

**TRADE AND ENVIRONMENTAL POLICY: A RACE TO THE BOTTOM?\*\*\***

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## 1. Introduction

Over the past fifteen years, the connection between trade and environmental policy has been the subject of considerable debate between the trade policy community and environmentalists. This debate was given much prominence during negotiations over the North American Free Trade Agreement (NAFTA) (e.g., Bhagwati and Daly, 1993), and has become more intense with completion of the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) and the subsequent formation of the World Trade Organization (WTO) (Ulph, 1997; Anderson, 1998; Copeland and Taylor, 2004). Two important and related questions arise from this debate: first, what is the connection between trade and the environment, and second, what is it about this connection that has stirred up such heated argument?

Ulph (1997) argues there are three factors that create a link between trade and the environment.<sup>1</sup> First, if the structure of production and consumption activities across countries is affected by trade, and if these activities negatively impact the environment, then by extension trade will also affect the environment. Of course the dual to this is that environmental policies targeted at production and consumption activities will also affect the pattern of trade. Second, production and consumption activities in one country may result in global environmental effects either in the form of trans-boundary pollution such as acid rain, or other spill-over effects such as depletion of the ozone layer due to the use of chlorofluorocarbons (CFCs). As a consequence, trade policy may be used as an instrument by the affected countries to reduce the damage they incur from public bads if they trade with the offending country. Third, and linked to the latter point, trade policies often form part of a package of sanctions designed to enforce international environmental agreements. For example, the Convention on International Trade in Endangered

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<sup>1</sup> See Bredahl *et al.* (1996) for a discussion of this issue specific to agriculture.

Species of Wild Fauna and Flora (CITES) prohibits the import and export of endangered species, including trade with non-parties to the convention (Hudec, 1996).

Why then has the connection between trade and the environment stirred up so much controversy?<sup>2</sup> First, environmentalists have argued that any benefits from increased trade liberalization will be outweighed by damage caused to the environment, i.e., more trade will result in increased consumption and production, which in turn will cause more environmental degradation (Ulph, 1997). For example, in the case of agriculture, environmentalists express concern about the impact of increased world commodity prices on developing country production in terms of deforestation and greater chemical use (Anderson and Strutt, 1996). Counter to this, economists have argued that trade and economic growth may be good for the environment (Antweiler, Copeland and Taylor, 2001; Copeland and Taylor, 2004). Specifically, if demand for environmental quality is a normal good, then increased national incomes resulting from trade liberalization will eventually generate an increased demand for environmental improvement.

Support for this argument draws on what is termed the environmental Kuznets curve (EKC) which hypothesizes an inverse-U-shaped relationship between per-capita incomes and environmental quality, i.e., increased incomes are linked to increased pollution in poor countries and lower pollution in rich countries.<sup>3</sup> There is a continuing discussion in the literature of the theoretical basis for this link. In particular, Copeland and Taylor (2004) argue that because the EKC literature relies on simple, reduced-form estimation, it is unable to isolate the income effect

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<sup>2</sup> Popular concerns about trade and the environment were particularly strong after the public release of a 1991 internal memorandum by Larry Summers when he was chief economist for the World Bank, which began by stating, "...Just between you and me, shouldn't the World Bank be encouraging more migration of dirty industries to the less developed countries?" Mokhiber and Weissman, *San Francisco Bay Guardian*, (1999) <http://www.globalpolicy.org/soecon/bwi-wto/sumers99.htm>.

<sup>3</sup> Empirical work on the EKC was stimulated by Grossman and Krueger's (1993) seminal paper on NAFTA. Using data for sulfur dioxide, they concluded that any income gains from trade liberalization due to NAFTA would result in lower pollution in Mexico.

from other effects such as capital-accumulation and export-led expansion that may put pressure on the demand for environmental inputs. In addition, the various explanations put forward for the EKC place specific restrictions on both preferences and technology.<sup>4</sup> Nevertheless, Copeland and Taylor (2004, p.8) conclude that, “...the EKC literature...has provided quite convincing evidence that there is an income effect that raises environmental quality.”

The second aspect of the controversy is the concern that with increased trade liberalization under the auspices of the GATT/WTO, governments will not set optimal environmental policies, due to the fact that they are now constrained in their use of trade instruments.<sup>5</sup> Specifically, environmentalists are concerned that with the process of international economic integration come additional competitive pressures. These pressures will result in lobbying for less stringent environmental policies (Ulph, 1997).<sup>6</sup> This argument is typically applied to developed countries where international competition may be expected to hurt domestic industries either through loss of market share or movement of those industries from developed countries with tough environmental standards to less developed countries with weaker environmental standards, i.e., a “pollution haven” effect (Copeland and Taylor, 2004).<sup>7</sup>

As a result of this possibility, environmentalists worry that developed country governments will either resist implementing tough environmental standards in a process Bagwell and Staiger (2001a) term “regulatory chill” or they will reduce the stringency of existing environmental

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<sup>4</sup> Copeland and Taylor (2004) list four explanations for the EKC: (i) assuming policy is income-inelastic, if per-capita incomes initially rise via capital accumulation and then acquisition of human capital, this results in increasing then decreasing pollution; (ii) demand for environmental quality is income elastic; (iii) at early stages of development, pollution is either unregulated or policies do not bind, and then it reaches a threshold and policy is either implemented or it starts to have an effect; and (iv) there are increasing returns to pollution abatement.

<sup>5</sup> This concern was given tremendous impetus by the 1991 GATT ruling in the US-Mexico tuna-dolphin dispute, where it was found GATT-illegal for the US to ban the import of tuna from Mexico because they used less dolphin-friendly fishing methods (Hudec, 1996).

<sup>6</sup> Bhagwati and Srinivasan (1996) have a nice discussion of the claimed “unfairness” of differential environmental standards.

<sup>7</sup> While the focus in this paper is on environmental standards, much of the argument can be applied to issues such as standards applied to animal welfare.

standards in a “race to the bottom” (Bhagwati and Srinivasan, 1996; Anderson, 1998; Bagwell and Staiger, 2001a), which in turn can create a process of “ecological dumping” where all governments relax their environmental policies (Rauscher, 1994; Ulph, 1997).<sup>8</sup> These fears have led to calls for individual governments to be allowed to use trade policies to countervail ecological dumping (Arden-Clarke, 1991), and also for international bodies such as the WTO to push for harmonization of environmental standards across countries (Bhagwati and Srinivasan, 1996; Bagwell and Staiger 2001b).<sup>9</sup>

The main focus of this paper is on the issue of regulatory chill and a race to the bottom in environmental standards and policies. In particular, it explores the possibility that resolution of this problem may lie in the broader application of existing GATT/WTO rules on border tax adjustments for environmental taxes. The structure of the discussion is as follows: first, a brief outline of the standard analysis of trade and environmental policy is laid out, allowing an initial evaluation of the environmentalists’ position; second, the theoretical analysis of and empirical evidence for the existence of pollution havens will be reviewed; third, the main arguments as to why governments may weaken domestic environmental policy with greater trade liberalization will be outlined; fourth, some recent analysis of border tax adjustments for environmental taxes by McCorrison and Sheldon (2005a) is briefly laid out, leading to the basic conclusion of this paper: a method for countering any tendency for regulatory chill and a race to the bottom in environmental policies is already embedded in existing GATT/WTO rules.

