q1, all produced with the dirty technology. This is the "optimal" level of production by the dirty firm (i.e., where it would produce if internalizing the externality at price P1) but comes with the unintended consequence of eliminating production of the less carbon intensive firm.[10]

[10] The negative consequences of punishing the firm that uses the clean technology obviously depends on how diverse are the types of technology in place between firms. If there were small differences between the firm types, this would create relatively small problems.

The domestic government in principle could impose a differential border tax on the two different foreign goods. If the dirty technology firm receives P2 in marginal revenue and the clean technology firm receives P1, then the optimal outcome occurs.

The primary difficulty arises with informational requirements. How is it that the foreign government will be able to obtain information about the costs structures of the two different types of firms? In the real world, the foreign dirty technology is also not likely to have the same externalities as the domestic analog. Thus, the government would not just distinguish between different foreign firm types but also what the level of the foreign negative externality might be.[11]

One can also interpret these graphs as the output from two separate foreign countries, one of which uses the clean technology and the other the dirty. If one interprets D_P and D_S as the cost curves of countries without a program and BC as the supply curve of countries with such a program, then the differential tariff approach is attempting to reach this optimal solution where marginal social cost is equalized across jurisdictions. But even this approach abstracts from the real possibility that individual firm carbon intensities will vary within countries.

Constraint 3: WTO Obligations

Policymakers also must consider constraints associated with WTO commitments. Ignoring them can lead to trade disputes and WTO sanctioned trade retaliation.

The postwar international trade system has one overriding principle: non-discrimination. This creates potential problems with the economically efficient policies described in the previous section since discriminating between different types based on country or firm-level production process lies at the heart of the approach above.

The two most relevant manifestations of non-discrimination are the: 1) most-favored-nation (MFN) principle; and 2) national treatment. MFN arises principally out of Article I of the General Agreement on Tariffs and Trade (GATT), which requires that each WTO member receive the same treatment for its exports as any other WTO member on an unconditional basis. National treatment arises out of Article III of the GATT and requires that once across the border, foreign producers exporting to a country be subject to taxation and regulation that is essentially the same afforded to domestic producers of a similar product.

Trade specialists for many years have been very concerned about whether governments could impose some sort of carbon adjustment at the border and still adhere to MFN and national treatment (and binding tariff) obligations. An extensive literature has developed dealing with these concerns. For example, Hufbauer et al. (2009), Pauwelyn (2007), and Bordoff (2009) all provide detailed legal discussions of how a CBTA could be designed that plausibly could pass muster before a WTO panel. Bhaghwati and Mavrodis (2007) explore the same issues but are less certain that such a regime could be constructed that would pass WTO muster. A complete discussion of the legal issues is beyond the scope of this paper and beyond the capabilities of its economist author. However, the consensus seems to be that it is at least conceivable that some sort of border adjustment involving a "tax" or cost on foreign producers might work *as long as* it mirrored the burden placed on domestic producers. In other words, a critical consideration is

[11] The vast literature inspired by Melitz (2003) and Bernard and Jensen (2004) on firm heterogeneity suggests that there are significant differences among different firms both domestic and foreign.

whether there is national treatment of foreign products. Also important is that the discrimination not be simply based on the national origin but instead an identifiable attribute of the imported good wherever it might originate (i.e. MFN treatment).

The WTO Appellate Body (AB), which could ultimately examine whether any CBTA arrangement adheres to GATT principles, has not ruled on such carbon adjustment cases. But there are two cases that highlight the critical importance of national treatment in designing a WTO-consistent CBTA system.

In the U.S.-Gasoline case (AB 1996), the AB ruled that the U.S. had violated its national treatment obligations by treating all foreign refiners under a baseline average while allowing domestic refiners to provide information that resulted in adjustments to their burdens under the regulation. In the EC-Asbestos case (AB 2001), the Appellate Body ruled that the European Communities could discriminate against different types of the same good based on whether each contained asbestos, a known carcinogen. In essence, the AB ruled that a good that contained such a dangerous product was not "like" one that did not so that the measure was consistent with Article III (national treatment). In the carbon tax context, this suggests that the AB would not look favorably on a system that treated foreign firms as undifferentiated entities while allowing domestic producers to face differentiated burdens based on their particular carbon emissions. The second case raises at least the possibility that the AB would allow governments to treat a widget produced using less carbon-intensive methods as distinct from one produced using high carbon emissions, if the carbon content makes the two goods "unlike" each other.[12]

WTO members may also impose restrictions on foreign goods under Article XX of the GATT, which deals with general exceptions to trade commitments. The relevant aspect for this discussion is the ability to restrict imports if "necessary to protect human, animal or plant life or health" [Article XX(b)] or if it relates to "conservation of exhaustible resources" [Article XX (g)]. However, Article XX also contains an overall requirement that the measure is not a hidden barrier to trade or implemented in a manner that is arbitrary. The most relevant example of a case involving Article XX is the U.S.-Shrimp case (AB 1998) where the AB determined that, in principle, the U.S. was able to restrict imported shrimp because of environmental concerns around the process of production (i.e. sea turtle deaths while catching the shrimp), provided that this administered in a non-arbitrary fashion and that domestic and foreign firms have similar treatment and that all WTO members are treated in a parallel fashion.

To summarize, WTO rules might permit the imposition of some sort of carbon border adjustment such as a tax or emissions permit requirement. This might occur under the general exceptions embodied in Article XX. However, governments must be careful that the program treats domestic and foreign products and producers in as similar a way as possible and is not hidden protectionism. If instead the program is evaluated under Article III, then the importing government might have to show that the foreign produce is not "like" the domestically produced good in order to justify a violation of national treatment (and the burden of proof in practical terms would likely be on the exporting country). But it is unclear *a priori* whether the Appellate Body would make such a determination. National treatment, in other words, will likely lie at the heart of any WTO dispute surrounding CBTAs.

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[12] A further complication for the AB is that asbestos has a very specific local environmental impact (i.e., potential health hazards for domestic consumers) while carbon emissions could have an international consequence (i.e. global climate change). It is unclear how the AB would assess the importance of the latter in making a ruling.

Constraint 4: Informational Burdens

Any regulatory scheme that imposes more costs on firms that emit more carbon necessarily must have a system to evaluate the carbon emissions of those firms. In the domestic context, governments have extensive potential regulatory power to audit domestic firms, including their carbon emissions. This is far more problematic in an international context.

CBTAs based on foreign carbon footprints would require that domestic administrators obtain information about the details of foreign companies' operations. For example, authorities would need to obtain data on the fuel mix used directly in the item's production as well as in upstream inputs. In some industries such as steel (see below), the carbon footprint can differ importantly based on the specific production techniques used. For multi-plant firms, administrators would need to obtain intra-firm details across plants as well as the production mix from these separate facilities. Investigators would also need to know what type of fuel was used when providing the plant with electricity. For example, does the company buy electricity from coal or nuclear or oil powered plants? Information about the source of any international inputs would be critical, especially in world with more and more integrated global supply chains.

This burden is mitigated somewhat by the initial plans to impose carbon taxes or cap-and-trade systems on a relatively small list of energy-intensive domestic and foreign sectors (e.g. steel, aluminum, paper, and chemicals). These industries are primarily intermediate inputs into more complicated products so that the amount of information is less onerous than imposing carbon taxes on final products. Expanding the covered sector to products like automobiles or electronics or clothing would be far more complicated because the larger number of transformations and intermediate inputs. The informational burden of even the more limited set of energy-intensive products is nonetheless problematic.

This daunting (partial) list of information has caused some analysts to suggest that the burdens are insurmountable. For example, Mattoo et al. (2009) point to the informational needs as one of the reasons to use domestic carbon footprints instead of foreign data to calculate CBTAs. Others that have noted the difficulties about assessing foreign carbon emissions for border adjustments include WTO (2009), Pauwelyn (2007), Houser et al. (2009), Hufbauer et al. (2009), and Brainard and Sorkin (2009).[13]

The implementation of a carbon tariff is also hampered by the lack of WTO guidance. There are simply no multilaterally accepted standards to provide a framework of rules for assessing foreign carbon intensities.

However, there are parallel issues that have come up with antidumping investigations, which provide at least some insight into how such investigations might operate in the CBTA context. Antidumping is a WTO-consistent procedure widely used in current international trade that involves complaints about foreigners pricing too low in the importing market. Antidumping duties have become the most widely used import restrictions today and have spread across the world. (See Bown (2005), Moore and Zanardi (2009) and Prusa (2001).)

[13] Jensen (2009) has noted the widely varying estimate of carbon footprint of based on different methodologies, even of extremely simple and homogeneous activities. For example, estimates of moving one metric tone of sugar two thousand kilometers by a sixteen-ton truck range from just over two hundred kilograms of CO_2 to over seven hundred.

Antidumping also requires that domestic administrators attempt to collect detailed firm-specific information about foreign firms' activities, costs, and sales. There is certainly extensive administrative experience with trying to acquire detailed information about foreign firms' costs and sales. But the world's experience with antidumping is also a warning about how contentious CBTAs would be. For example, antidumping has represented about 30 percent of all WTO trade disputes for the 2001-2008 period (Bown, 2009). There are many antidumping controversies that have direct analogs to the CBTA debate. For example, there are contentious disagreements in WTO negotiations and disputes about how to treat foreigners if they do not cooperate with domestic investigators seeking (Moore and Fox, 2009), how to remove antidumping orders when circumstances have changed (Moore, 2002), and how to deal with new foreign firms that try to enter the domestic market and that have not been part of earlier antidumping investigations. Nearly identical problems will arise with implementing firm-specific CBTAs. But antidumping investigations at least have decades of jurisprudence, administrative experience, and the formal international agreements to guide them; CBTAs would have no such advantages.