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<sup>8</sup> Rauscher (1994) notes the popular definition of ecological dumping is one where environmental standards in one country are lower than another. He suggests a better definition is one where firms can sell on international markets at prices below the marginal social cost of production.

<sup>9</sup> The WTO Committee on Trade and Environment, set up at the formation of the WTO, is essentially a response to concerns about a race to the bottom (Bagwell and Staiger, 2001b).

## 2. Traditional Analysis of Trade and Environmental Policy

In order to understand economists' typical response to the arguments put forward by environmentalists against increased trade liberalization, it is useful to lay out briefly the standard analysis of commercial policy in the presence of market distortions, the discussion loosely following that presented in Bhagwati and Srinivasan (1996) and Ulph (1997).<sup>10</sup> Assume that households and firms act competitively, damage caused to the environment is purely domestic, and the available environmental policy instruments are either an emissions tax or standard. In addition, assume that factors of production are internationally immobile, and if international prices are endogenous, there is no foreign retaliation against domestic policy choices. Pollution is assumed to be caused by production, with production of  $n$  goods generating  $m$  pollutants.

Suppose a country is small. First-best policy requires that it set tariffs to zero, and that it should either set an emissions tax equal to marginal pollution costs or set an emissions standard so that marginal abatement costs equal marginal damage costs. In addition, if all countries follow this policy choice, global resource allocation is Pareto efficient.<sup>11</sup> However, as Bhagwati and Srinivasan (1996) note, there is no reason why optimal emissions taxes (standards) should be equal across all countries, due to differences in technology, endowments and preferences.

If the government is unable to set first-best environmental policy, the optimal trade policy will depend on the environmental policy instrument. With an emissions tax, imports should be subsidized, thereby reducing domestic production. For emissions standards, if these are not set at the first-best level, free trade remains optimal as the externality is being targeted by a quantity restriction. Hence, in a second-best setting, trade policy substitutes for environmental policy.

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<sup>10</sup> Essentially this is an application of the optimal policy targeting literature, e.g., Johnson (1966), Bhagwati (1971), and Dixit (1985). Ulph (1994; 1997) contains the proofs.

<sup>11</sup> In the case of trans-boundary pollution, a Pareto efficient allocation requires a cooperative equilibrium between countries where free trade is pursued, but each country sets either emission taxes equal to global marginal damage costs or standards that equate marginal abatement costs with global marginal damage costs (Ulph, 1994).

Alternatively, if tariffs are not zero, the second-best policy will be to set the environmental tax below the first-best level in order to encourage imports, if imports would otherwise be too low. Alternatively, if weaker environmental policy actually discourages imports, the environmental tax should be raised above the first-best level. The same rule will hold for emissions standards.

Turning to the case where a country is large, world prices are now endogenous. As a result, first-best policy requires use of an optimal emissions tax along with an optimal tariff, the latter being inversely proportional to the elasticity of net import demand for each good, assuming import demand depends only on the own-price of each good.<sup>12</sup> This is the standard optimal tariff argument where a large country can improve its terms of trade by exercising its market power (see Bhagwati, Panagariya, and Srinivasan, 1998).<sup>13</sup> Of course this solution will not result in a Pareto optimal allocation of resources.<sup>14</sup> In the case of second-best, suppose tariffs are not optimal, the emissions tax should be set either above or below marginal pollution costs, depending on whether the country is a net exporter or importer of a specific good. Here, the level of the emissions tax reflects the extent to which tariffs deviate from their optimal value, the objective being to change domestic production costs, and thereby improve the country's terms of trade. If emissions standards are not first-best, then the optimal tariff should still be used. If optimal tariffs are not used, then second-best emissions standards vary in the same way as second-best emissions taxes.

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<sup>12</sup> Formally, this analysis ignores income effects, and also assumes separability between the externality and consumption demand (Ulph, 1994; 1997)

<sup>13</sup> For a net exporter, a tariff raises the world price, generating monopoly rents, while for a net importer a tariff lowers the world price, generating monopsony rents.

<sup>14</sup> In the large country case, if there is trans-boundary pollution, and each country takes other countries' policies as given, first-best requires optimal emissions taxes and tariffs that take into account the effect of world prices on foreign emissions, i.e., if higher world prices increase foreign pollution, import tariffs should be increased in order to drive down the world price, and hence pollution. In the case of emissions standards, tariffs have no effect on foreign pollution, so domestic environmental policy has to deviate from first-best, taking account of how it impacts foreign pollution damage (Ulph, 1994).

Some key points can be drawn here concerning the debate between economists and environmentalists over trade liberalization. First, in the presence of a production externality, it is quite possible that the benefits of increased trade will be outweighed by environmental damage (Pethig, 1976; Anderson, 1992). However, the analysis laid out shows that the first-best policy would be to target this distortion at source through the use of optimal environmental policy, in which case the usual gains from trade apply (Anderson, 1992). Second, in a first-best solution, there is no reason why environmental policies will be the same across countries, and as a consequence, attempts to harmonize standards are likely to be welfare-reducing (Bhagwati and Srinivasan, 1996; Ulph, 1997). Third, there is nothing in the analysis to indicate that there will necessarily be a race to the bottom. If a country is small, a government has no incentive to set non-optimal environmental policies as they are unable to influence their terms of trade, and non-targeted externalities simply reduce welfare. In the case of a large country, while governments have an incentive to manipulate their terms of trade, the first-best policy is to use an optimal tariff in combination with the appropriate environmental policy. If environmental policy is second-best, distorting tariffs may substitute for first-best emissions taxes. Alternatively, if trade policy is second-best, environmental policies will deviate from first-best, however, there is nothing to suggest, *a priori*, that all governments will set less stringent environmental policies, i.e., net exporters will actually set tougher environmental policies in order to maximize monopoly rents.