III. Steel Industry Example: Evaluating Carbon Tariff Proposals

The steel industry provides a very useful example of the difficulties associated with a border carbon tax adjustment regime. The critical issue is the important variation in the carbon footprint of steel depending on the production process used. I will evaluate various proposals if the United States implements a carbon border tax using the constraints described in the previous section. The specific scenarios are merely illustrative of the complicated nature of satisfying all of the constraints facing policymakers.

Understanding the basic production processes is critical to the steel discussion. Crude steel can be produced basically in two ways.

The traditional way, and the manner most often associated with steel production in the public's mind, is an "integrated" mill using a basic oxygen furnace (BOF). In this process, iron ore and coal are converted to pig iron and coke in a blast furnace and coke oven, respectively. These inputs are then combined in a BOF facility to create crude steel that can then be used for rolling into useable products such as coil, plate, or rod. The most carbon-intensive part of the process is during the blast furnace stage in which large amounts of carbon dioxide gas are produced as a byproduct.

The alternative steel-making process utilizes an electric arc furnace (EAF) that involves recycling steel. (These facilities are sometimes called "minimills.") Scrap steel is melted into useable crude steel in the EAF and then processed using similar rolling facilities as with a BOF. An EAF produces considerably less carbon dioxide since the blast furnace stage of the traditional BOF is entirely skipped. The amount of carbon dioxide emitted in the EAF process however depends in large part on the fuel source for the electricity used to melt the scrap.

Both processes have some flexibility in their use of inputs. For example, scrap steel can be inserted into a blast furnace in addition to iron ore to make pig iron. EAF steel producers can also use "directly reduced iron" or DRI as substitute for scrap. This has the advantage of fewer impurities that are often present in scrap and therefore is helpful in producing higher quality steel products, although it is more expensive and does result in higher carbon emissions because of the processing involved. In the tables below, "EAF (Scrap)" refers to minimills using scrap, which is much more common, while “EAF (DRI)” refers to mills using direct-reduced-iron as an input instead of scrap.[14]

The variety of methods used in individual steel plants as well as different sources of electricity, environmental regulations, and sources of intermediate inputs result in a range of carbon footprints. For example, Table 1, reproduced from a OECD (2002), depicts this variation across process and five important regions/countries of the world. The ratio of CO_2 emissions for BOF to EAF (Scrap) ranges from 3.3 in North America to 4.3 for China to 8.3 for South America. The carbon footprint also varies importantly within processes across regions. Estimated Chinese BOF carbon emissions are almost twice as high per tonne of steel (3.9) as in North America (2.0) and the EU (2.1). There is less variation among EAF users where the main source of differences in carbon footprint depends on the type of electrical power. For example, South America has relatively important hydroelectric sources so that its EAF steel production emits the least amount of CO_2.

Table 1: Tonnes of CO2 emissions per tonne of crude steel

	BOF	EAF (Scrap)	EAF (DRI)
EU (excluding Sweden and Finland	2.1	0.5	1.0
North America	2.0	0.6	1.0
Japan	2.5	0.4	-
China	3.9	0.9	-
South America	2.5	0.3	1.1

Notes: BOF: Basic Oxygen Furnace; EAF: Electric Arc Furnace; EAF (Scrap): EAF furnace using scrap as input; EAF (DRI): EAF furnace using direct reduced iron
Source: Reproduced from OECD (2002)

The variation in steelmaking processes is similar to the scenario modeled in Figures 1 and 2. One can interpret the minimills’ production process as the clean technology in terms of carbon emissions while the integrated firms use the dirty technique. Note that there also can be important variation within production types: one BOF operation inside North America could be very carbon efficient while another BOF producer could use much older and more carbon-intensive procedures. The same could be true for EAF production.

Table 2 depicts the world distribution of these production types as reported by the World Steel Association that makes clear that there is substantial variation of steel production process used across the world. EU-27 countries produce about 58 percent of its crude steel using BOF compared to 41.4 for EAF. The U.S. has the reverse composition (only 42 percent for BOF and 58 for EAF). Most relevant for the discussion here is the wide variation across developing countries: Brazil (74.8 for BOF and 23.5 for EAF); China (90.9 for BOF and 9.1 for EAF) and India (40 for BOF and 58.2 EAF). It is also important to note that these are not unchanging percentages. The U.S. for example used to look much more like the EU in decades past.

[14] There is also a very much older process called an “open hearth furnace” (OHF), which represents a declining and very small part of world production. It is very carbon intensive and now considered obsolete.

Table 2: Crude Steel Production by Process (2008)				
	Production (million tonnes)	BOF (%)	EAF (%)	OHF (%)
EU (27)	198	58.2	41.4	0.3
U.S.	91.4	41.9	58	NA
Japan	118.7	75.2	24.8	NA
Brazil	33.7	74.8	23.5	NA
Russia	68.5	55.2	28.4	16.5
China(e)	500.5	90.9	9.1	NA
India (e)	55.2	40	58.2	1.8
World	1322.7	67.2	30.6	2.2

Notes: OHF: Open Hearth Furnace; (e): estimate; NA=not applicable
Source: World Steel in Figures 2009 (World Steel Association)

We now consider the consequences for net revenue for the various types of steel in the different jurisdictions under the assumption that the U.S. has imposed a simple domestic carbon tax of \$25/tonne of CO_2.[15] In the scenarios below (summarized in Table 3), I will use average 2009 spot prices for hot-rolled coil (HRC) of \$540, which is a common benchmark product in the steel industry.[16] I will assume that the EU and Japan have implemented similar, if not more stringent carbon reductions policies than the U.S., so that they can be ignored for the analysis below.

Table 3: Marginal revenue for hot-rolled coil								
	Technique	Carbon intensity	Baseline Scenario: No border tax	Scenario 1: Firm-specific tax	Scenario 2: Average foreign emissions	Scenario 3: Average domestic emissions	Scenario 4: "Best available" U.S. technology	Scenario 5: "Worst available" U.S. technology with foreign firm submissions
China	BOF	3.9	540	443	480	510	525	490
	EAF (Scrap)	0.9	540	518	480	510	525	518
Brazil	BOF	2.5	540	478	505	510	525	490
	EAF (Scrap)	0.3	540	533	505	510	525	533
US	BOF	2	490	490	490	490	490	490
	EAF (Scrap)	0.6	525	525	525	525	525	525
	EAF (DRI)	1	515	515	515	515	515	515

Notes and sources: (1) Carbon intensity based on OECD (2002); "Brazil" is South America in that study while "U.S." is North America; (2) Hot-rolled coil price is average of 2009 spot price. In all scenarios, tax is assumed fully absorbed by the producer.

[15] One could also analyze a more complicated emission permit emission program but the basic insights would be unchanged.

[16] These prices were obtained from www.steelonthenet.com/price_info.html

For simplicity, I do not take into account any demand- or supply-side price adjustments as a consequence of pricing carbon. Instead I only consider the static reduction in net unit revenue for the different types of technologies in different jurisdictions. The point is not to provide a prediction of the resulting market impacts of the scenarios *per se* but rather a sense of the variation of the effects across steel production types.[17] I also refer to the "U.S." and "Brazil" but the reported data are in fact those for "North America" and "South America" in OECD (2002).

Baseline Scenario: No Border Adjustment

Under the baseline scenario, the U.S. imposes a carbon tax based on the carbon footprint on all three types of U.S. firms but leaves foreign firms untouched. This leads to sharply reduced domestic net unit revenue, though with variable effects on the different U.S. steel types while foreigners continue to receive \$540 per tonne of steel. U.S. BOF firms receive \$490 per tonne while minimills using scrap as an input receive \$525 per tonne of steel.[18]

Table 4: Satisfying Policy Constraints

Constraint	Baseline Scenario	Scenario 1: Firm-specific tax	Scenario 2: Average foreign emissions	Scenario 3: Average domestic emissions	Scenario 4: "Best available" U.S. technology	Scenario 5: "Worst available" U.S. technology with foreign firm submissions
1.a Domestic firm buy-in	N	Y	?	N	N	?
1.b Foreign firm buy-in	Y	N	N	N	Y	?
2. Incentives for foreign firm CO2 reduction	N	Y	N	N	N	Y
3. Adherence to WTO rules	Y	Y	N	N	N	Y
4. Administrative tractability	Y	N	N	Y	Y	Y

Notes: Y=Plausibly does satisfy constraint; N=Does not plausibly satisfy constraints; ?=unclear
Source: Author's compilation.

How does this scenario fit into the constraints discussed above? The policy is administratively tractable in the domestic economy so meets Constraint 2, at least to the extent that the domestic government can reliably audit domestic steel carbon emissions.[19] The policy

[17] Note as well that the carbon footprint of HRC is higher than the crude steel emission numbers in Table 4, which are based on crude steel production. However, the greatest variation in carbon footprint occurs at the crude steel production stage since modern rolling operations are relatively similar across jurisdictions and processes.

[18] Note that there could be significant variability even within U.S. steel types. For example, an EAF using nuclear generated electricity would have a substantially lower carbon footprint than one using coal generated power. This would be reflected in the carbon tax (or emission permits) burden on individual domestic firms. I ignore this complication in the analysis.

[19] I will assume that such ability exists though it would not be administratively trivial. The current EU Emissions Trading System is a current example.

provides no additional incentives for foreign firms to adopt carbon emission reducing technology so Constraint 2 is not met. The policy also is consistent with WTO rules; no burdens are placed on foreign imports and MFN and national treatment rules are not violated so Constraint 3 is satisfied. The most important difficulty comes in Constraint 1.a concerning "buy-in" from domestic firms. The less burdensome impact on foreigners means that domestic steel companies will complain, i.e. raise the issue of competiveness to officials.