This would seem to suggest that the environmentalists have no case. However, the analysis rests on three key assumptions: there is no retaliation when individual large countries manipulate their terms of trade; markets are perfectly competitive, and factors are immobile. The first two points relate to what Copeland and Taylor (2004) describe as “tariff substitution”, i.e., with trade

liberalization, governments will weaken their environmental policy as a substitute for trade policy. As discussed earlier, it is optimal for a large country to manipulate its terms of trade through the use of optimal tariffs. However, in Nash equilibrium other countries also have this incentive, resulting in a Pareto-inferior outcome. Consequently, countries can avoid this Prisoners' Dilemma by entering a binding trade agreement to remove tariffs (Bagwell and Staiger, 1999). However, unless the trade agreement also places restrictions on the use of environmental policies, these will of course be used as alternative instruments to manipulate countries' terms of trade. As shown by Bagwell and Staiger (2001b), the incentive to manipulate the terms of trade through environmental policy, can result in race to the bottom effects, for which they offer a potential solution in terms of an adjustment to current GATT/WTO rules. In the case of imperfect competition, it is well-known from the strategic trade literature that governments have an incentive to use trade policy instruments such as export subsidies to shift rents to domestic firms (Brander and Spencer, 1985). Without trade instruments, there is an incentive to substitute environmental policies, resulting in ecological dumping (Ulph, 1997). Finally, the regulatory chill and race to the bottom arguments only make sense if there can be "capital flight", foreign investment being targeted at pollution havens, presuming of course cross-country differences in the stringency of environmental policy.<sup>15</sup> The theoretical analysis of and empirical evidence for pollution havens will be examined in the next section, followed by a section discussing the issue of tariff substitution.

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<sup>15</sup> Copeland (1994) does allow for a subset of factors of production to be internationally mobile in the small country case when analyzing optimal policy, showing that the welfare benefits of an increase in emission taxes towards the first-best level are larger than the case where factors are immobile. In the large country case, Ulph (1994) notes that a capital exporting country will have an incentive to relax its environmental policy in order to increase the rate of return on its domestic capital, and drive up the rate of return on foreign investment by reducing the export of capital, i.e., a capital-rich country will have lower environmental quality.

### 3. Pollution Havens

Copeland and Taylor (2004, p.29) note, "...a major preoccupation of the literature has been an investigation of which countries attract dirty industries when trade is liberalized..." In order to understand the arguments, it is useful to sketch out two competing hypotheses concerning industry location: the *pollution haven* hypothesis, which states that, at the margin, dirty industries will locate in countries with weak environmental policies, the latter typically being lower income, less developed countries; and, the *factor endowments* hypothesis, which states that it is differences in factor endowments or technology determine the pattern of trade not differences in environmental policy.

Following Copeland and Taylor (2004), assume two regions in the world, North and South, the only difference between them being their factor endowments and/or their environmental policies. In all other respects they are identical. Each region produces two goods,  $X$  and  $Y$  under constant to returns, using capital  $K$  and labour  $L$ . Good  $X$  is capital-intensive in production, while good  $Y$  is labour-intensive. In addition, production of good  $X$  generates pollution emissions of  $Z$ , production of good  $Y$  being clean.<sup>16</sup> Each region has  $N$  identical consumers who maximize utility, treating pollution as given. Preferences over  $X$  and  $Y$  are homothetic, and the utility function is separable with respect to goods and environmental quality  $Z$ , the latter being a pure local public bad. Pollution is regulated through either an emissions tax  $\tau$  or through a system of tradable emissions permits, where government sets the total level of pollution  $Z$ , and the price of permits  $\tau$  is market determined.

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<sup>16</sup> In terms of an agricultural example, one might think of  $X$  as soybean production, which requires land and capital, the North and South regions being the US and Brazil respectively. In addition, assume that soybean production affects the environment in terms of its impact on land-use and water-quality.

Let the price of good  $X$  be  $p$ , and let good  $Y$  be the *numeraire*. Assuming perfect competition, and full employment of factors, the output of each good is given as:

$$x = x(p, \tau, K, L) \quad (1)$$

$$y = y(p, \tau, K, L). \quad (2)$$

Relative supply and demand analysis can now be used to illustrate the two competing hypotheses for industry location and trade. Given the assumption about preferences, demand for  $X$  relative to  $Y$  is independent of income, such that  $RD(p)$ , where  $RD'(p) < 0$ . As North and South are identical, the relative demand curve is the same for each region. Given (1) and (2), and the assumption of constant returns, relative supply can be written as a function of  $K/L$  and prices:

$$RS(p, \tau, K/L) = \frac{x(p, \tau, K/L, 1)}{y(p, \tau, K/L, 1)}, \quad (3)$$

an increase in  $p$  resulting in an increase in the supply of  $X$  relative to  $Y$ .  $RS$  will differ across the two regions depending on the differences between their environmental policies and factor endowments. In figure 1, if each region were initially identical, autarky prices would be same, and there would be no reason to trade. Suppose pollution policy is exogenous, and that it is less stringent in the South,  $\tau > \tau^*$ , their relative supply shifts to  $RS^*$ , factors moving from industry  $Y$  to  $X$  (variables with a \* refer to the South). Autarky prices now differ between the two regions,  $p^A > p^{A*}$ , reflecting comparative advantage. With free trade, the North imports the dirty good,  $X$  from the South, while the South imports the clean good  $Y$  from the North, the equilibrium world price being  $p^T$ . As a result, production of  $X$  contracts in the North, and expands in the South, and because policy is fixed exogenously, pollution increases in the South and declines in the North, i.e., there is a pollution haven in the South. Depending on how weak pollution policy is in the

South, it may actually lose if the externality is not fully internalized, despite the increase in its income. In addition, world pollution will tend to increase.<sup>17</sup>

Now allow for pollution policy being endogenous. Suppose each region has the same number of consumers, and endowment vectors are such that  $K=\lambda K^*$  and  $L=\lambda L^*$ , where  $\lambda>1$ . The capital-to effective labour ratio  $K/L$  is the same across regions, but North's labour is more skilled than that in the South. As a result, the North is richer than the South, and given environmental quality is a normal good, then  $\tau > \tau^*$ , assuming each country takes world prices as given. Referring to figure 1,  $RS$  for the North again lies to the left of that for the South  $RS^*$  for any given world price  $p$ . With free trade, the North again imports the dirty good  $X$  from the South and exports the clean good  $Y$  to the South, i.e., the low income region becomes the pollution haven. Pollution falls in the North due to both substitution and income effects of increased trade inducing the policymaker to make environmental policy more stringent. At the same time, pollution increases in the South and the world if the income effect is not too strong, as the dirty industry shifts to the South (Copeland and Taylor, 1994). However, as environmental policy is endogenous, both the North and South fully internalize the externality, and, therefore, trade is welfare-increasing for both regions.

Assume again that environmental policies are exogenous, and that  $\tau = \tau^*$ , but relative factor endowments are such that  $K/L > K/L^*$ . If emissions intensities are constant,  $RS$  for the North lies to the right of that for the South in figure 2. With free trade, the relatively capital-abundant North exports the dirty good  $X$  and its pollution increases, and vice-versa in the South. This result contrasts with the pollution haven hypothesis: if the South is relatively abundant in  $L$ , the factor used intensively in the clean industry  $Y$ , its pollution will actually fall with free trade.

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<sup>17</sup> In the agricultural example, one could argue, *a priori*, that relatively strict environmental standards and land-use regulation imposed on US soybean producers may in the long-run result in further increases in Brazilian soybean production and exports to the US.