Table 4 contains a summary of this and other scenarios in terms of Constraints 1-4.

Scenario 2: Firm-specific Border Tax

Under Scenario 2, the U.S. government imposes a border tax of $25/tonne of CO_2 emissions to "offset" the fact that Chinese and Brazilian governments have imposed no such burdens. The impact on the unit revenue now would vary dramatically across countries and across technology types. Among all BOF producers across regions, U.S. firms would receive the highest revenue ($490) while Brazilian and Chinese firms would receive $478 and $443, respectively. Among EAF users, there is much less variation though Chinese firms are once again most affected by pricing carbon in both scenarios. The carbon efficiency of Brazilian EAF firms yields $533 per ton of steel coil, which gives them the highest net unit revenue of all firm types considered in Scenario 2.

If one assumes for simplicity that the foreigners continue to sell at an unchanging domestic price of $540 and therefore fully bear the burden of the tax, this is equivalent to an 18 percent tax on Chinese BOF steel exports (compared to 9 percent for the North American equivalents).[20] For the Chinese EAF producer, the tax is equal to only 4 percent (compared to 3 percent for U.S. firms using EAF). For Brazilian producers, this rate is much lower than their Chinese counterparts at 11 percent (BOF) and 2 percent (EAF). Notably, this means that Brazilian EAF steel producers would be taxed by a lower amount than their U.S. counterparts according to OECD carbon footprint estimates.

Imposing differentiated border taxes on imported steel does satisfy some of the policy constraints. It likely would result in support from domestic firms (Constraint 1a). It also would provide incentives for foreign firms to use the less intensive carbon technique (Constraints 2). It would plausibly be consistent with WTO national treatment rules (individual domestic and foreign firms are both charged according to their carbon emissions). And since the U.S. therefore might win a WTO dispute, foreign firms may be loath to ask their government for a formal complaint at the dispute body.

The real problem rests with Constraint 4. Unfortunately, one cannot look at the steel coil and know if it is produced by one technique or the other.[21] One cannot perform tests on the steel itself since the CO_2 is not contained in the steel but instead is emitted in the production process. Similar problems occur for requiring importers to buy emission permits as envisioned under various U.S. legislative proposals. Without cooperation by the Chinese and Brazilian

[20] Naturally, the tax incidence in practice would not fully be born by exporters but the magnitude is still instructive.

[21] There are certain steel types that currently cannot be produced economically using EAF processes (e.g. exterior grade auto steel) because of the impurities present in recycled steel. For many other products, including flat rolled coil used in many situations, EAF and BOF processes could both be used. Moreover, the range of items where EAF produced steel is used has expanded dramatically in recent years; a few decades ago, minimills produced only for the low-end long product market such as rebar.

governments and their respective industries, such a program would be extremely difficult to administer. In short, this brings up all of the informational issues addressed above.

The administrative burdens also extend to Chinese and Brazilian firms covered by the program and likely result in vociferous opposition to the policy abroad. It is not clear that a foreign government would be able to win a case at the WTO but there would be intense domestic pressure from now-burdened exporting firms for some form of retaliation by the exporting country government. But it is highly likely that at least some foreign firms might decide not to cooperate so that the U.S. authority would have to decide what information it would use to assess the carbon footprint of non-cooperating firms. This raises a whole host of issues that have been confronted, albeit contentiously, in antidumping investigations where many foreign firms do not cooperate with investigators.

Scenario 3: Border Tax Based on Average Foreign Emissions

Suppose that the U.S. government views the policy of Scenario 2 as impractical because of informational difficulties of firm-specific duties.

Under Scenario 3, the U.S. could impose a separate tax on the *average* for Chinese and South American emissions. In this particular example, this could mean a simple unweighted emissions average of 2.4 tonnes of CO_2 or a charge of \$60/tonne of steel, with resulting net revenue of \$480 for *all types* of Chinese firms, regardless of the production technology used in practice. For Brazilian companies, the unweighted average emissions are 1.4 tonnes of CO_2 per tonne of steel, which is equal to a tax of \$35/tonne of steel when a tonne of carbon is priced at \$25 for net unit revenue of \$510.

This option might receive support from U.S. firms (Constraint 1a). All U.S. EAF producers receive higher unit revenue than every foreign EAF country counterpart. U.S. BOF producers receive more than Chinese BOF producers but less than Brazilian BOF firms. Ultimately, their support would depend on the capacity of less burdened competitors to displace U.S. BOF producers in the marketplace.

This policy however creates few short-term incentives for individual foreign firms to switch to the less carbon-intensive process than the differentiated tariff since they are charged the same for both types of steel. If there were large firms that understand that they can affect the average (e.g. Mittal in India) then there would be some incentives to change the carbon intensity. Nonetheless, for small firms there would be no such incentive so that I consider this still a violation of Constraint 2.

Scenario 2's administrative burden superficially would be less onerous than the firm-specific tax of Scenario 1. In fact, it is just as complicated since the inputs into the calculation of average emission calculation are, of course, the individual firm emission numbers. One might take a sample of foreign firms as in the "all others rate" in the antidumping context, but this raises a host of problematic issues on the appropriate sampling techniques. This certainly has been a contentious issue in antidumping cases. So Constraint 4 is violated for the same reasons as in Scenario 1.

An unweighted average across steel types also is unlikely. Instead, one would probably expect that U.S. authorities would choose a weighted average based on by the amount of production of each type of steel in each jurisdiction. (See Table 2.) Thus, the composition of steel production techniques in each jurisdiction would be very important. Once again, administering authorities would confront very difficult decisions and requirements. For example, would the weights be based only on steel exports? Only on steel destined for the U.S.? Or all of Chinese or Brazilian domestic production, regardless of the final market? One might argue that it should be the latter since carbon emissions have global rather than local environmental effects. But in all scenarios, one would have to determine how much steel of each type is produced in each country so that averaging does not fully obviate the need for detailed information about foreign firms' behavior and production techniques.

There are also problems from the standpoint of WTO consistency. Since the U.S. would be treating all foreign firms within each affected country alike but allowing the burden on domestic firms to vary across enterprises based on the individual emissions, the Chinese and Brazilian governments might have a strong case at the WTO dispute similar to the arguments found in the U.S.-Gasoline case (i.e. a violation of Constraint 3). In addition, both types of Chinese firms and Brazilian EAF firms would be earning less than either of the U.S. firms using the same technology so that they would likely support a WTO case. Foreign firm support for the policy also would be unlikely given the substantial compliance costs (violation of Constraint 1b).

Scenario 4: Border Tax Based on Average Domestic Emissions

Mattoo *et al.* (2009), recognizing the informational constraints as well as the high resulting tariffs associated with CBTAs based on foreign information, have suggested instead that foreign producers be charged based on average *domestic* carbon emissions in the targeted industry. This reduces significantly the informational burden since domestic authorities would be in a much better position to acquire data and even audit the data from domestic firms and thus more likely to pass Constraint 4.

Under this proposal (Scenario 3), the average of carbon emissions for U.S. steel would be based on three different basic production types: BOF, EAF (Scrap), and EAF (DRI). The unweighted average would be 1.2 CO_2 tonnes per steel tonne based on the OECD 2002 estimates in Table 1. This would result in an equal tax burden of $30 per tonne for all types of Chinese and Brazilian steel, with net marginal revenue of $510 per tonne of HRC for both countries. In this case, BOF producers in both countries would be better off compared to either scenario based on foreign carbon footprints. Not surprisingly, carbon efficient EAF producers receive less unit revenue. For the Chinese EAF firms, revenue is only slightly below the situation where the tax burden is based on their own emissions ($510 vs. $518). Brazilian EAF producers, with the smallest carbon footprint of all firms, would face 4.3 percent lower revenues ($510 vs. $533).

This option certainly has some advantages, most notably relatively low informational costs and ease of implementation. However, there would still be some practical problems. For example, the average domestic carbon emissions are not unchanging---it depends on the composition of U.S. steel output. Is this historical? Based on what period? In 1991, minimills represented only 24 percent of U.S. crude steel production (Moore, 1996) compared to 58 percent in 2008. Using the earlier period for assessing the weighted average would increase the burden on foreign firm. U.S. firms might argue that using this earlier period would better reflect contemporary Chinese production patterns and insist on its use. Chinese producers would prefer 2008 U.S. production patterns be used. Which in the end would be used? Would it change over time?

There certainly could be a potential WTO challenge to this system. All foreign firms would be treated identically while domestic firms would see their carbon charge burden vary depending on their own decisions. This would run afoul of the WTO requirements of national treatment (i.e. violates Constraint 3). This system also provides no incentives for foreign firms to alter their carbon footprint since they are burdened equally (Constraint 2). Indeed, since implementing carbon reducing technologies is likely expensive, then foreign firms would be less likely to do so if they are charged the same as those using carbon intensive processes. The prospects for buy-in from foreigners is unlikely; a WTO case would likely be won so they could hope to revert to the situation where they all receive more unit revenue (i.e. under the baseline no tax scenario).

Finally, and most importantly from a political economy standpoint, under Scenario 3, all foreign firms would be burdened less than large integrated U.S. BOF producers, which would receive only $490 per tonne. In other words, Constraint 1a would surely be violated so that an important domestic constituency would oppose the policy.