What if North and South differ in both their pollution policies and factor endowments? It is reasonable to assume that a rich North is both capital abundant and has more stringent environmental policies relative to the poor South. As a result, its relative abundance in capital tends to make it an exporter of the dirty good  $X$ , while its tougher environmental policy tends to make it an importer of the dirty good.<sup>18</sup> Consequently, the pattern of trade depends on which effect is stronger (Copeland and Taylor, 2003). Importantly, if relative factor endowment differences dominate, the rich North will export the dirty good  $X$ , even though it has more stringent environmental policy, reversing the pollution haven hypothesis. In addition, global pollution will be reduced as production of  $X$  shifts to the North where environmental regulation is more stringent compared to the South (Copeland and Taylor, 2003).

In terms of empirical support for the pollution haven hypothesis, two types of analysis have been conducted.<sup>19</sup> First, due to a lack of consistent cross-country pollution data, industries have often been classified as either clean or dirty, the classification typically being based on US data for either emissions intensity, toxic intensity, or abatement costs as a fraction of value added.<sup>20</sup> Assuming this classification holds across time and space, a cross-country panel of data for trade and output trends is then regressed on variables such as income, income growth rates, and openness. For example, Low and Yeats (1992) found that over the period 1965-88, the share of dirty goods in industrial country exports fell from 20 to 16 percent, but at the same time rose for less developed countries, e.g., from 21 to 28 percent in Eastern Europe, and from 17 to 21

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<sup>18</sup> In the soybean example, there will likely be competing forces at work. On the one hand, the US may have relatively strict environmental standards and land-use regulation, but it has very productive capital in the agricultural sector, free access to genetically modified (GM) varieties, and an efficient commodity handling/transport system in place, allowing it to maintain a comparative advantage in soybean production. On the other hand, Brazil has a large endowment of land that can be put into soybean production, and relatively weak environmental regulation, but its commodity handling/ transportation system is not efficient at present, and until recently, there were restrictions on the use of GM soybean varieties.

<sup>19</sup> See Copeland and Taylor (2004) for a detailed review of this empirical work.

<sup>20</sup> Interestingly, Mani and Wheeler (1997) rank food manufacturing (SIC 311) to be the ninth dirtiest industry in terms of its impact on water quality in the US.

percent in Latin America. In another study, Mani and Wheeler (1997), using data for the period 1965-95, found that pollution-intensive output as a percentage of total manufacturing output had fallen in the OECD but had risen in the developing countries, and at the same time, the increase in net exports of pollution-intensive exports from the developing countries had coincided with increasing abatement costs in the OECD countries.

As Copeland and Taylor (2004) note, the results reported in this literature are consistent with the pollution haven hypothesis. Equally, they are consistent with a weaker version of this hypothesis termed the *pollution haven effect*. Specifically, if factors other than environmental policy can impact trade and investment, *some*, but *not all* dirty goods production will have shifted to the South as the North has implemented tougher environmental policy. This follows from the fact that the North's relative supply, and that for the world, will have shifted left, resulting in an increase in the world price of dirty goods, stimulating increased production in the South. Finally, these results are also consistent with economic development in the South. Suppose the South's capital stock increased, shifting the South's relative supply and that for the world to the right, driving down the world price of dirty goods. The net result is that increased international competition has resulted in the North specializing less and the South specializing more in dirty goods production.

The second type of empirical analysis is based on using data on the toughness of environmental policy to test whether it has an impact on either trade and investment flows. As summarized in Jaffe, Peterson and Portney (1995), the early empirical work concluded that, cross-country differences in environmental policy have very little impact on trade and investment flows. For example, Tobey (1990), using a panel of 23 countries, regressed 1977 data for exports of five dirty commodity industries, mining, paper, chemicals, steel and metals, on

measures of factor endowments and stringency of environmental policy, his results finding the latter variable to be an insignificant determinant of net exports. Other studies have regressed, US data for the cross-sectional pattern of trade in manufactures on pollution abatement costs and a set of control variables such as the costs shares of capital and labour, e.g., Kalt (1988), and Grossman and Krueger (1993).<sup>21</sup> Almost all of these studies find no evidence that pollution abatement costs affect the cross-industry pattern of trade, and some even find a positive coefficient on abatement costs, which is cited as evidence in favour of what is known as the “Porter hypothesis” whereby more stringent environmental policy stimulates innovation, which in turn results in increased net exports (Porter and van der Linde, 1995).

A problem with this research is that policy is treated as exogenous, and as a result, more stringent environmental policy is expected to result in a reduction in net exports of dirty goods. Alternatively, if policy is endogenous, an unmeasured industry or country characteristic may have a confounding effect. For example, an increase in a country’s capital stock will result in an increase in dirty goods production and hence an increase in net exports of dirty goods, but at the same time abatement costs will increase with tougher environmental policy. Consequently, there will be a positive relationship between net exports of dirty goods and higher abatement costs. More recent empirical research of the second type does account for endogeneity of environmental policy and unobservable industry- or country-specific variables, the results tending to show that differences in environmental policy can affect trade and investment flows. For example, Levinson and Taylor (2004), using data for the period 1977-86 on US environmental regulations and net trade flows among the US, Canada, and Mexico, for 130

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<sup>21</sup> Kalt (1988) regressed changes in net exports for the period 1967-77 across 78 industry categories on pollution abatement costs and other variables, the coefficient on abatement costs being negative but insignificant. Grossman and Krueger (1993), using 1987 data, found that US pollution abatement costs had not affected imports from either Mexico or the maquiladora sector along the US-Mexican border.

manufacturing industries, find that industries whose abatement costs increased most experienced the largest increases in net imports.

The overall conclusion on the empirical work on pollution havens is that there is evidence for both trade and investment flows being affected by environmental policy. The evidence though is more in favour of a *pollution haven effect* where only some dirty industries move, i.e., environmental policy is not the only factor affecting trade and investment patterns (Copeland and Taylor, 2004; Levinson and Taylor, 2004). What are the implications of these findings for arguments about a race to the bottom? Essentially, if some pollution-intensive industries relocate to countries with low environmental standards with trade liberalization, then there will be incentives for regulatory chill and a race to the bottom in environmental regulation in those countries that would otherwise have had a preference for strict environmental standards.

#### **4. Tariff Substitution**

##### *(i) Imperfect Competition and Ecological Dumping*

As noted earlier, the argument that governments may have an incentive to weaken environmental policy in the presence of imperfect competition is a straightforward extension of the strategic trade literature pioneered by Brander and Spencer (1985). A typical variant of this model assumes a three-stage game: at the first stage governments select the type of environmental policy they will use; at the second stage, governments choose the level of the environmental policy; finally, at the third stage, firms compete in either output or price (see Conrad, 1993; Barrett, 1994; Kennedy, 1994; and Ulph, 1996; 1997).