Scenario 5: Border Tax Based on "Best Available" Domestic Technology

Ismer and Neuhoff (2007) have proposed a different method to avoid some of the informational problems associated with a firm-specific taxation approach for foreign firms. In particular, they argue that foreign products be taxed at the border according to the "best available technology" used by a U.S. producer. This approach (Scenario 5) would have distinct advantages in terms of implementation and impose upon foreigners the best-case-scenario tax relative to domestic producers.[22]

For the particular example summarized in Table 3, this approach likely could garner foreign participation. Each foreign firm receives $525 in marginal revenue, which exceeds net unit revenue for all foreign firms in Scenarios 2 through 4, except for the very efficient Brazilian EAF producers (which receive $533 under the differentiated tax approach in Scenario 2) and only slightly below the $540 marginal revenue of no intervention. Thus, Constraint 1b might be satisfied. It is true that foreign firms do not receive "national treatment" since they do not receive differential taxation as do domestic firms so that pressure for a WTO dispute case still would be possible.

There are some administrative burdens for the U.S. government to identify the domestic "best available technology." In fact, the domestic firms have an incentive to miscast their best carbon emissions since this determines the burden imposed on foreign firms. The U.S. authorities would have to carefully assess the submissions about technology but it is plausible that Constraint 4, which concerns domestic administrative feasibility, would be met. As with other uniform border tax adjustments, this approach would not provide incentives for foreign firms to adopt this "best available technology" or any carbon emission reducing technology so that Constraint 2 is not satisfied.

The feasibility of this plan is even more problematic from a domestic political standpoint, i.e., Constraint 1a would be violated. In particular, it is not clear that domestic firms using BOF and EAF (DRI) would agree to let all foreign firms face a tax burden based on the most efficient domestic firms (U.S. EAF (scrap)); domestic opposition is very likely.

[22] Their specific approach would only count CO_2 created by the processed inputs plus an allowance for the fuel mix for energy but only at the regional rather than firm level. This approach would help limit the information needs of the government.

Scenario 6: Border Tax Based on "Worst Available" Domestic Technology with Foreign-Initiated Adjustments

The two biggest problems of the Ismer and Neuhoff approach are potential gaming of information provided by domestic firms to establish the "best available technology" and a lower tax burden on foreign firms than on some of the U.S. companies.

One potential way around this is a two-fold approach that applies the "worst domestic technology" tax burden to foreigners but allows individual foreign firms to volunteer to provide information to lower their tax burden.

Under this arrangement, every Chinese and Brazilian firm would initially be taxed based on the highest reported carbon emission by a U.S. firm producing the product.[23] In this steel industry example, this would be a \$50 per tonne tax (i.e., 2 tonnes of CO_2 per tonne of steel at \$25/tonne) based on U.S. BOF producers. Every foreign firm would have the right, but not the requirement, to provide information to U.S. authorities in order to establish that it had lower emissions than the most carbon-intensive U.S. producer. Investigations on the carbon footprint therefore would be done with a maximum of cooperation from foreign firms.

This arrangement has some analogs in antidumping procedures. If a foreign respondent in an antidumping investigation does not submit reliable information to a domestic administrator, then "adverse" facts available (typically the allegations of the domestic petitioner) are used to calculate dumping margins. In the case of a "non-market-economy" such as China, a surrogate country's factor and input prices (such as Bangladesh or India) are used in conjunction with Chinese-provided information about input quantities. In the current context, the domestic authority is assuming a kind of "worst case" scenario based on domestically provided information but allowing the foreign firm to provide information to adjust its burden.

The results for Scenario 6 are displayed in Column 5 of Table 4 where I assume that all foreign firms that have a less carbon intensive process than the "worst technology" U.S. firm ask for adjustments based on their own emissions.

This approach would have some advantages. U.S. firm would not have an incentive to misrepresent the technology used to establish the tax (as in the Ismer and Neuhoff case). "Padding" the carbon intensity would result in higher burdens on their own operations and foreign firms would be able to avoid this tax burden through their own submissions. U.S. authorities would only conduct carbon intensity investigations if a foreign company voluntarily asks for such an adjustment, which would help ensure cooperation. This of courses helps satisfy Constraint 4.

All foreign firms can receive higher revenue from adopting less carbon-intensive methods (i.e. Constraint 2 is satisfied).

There is some question whether this scenario would preclude a WTO dispute (Constraint 3). On the one hand, domestic and foreign firms are not treated exactly alike. On the other hand, U.S. administrators could argue that *any* foreign firm would have its carbon tax burden adjusted in a way analogous to U.S. firms just for the asking. This would create a plausible scenario wherein foreign governments might not bring a WTO case.

[23] In practice, this would likely be the average for some percentage of U.S. production.

We see that each foreign firm receives unit revenue of equal to or greater than those under the differentiated approach tariff approach (i.e., Scenario 1). However, since each firm also receives less than under the baseline no-tax scenario, their ultimate support would be unclear.

The greatest uncertainty would come from U.S. firms' acceptance of the arrangement. While no foreign firm gets less burdensome carbon taxes than a U.S. firm (as is the case for some firms under Scenarios 1 through 5), inefficient foreign firms are not as burdened as under the differentiated tax case of Scenario 2. Domestic firms might try to hold out for such an outcome but, as noted above, the administrative burdens of obtaining specific firm data from often uncooperative foreign companies probably precludes that approach in any event.