Following Ulph (1997), assume a duopolistic market structure, where there are two identical firms, home and foreign, each exporting a good to the world market, there being no consumption

in either country. Each firm chooses output  $x$  to maximize profits given the output choice of the other firm  $y$ , i.e., Nash-Cournot competition, where the output technology is one of constant returns  $C(x)$ . Each unit of output  $x$  generates one unit of pollution, but either firm is able to abate pollution, so that net emissions are  $e = x - a$ , where  $a$ , is the amount of pollution abated, the total abatement cost curve being the convex function  $A(e)$ . Pollution is domestic, the total damage cost function being  $D(e)$ , which is assumed strictly convex. The home and foreign governments can choose either an emissions tax  $t$  or an emissions standard  $s$ , trade policy being unavailable to them. Given this structure, the objective is to derive the sub-game perfect Nash equilibrium of the three stage game, by solving backwards from stage three.

To get the basic idea of this approach, assume that each government chooses an emissions tax  $t$ . At the third stage of the game, each firm takes the level of the emissions tax  $t$  as given, and given output  $x$  is the relevant strategic variable, the Nash equilibrium is given in figure 3 at point  $N$  where the downward-sloping reaction functions intersect, which given the assumed symmetry, occurs on the  $45^\circ$  line. The standard result holds here that if the home government pre-commits to a reduction in  $t$ , the home firm's reaction function will shift out, output of the home firm increasing, output of the foreign firm decreasing, the absolute impact on the home firm's output being larger than for its foreign rival.<sup>22</sup>

At the second stage of the game, each government takes as given the emissions tax set by the other government, and chooses the level of the emissions tax to maximize social welfare, which consists of firm revenue  $R(x, y)$  minus total social costs  $C(x) - A(a) - D(x - a)$ . An analogy

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<sup>22</sup> Ulph (1997) shows that if the relevant policy instrument were an emissions standard, the firms' reaction functions are shallower than for the case of an emissions tax. This follows from the fact when a firm is faced with an emissions standard, each extra unit of output must be matched with an additional unit of abatement, and the marginal cost of abatement is an increasing function of abatement, compared to an emissions tax where the firm faces a constant marginal cost of production. As a result, domestic output will increase by less relative to the reduction in foreign output if the government reduces the emissions standard.

to the Brander and Spencer (1985) result for export subsidies will hold under these assumptions: each government has an incentive to reduce the emissions tax below marginal damage costs in the belief that this will reduce the output of the rival firm, thereby shifting duopoly rents to their firm, and in so doing increasing social welfare.<sup>23</sup> Of course, the Nash equilibrium of the policy game between the home and foreign government has the structure of a Prisoners' Dilemma, whereby it is a dominant strategy for both governments to reduce their emissions taxes, the net effect being to expand output and pollution in both countries, and thereby reduce firm profits, and, hence social welfare in both countries.<sup>24</sup> The outcome of the non-cooperative policy equilibrium is given by point *P* in figure 3, i.e., both countries would be better off by cooperating and setting first-best emissions taxes as opposed to ecological dumping.<sup>25</sup>

It turns out that this result is quite fragile if three key assumptions of the model are changed. First, if trade instruments can be used, it is no longer necessary to distort environmental policy, e.g., an optimal emissions tax could be used in conjunction with an export subsidy (Barrett, 1994). Second, as the number of firms in each country is increased, the Nash-Cournot equilibrium asymptotically approaches the competitive outcome, and as a result optimal policy switches to making environmental policy tougher than first-best, i.e., the policy raises firms' costs, resulting in a reduction in output and a less competitive outcome (Dixit, 1984; Barrett, 1994). Third, as is well-known from Eaton and Grossman (1986), the result of ecological dumping is very sensitive to the game played by firms. Specifically, if the relevant strategic

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<sup>23</sup> Following Brander and Spencer (1985), it can be shown that the deterioration in the country's terms of trade due to the reduction in the emissions tax is outweighed by the increase in duopoly rents accruing to the domestic firm. In addition, if domestic consumption is allowed for, the emissions tax is targeted at both the imperfect competition and pollution distortions, reinforcing the incentive to reduce the emissions tax below the first-best level (Ulph, 1997).

<sup>24</sup> In the case of emissions standards, governments will have an incentive to relax them such that marginal abatement costs are less than marginal damage costs.

<sup>25</sup> If there is trans-boundary pollution, each country has an incentive to reduce the other country's production, increasing the incentive to shift output to the domestic firm, reinforcing ecological dumping (Kennedy, 1994).

variable is price, reaction functions are upward sloping, and the equilibrium is Nash-Bertrand. In this case, governments again have an incentive to set tougher environmental policy, inducing both firms to raise prices in equilibrium (Barrett, 1994). In addition, if trade policy is available, an optimal emissions tax should be used in conjunction with an export tariff. The overall conclusion is that the argument for ecological dumping is not very robust, and that inclusion of imperfect competition in the model is essentially an extension of the optimal tariff argument outlined earlier.

*(ii) Environmental Policy and the Terms of Trade*

In earlier discussion it was noted that the non-cooperative Nash equilibrium is for all large countries to implement optimal tariffs, which is Pareto-inferior. This argument was originally due to Johnson (1953-54), and was subsequently formalized by Dixit (1987). More recently, Bagwell and Staiger (1999; 2002) have considered the rationale of the GATT/WTO as providing governments with a means of avoiding the terms-of-trade-driven Prisoners Dilemma, through their entering a binding trade agreement to reduce tariffs. The question then arises as to what happens when environmental standards are introduced into this set-up, i.e., will there be regulatory chill or a race to the bottom?<sup>26</sup>

Following Bagwell and Staiger (2001b), assume a two-country model where two goods,  $x$  and  $y$ , are produced under perfect competition, the home country being an importer of  $x$  and the foreign country an importer of  $y$ . Local relative prices are  $p = p_x/p_y$  for the home country and  $p^* = p_x^*/p_y^*$  for the foreign country, prices differing due to the tariff policies,  $t$  and  $t^*$ , of each country. If  $\tau = (1+t)$ , and  $\tau^* = (1+t^*)$ , then local relative prices can be written as  $p = \tau p^w = (\tau p^w)$ , and  $p^* = p^w/\tau^* = p^*(\tau^*, p^w)$ , where  $p^w = p_x^*/p_y$  are world prices. The terms of trade are

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<sup>26</sup> Other recent papers that have focused on the links between domestic environmental policy and trade policy include Anderson (1998). Ederington (2001) also considers issues relating to the co-ordination of trade and domestic policies in the context of GATT/WTO rules.

then given as  $1/p^w$  for the home country and  $p^w$  for the foreign country, and both countries are large enough to affect their terms of trade.<sup>27</sup>

The import demand and export supply for each country will be a function of their local relative prices and terms of trade, and also each country's choice of environmental standards,  $s$  and  $s^*$ , where the environmental externality is assumed to be local, and the standard is imposed on production. Consequently, each country's environmental standard acts as a shift parameter in their respective import demand and export supply functions, and any international effects of these standards occur only through prices. The trade balance and equilibrium conditions are expressed as:

$$p^w M_x(s, p, p^w) = E_y(s, p, p^w) \quad (4)$$

$$M_y^*(s^*, p^*, p^w) = p^w E_x^*(s^*, p^*, p^w), \quad (5)$$

the equilibrium world price  $\tilde{p}^w(\tau, s, \tau^*, s^*)$  being a function of the market-clearing condition for good  $x$ :

$$M_x(s, p(\tau, \tilde{p}^w), \tilde{p}^w) = E_x^*(s^*, p^*(\tau^*, \tilde{p}^w), \tilde{p}^w), \quad (6)$$

with market-clearing for good  $y$  given by (4)-(6). Consequently, tariffs and standards imply local and world prices, and hence the levels of production, consumption, imports, exports, and tariff revenue.<sup>28,29</sup>

Given this framework, home and foreign country preferences are expressed via the functions,  $W(s, p, \tilde{p}^w)$  and  $W^*(s^*, p^*, \tilde{p}^w)$  respectively. Each country cares about the other's

<sup>27</sup> A legitimate question could be raised at this point about the relevance of this assumption, i.e., to what extent can countries influence their terms of trade? Bagwell and Staiger (2001a) respond to this by arguing that even small countries may be able to shift some incidence of their tariffs onto exporters, citing a WTO case brought by Mexico against Guatemala's tariff on Mexican cement imports.

<sup>28</sup> Tariff revenue is returned to consumers in each country as a lump-sum transfer.

<sup>29</sup> The Marshall-Lerner symmetry conditions are assumed to hold whereby an inward shift in home (foreign) import demand lowers (raises) the equilibrium world price. Equilibrium prices are also assumed not to exhibit the Lerner and Metzler paradoxes, i.e.,  $dp/d\tau > 0 > dp^*/d\tau^*$  and  $d\tilde{p}^w/d\tau < 0 < d\tilde{p}^w/d\tau^*$ .

policy choices only insofar as they affect equilibrium world prices. This follows from the fact that the trade effects of policies work through world prices, and that global production externalities have been ruled out by assumption. The key structure imposed on  $W(.)$  and  $W^*(.)$  is that, holding the local price and standards fixed, the welfare of each country increases as its terms of trade improve,  $dW(s, p, \tilde{p}^w)/dp^w < 0$  and  $dW^*(s^*, p^*, \tilde{p}^w)/dp^w > 0$ .

If a country imposes a tariff on imports, the inward shift in their import demand function lowers the world price, improving their terms of trade, but at the same reducing the exporting country's export volume as they bear part of the incidence of the tariff. Consequently, if countries agree to reduce and then bind their tariffs at an efficient level,  $(\bar{\tau}^E, \bar{\tau}^{*E})$ , given their choices of efficient environmental standards  $(\bar{s}^E, \bar{s}^{*E})$ , this internalizes the harm caused to exporters. As a result, in a cooperative game, both countries have an incentive to reduce their tariffs, as they each benefit from increased access to the other's market (Bagwell and Staiger, 1999).<sup>30</sup> In other words, the GATT/WTO allows the reciprocal exchange of market access between countries.

The problem with the tariff binding as described is that each country has an incentive to distort their environmental standards in order to claw back some of the increased access to their market they have exchanged for increased access to the other country's market. The home country, believing that the foreign country will stick to its environmental standard, will reduce its environmental standard in the import competing sector in order to substitute for its bound tariff. Of course, the foreign country also has this incentive, in which case we get a race to the bottom. As Bagwell and Staiger (2001b) note, this follows from the two countries agreeing to bind their

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<sup>30</sup> Bagwell and Staiger (1999) offer their theory of the GATT/WTO as an argument against Krugman's (1991, p. 25) view that "...GATT-think is enlightened mercantilism..." as it reduces the inefficiencies caused by unilateral use of tariffs.

tariffs, but retaining complete sovereignty over their choice of environmental standards. Is there any way out of this? Bagwell and Staiger (2001a; 2001b) argue that the provisions in GATT/WTO's Article XXIII for non-violation complaints provide a possible solution.

In order to make sense of this, it is necessary to start with the GATT/WTO's position on domestic policies such as environmental standards. Focusing on production standards, this is considered to be the legitimate domain of each member country. In other words, an individual member country is allowed to set its own production standards, as long as they are non-discriminatory, and weak standards are not considered a violation of a member country's obligation under GATT/WTO. However, GATT/WTO members with tough production standards are not exempted from their commitments on market access, and, therefore, are not allowed to respond to less stringent standards of other member countries.<sup>31</sup>

Given this general presumption, how do GATT/WTO members proceed if they believe the production standards of another member country are affecting their rights to market-access? Under Article XXIII of GATT, situations are described where actions taken by one member may be expected to "nullify or impair" the market access benefits expected by another member. As a result, complaints may take two forms: a *violation* complaint can occur if a member country fails to meet its GATT/WTO obligations, e.g., it breaks a tariff binding; a *non-violation* complaint occurs in the case where a member's commitments to market access are being offset

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<sup>31</sup> For example, in the 1991 GATT panel ruling in the US-Mexico tuna-dolphin dispute, the right of the US to set its own standards for conservation of dolphins was not challenged, but it was found GATT-illegal to ban the import of tuna from Mexico because they used less dolphin-friendly fishing methods. Under GATT Article III, the US defended its ban on tuna imports from Mexico on the grounds that it was part of a domestic measure applied equally to both imported and domestic products, i.e., it was non-discriminatory. The panel ruled, however, that Article III is based on, making a comparison between the treatment of imported tuna as a *product* rather than the *process* of tuna fishing, i.e., catching dolphins along with the tuna could not affect tuna as a product. In other words, the panel interpreted GATT Article III to apply only to any impact the imported tuna would have inside the US as opposed to any harm caused to dolphins by tuna fishing activities outside of the US (Roessler, 1996; Hudec, 1996). Therefore, if Article III is limited only to the domestic effects of imports, then the ban on Mexican imports of tuna was an embargo, and, therefore, in violation of GATT Article XI:1. The US also tried to justify its import ban under GATT Article XX (b), but the panel ruled this would have allowed one party (the US) to determine unilaterally the policies of another party (Mexico), which would have undermined the multilateral nature of the GATT (Roessler, 1996).

by an unanticipated policy change such as their setting tougher environmental standards, even if these policies do not violate any GATT rules (Petersmann, 1997). Under a successful non-violation complaint, the affected member country is entitled to a re-balancing of market commitments which can take the form of compensation for the domestic policy change in the form of other policy changes.<sup>32</sup> In other words, the sovereignty of member countries over their choice of environmental policies is constrained by GATT/WTO rules insofar as they have to meet their existing market-access commitments (Bagwell and Staiger, 2002).