Standards of how to assess foreign information submissions could also be fraught with difficulties. In the antidumping analog, there are frequent arguments about whether data supplied by foreign firms is accurate. In addition, there are a myriad of small decisions that allow discretion on the part of domestic investigators to raise or lower the antidumping duty. Similar discretion in a carbon footprint investigation might easily be imagined, even when there is an attempt by foreigners to cooperate.

In summary, this discussion above makes clear that there are significant problems for any of the carbon tax proposals. They range from clear violations of WTO rules to extremely complicated administrative procedures needed to calculate foreign firms' carbon footprint. But there are other issues that apply to all approaches.

Circumvention is probably the most daunting problem. Arbitrageurs would have incentives to buy, for example, Chinese BOF steel (in most scenarios subject the highest tax in many of the scenarios) and label it as EAF steel before sending it to the U.S. Even if there were a common carbon tax imposed on all Chinese steel, there would be similar incentives to pass the product off as coming from a country with a strict carbon emissions system like Germany. (These problems are quite familiar to those who follow antidumping duties where allegations of circumvention are very common.) Of course, there would be a possibility of a system of rules of origin that would attempt through bureaucratic means to identify the true source of a product, but this would be extremely cumbersome for products for which their origin is unclear from their physical characteristics.

Countries faced with carbon tax burdens would also have an incentive to shuffle their production around so that only the "clean" products are sent abroad while the identical product using carbon-intensive methods would be sold at home. This would satisfy the formal procedures but undercut the point of the exercise.

There is also the general problem that steel subject to these types of taxes would arrive at the border instead embodied in further processed goods such as automobiles. This is a common problem with garden-variety protection. But it does raise the possibility that if a carbon border tax scheme does come into play in the future, there will be pressure to impose similar taxes on downstream products. Such an attempt would make the administrative burdens in the examples above pale in comparison.

IV. Conclusions

Policymakers face a very difficult set of constraints as they try to develop a policy for carbon border taxes They must deal with the domestic political pressures to impose such taxes but in a way that both meets the obligations of international trade rules but also with acceptable administrative costs, all the while avoiding the potential for foreign trade retaliation.

Many politicians have called for "carbon tariffs" or their equivalent on imports from countries that are not imposing similar burdens on their own manufacturers. In the case of Europe, these pressures are rising because of the looming pressures as the EU cap-and-trade schemes start to bite more heavily. In the U.S., adopting such a tax may be one of the costs of establishing any kind of a climate change law at all. The results described above suggest that while politicians may have strong incentives to try to impose such a carbon tax program, the practical realities are such that they will be very difficult to implement.

But the general approach of taxing foreign products based on their carbon content is just too fraught with administrative difficulties to make it viable. Even more disturbing, a system based on invasive and aggressive investigations by domestic authorities seeking out detailed information about foreign firms intimate commercial and technological decisions is eerily reminiscent of controversial antidumping investigations. The lessons from antidumping suggest that such an intrusive approach should be avoided at all costs because of its corrosive effects. Frankel (2009) for example recognized this and proposed an "independent panel of experts" should be responsible for collecting the requisite data instead of self-interested parties. This would certainly be a welcome approach but the antidumping experience suggests that this is an unlikely outcome. Instead, domestic investigators with potentially aggressive and even biased approaches would be more likely to administer such a program. And the more discretion that administrators have (and they would likely have considerable leeway given the complicated nature of the investigations) the more likely that controversies will arise about the reasonableness of their inquiries.

Alternatives to taxes on firm level carbon content also have strong difficulties. They either raise real problems associated with WTO consistency, similar data issues, or likely domestic industry blowback. There just are no easy alternatives.

A far more benign approach would be to leave each country to its own policies and move towards a system of rigorous labeling about the carbon-content of products. This kind of a voluntary program, based perhaps on work of a neutral actor such as the International Organization for Standardization, would not have the coercive teeth of a border tax but would enable a cooperative approach so that consumers who care could make purchases based on carbon footprint. However, this type of voluntary approach presumes a level of cooperation across countries with very different attitudes towards the interaction between economic growth and carbon emissions. At this stage, such cooperation does not seem likely.

Under the current multilateral trading system, the WTO dispute settlement system is potentially in the middle of a very difficult situation. The current lack of a multilaterally negotiated arrangement to regulate carbon taxes on international trade may mean that the Appellate Body might have to rule on the "legality" of domestic climate change legislation. This might entail choosing either to adhere to current legal standards of the international trading system or opening a potential Pandora's box of import restrictions under the guise of environmental protection. Far better would be for major trading nations to agree to a system with clear rules on how to measure and verify carbon emissions and the implications for import restrictions that the WTO would then enforce. Otherwise, the imposition of carbon tariffs have the real possibility of leading the world to a debilitating escalation of trade disputes with the WTO Appellate Body determining legal standards with little "legislative" input from Member governments. This research makes clear that the current policies under consideration are fraught with serious problems without further guidance from Members.

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