In terms of the problem outlined above, the ability of countries to weaken their environmental policies following commitments to lower tariffs is now constrained by the threat of a non-violation complaint. As a result, there should be no race to the bottom. However, Bagwell and Staiger (2001b) note that this only works if weakening of environmental policy by one country reduces market access of the other country. It may be the case that after tariffs have been bound, a country may choose to set more stringent environmental policies, which will then increase market access of the other country, but under GATT/WTO rules it is not able to unilaterally increase its tariff above the bound level in order to maintain market access at the previously negotiated level.

More formally, suppose GATT/WTO consists of a two-stage tariff negotiation game, where, before negotiations begin, the existing environmental standards of each country are noted.<sup>33</sup> At the first stage of the game, bound tariffs are negotiated, implying a set of market access commitments by the two countries. At the second stage of the game, the two countries are able to make unilateral changes to their mix of policies, providing that tariffs do not exceed their

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<sup>32</sup> Very few non-violation complaints have actually been brought to the GATT/WTO, and none have involved environmental standards. This may be due to the difficulty in evaluating the trade impact of changes in domestic policies.

<sup>33</sup> See Bagwell and Staiger (2001b) for the technical details.

bound level, and implied market access commitments are maintained. Focusing first on the case where market access might be reduced and focusing only on the home country, in panel (a) of figure 4. Suppose that there is a set of efficient policy choices  $(\tau^E, s^E, \tau^{*E}, s^{*E})$  that maximizes the welfare of the home country  $W(s, p, \tilde{p}^w)$  such that  $W^*(s^*, p^*, \tilde{p}^w) \geq \bar{W}^{*E}$ , where  $\bar{W}^{*E} = W^*(s^{*E}, p^*, \tilde{p}^{wE})$  and  $\tilde{p}^{wE} \equiv \tilde{p}^{wE}(\tau^E, s^E, \tau^{*E}, s^{*E})$ . With the home country's initial tariff and standards set at  $(\tau^N, s^N)$ , the bound tariff consistent with  $s^N$  is given as  $\tilde{\tau}$  on the iso- $\tilde{p}^{wE}$  locus.<sup>34</sup> As the home country is constrained to operate on or below the iso- $\tilde{p}^{wE}$  locus by the threat of a non-violation complaint, it cannot unilaterally lower its environmental standard below  $s^N$ . However, subsequent to the initial tariff binding, if its preferred point on the iso- $\tilde{p}^{wE}$  locus is at  $(\bar{\tau}^E, \bar{s}^E)$ , it can only reduce its environmental standard from  $s^N$  to  $\bar{s}^E$  by agreeing to further reduce its tariff from  $\bar{\tau}$  to  $\bar{\tau}^E$ . Similar analysis for the foreign country allows for an efficient combination of policies to be achieved through tariff negotiations alone (Bagwell and Staiger, 2001b).

What happens though if the preferred choice of environmental policy generates an increase in market access? This case is shown in panel (b) of figure 4. The analysis is exactly the same as before except that the home country's preferred point on the iso- $\tilde{p}^{wE}$  locus implies that subsequent to the tariff negotiations it would need to raise its environmental standard, resulting in an increase in the foreign country's market access. In order to maintain its market access commitment, it would also need to raise its tariff above the bound level, which it is unable to do

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<sup>34</sup> If the home environmental standard  $s$  were made more stringent, this would shift out the home import demand function, causing an increase in the world price  $\tilde{p}^w$ , and a resulting deterioration in the home country's terms of trade, which would have to be offset by an increase in the home country tariff  $\tau$ , hence the iso-world price locus  $\tilde{p}^{wE}(\cdot)$  is upward-sloping. At the efficient policy choices  $(\bar{\tau}^E, \bar{s}^E)$ , the home country's iso-welfare contour  $W(s, p, \tilde{p}^w)$  is tangent to the iso-world price locus  $\tilde{p}^{wE}(\cdot)$ , which is also the iso-welfare contour of the foreign country, given the definition of  $W^*(\cdot)$ .

under current GATT/WTO rules due to the threat of a violation complaint. Similar analysis of the foreign country suggests that there will be regulatory chill as the two countries delay introducing more stringent and efficient environmental standards.

Alternatively, one can imagine a case where the foreign country is either in equilibrium after the tariff negotiation game, such that  $(\bar{\tau}^*, s^{*N}) = (\bar{\tau}^{*E}, \bar{s}^{*E})$ , or it wishes to set a lower standard due to its stage of development – panel (a) of figure 4. In which case, it either maintains or lowers its bound tariff  $\bar{\tau}$ . At the same time, the home country would prefer to raise its environmental standard due to it having a higher per capita income, but is unable to because it cannot raise its bound tariff  $\bar{\tau}$  to prevent an increase in market access beyond what is initially negotiated – panel (b) of figure 4. In this case, both countries maintain their negotiated market access, but there is regulatory chill in the home country.

Either of these cases would appear to be a robust argument supporting the fears of environmentalists over trade liberalization. Bagwell and Staiger (2001b) argue that resolution of this problem lies in providing more flexibility to the current GATT/WTO rules by allowing country's to renegotiate their bound tariffs if unilateral changes in their environmental standards would increase access to their market.<sup>35, 36</sup> Copeland and Taylor (2004, p.62), however, suggest that "...Although this is an elegant solution to the problem, it requires that we monitor country's market access commitments very closely to eliminate possible abuses..." In a specific sense, though, the principle of this argument is already applied in GATT/WTO rules relating to border

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<sup>35</sup> In the case of global externalities, Bagwell and Staiger (2002) note that it is not possible to reach efficient policy outcomes with negotiations over tariffs alone. This follows from the fact that the inefficiency is more than just about market access. It is typically argued that such inefficiencies should be dealt with outside of GATT/WTO via other international institutions such as CITES and the Kyoto Protocol.

<sup>36</sup> It is important to note that this is not an argument in favor of setting harmonized minimum standards, i.e., the increase in market access comes about not because of a lower environmental standards of the foreign country but because the home country raise its own environmental standards (Bagwell and Staiger, 2001a).

tax adjustments for environmental excise taxes, although as shown in the next section, there is still potential for getting it wrong.

## **5. Border Tax Adjustment for Environmental Excise Taxes**

In a forthcoming paper, McCorriston and Sheldon (2005a) examine the implications for trade policy of the use of environmental excise taxes. Such instruments are being used widely in many countries to improve the environment. In the US, excise taxes are levied on products that adversely affect the environment, e.g., CFCs, while others have been and are used as a source of revenue to deal with (potential) environmental hazards.<sup>37</sup> In several European countries (Denmark, the Netherlands, Norway and Sweden) carbon taxes currently apply while the European Commission has considered the use of carbon taxes throughout all members of the European Union (EU). The US government has also considered the introduction of carbon taxes.

As the preceding analysis suggests, the use of excise taxes for environmental purposes, however, is likely to impact on trade flows and the competitiveness of firms to which the environmental tax applies. Clearly, firms in an importing country faced with the imposition of an environmental excise tax may argue that the resulting cost will improve the market access of imported goods. In such circumstances, there are likely to be demands for a corresponding border tax adjustment to offset the impact of the environmental tax. In addition, where the environmental excise tax is applied to an intermediate good but it is the final good that is imported, the market access issue will arise because domestic producers of the final good face an increase in the cost of intermediate inputs which places them at a disadvantage vis-à-vis final imported goods where the cost of intermediates is lower in the absence of the environmental tax.

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<sup>37</sup> A range of excise taxes have been and are currently applied in the United States targeted to various environmental objectives (Barthold, 1994).

In such cases, demands for any border tax adjustment would relate to the final derivative imported good.

In principle, such border tax adjustments do not contravene GATT/WTO guidelines: Articles III and XVI of GATT allow contracting parties to adjust excise taxes on imported products up to the same level as those applied on domestic products, i.e., taxes on imported goods imposed on the same basis as domestic excise taxes are not regarded as being discriminatory (WTO, 1997).<sup>38</sup> In addition, GATT/WTO rules extend to border tax adjustments of imported derivative products when the environmental excise tax is imposed on intermediates (Davie, 1995).<sup>39</sup> In light of Bagwell and Staiger's (2001a; 2001b) arguments, this looks like a specific method for dealing with regulatory chill in environmental policy: countries are permitted to set border tax adjustments to offset the impact of increased market access arising from higher domestic environmental taxes.<sup>40</sup>

The question of interest here is the appropriate tax treatment of imported final products that use the intermediate input but yet remain untaxed in the exporter's country. Poterba and Rotemberg (1995) have shown that if both the intermediate and final goods sectors are perfectly competitive, an import tax on the final good equal to the level of the environmental excise tax times the extent to which the intermediate good enters the domestic downstream firm's cost function, would raise marginal costs for the importer by the same amount, and consequently will have a neutral effect on imports.

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<sup>38</sup> Here the focus is on border tax adjustments on imports. However, environmental tax legislation usually allows exemption from domestic environmental taxes when the good is being exported. This implicit subsidy is also legitimate in the context of the GATT/WTO framework. See McCorrison and Sheldon (2005b) for further analysis of the export case.

<sup>39</sup> In the case of the US legislation dealing with the tax on CFCs, imported products containing CFCs are taxed on the basis of the weight of CFCs contained in the product with the extent of CFC used determined by the predominant method of US production.

<sup>40</sup> In fact, the issue of border adjustments for domestic taxes has been long-recognized, Ricardo noting: "In the degree then in which [domestic] taxes raise the price of corn, a duty should be imposed on its importation . . . By means of this duty . . . trade would be placed on the same footing as if it had never been taxed" (Sraffa 1953).

McCorrison and Sheldon (2005a) examine the case where the domestic intermediate and final goods markets are imperfectly competitive, and where maintained market access is defined in terms of either import volume or import market share neutrality. Focusing on the final goods market, they assume a symmetric duopolistic market structure, where a home firm (foreign firm) chooses output  $x(y)$  to maximize profits given the output choice of the other firm  $y(x)$ , the home firm purchasing an environmentally harmful input from a domestic, duopolistic intermediate goods market, which is subject to an environmental tax. Assuming a constant returns downstream technology of one-to-one fixed proportions, and a move structure where the home government initially commits to tax policies, their key result is that the size of the border tax adjustment relative to the environmental tax is sensitive to the definition of maintained market access, which in turn generates quite different downstream profit effects.

In the case of import-volume neutrality, the combination of the environmental tax and border tax adjustment shifts profits away from the home to the foreign downstream firm. In figure 5, the environmental tax shifts the home firm's reaction function from  $RF_x$  to  $RF_x'$ , output falling to  $x'$ , and the border tax adjustment shifts the foreign firm's reaction function from  $RF_y$  to  $RF_y'$ , the new Nash equilibrium being  $N'$ , such that the foreign firm's output remains at  $y = y'$ . Home firm profits fall to  $\pi_x'$ , and foreign firm profits increase to  $\pi_y'$ . It is also important to note in this case, the appropriate border tax adjustment is less than the environmental tax. This is due to the latter not being fully transmitted by the upstream intermediate goods sector into an increase in the home downstream firm's costs.

In the case of import-share neutrality, the combination of the environmental tax and border tax adjustment increases the profits of both the home and foreign downstream firms – figure 5. The environmental tax shifts the home firm's reaction function from  $RF_x$  to  $RF_x'$ , output falling

to  $x''$ , and the border tax adjustment shifts the foreign firm's reaction function from  $RF_y$  to  $RF_y''$ , the new Nash equilibrium being at  $N''$ . In order that home and foreign firm market shares, net of the environmental and border taxes, remain constant along the ray from the origin, the environmental and border taxes are now the same. Home firm profits increase to  $\pi_x''$ , and foreign firm profits increase to  $\pi_y''$ . In terms of political economy, the home downstream firm will lobby for maintained market access to be defined in terms of market-share neutrality, while the foreign firm would prefer it to be defined in terms of market-volume neutrality.

In principle, border tax adjustments for environmental taxes should leave either the volume of imports, or the market share of imports of the final good unchanged. This is consistent with Bagwell and Staiger's (2001a; 2001b) analysis of regulatory chill. However, as just outlined, setting appropriate border tax adjustments may be more complex than what the simple competitive market rule implies and is dependent on how 'maintained market access' is defined. Even if set appropriately, they may result in the re-distribution of profits between domestic and foreign firms. The overall conclusion is clear: market structure considerations in both final and intermediate sectors are important in setting the level of border tax adjustments for environmental excise taxes if the authorities are to maintain negotiated market access.

## **6. Summary and Conclusions**

In summary, this paper has focused on the connection between trade and environmental policy. In particular, it asked the question of whether there will be a race to the bottom in environmental policy as trade is further liberalized. Standard analysis of optimal intervention suggests that this is unlikely to happen in either the small or large country case. However, as

pointed out in section 2, this assumes no retaliation, perfect competition and immobile factors of production.

Relaxing the latter assumption for a sub-set of factors allows for the possibility of capital flight from rich developed countries with tough environmental policies to poorer less developed countries with weaker environmental policies, creating pollution havens. The empirical evidence supporting a pollution haven effect gives some credence to the fears of environmentalists that freer trade may encourage developed countries to either weaken their environmental policies in a race to the bottom or at least not make them any tougher, through regulatory chill, in order to maintain their competitiveness as tariffs are lowered.

As was shown in section 4, a race to the bottom in the form of ecological dumping can occur in the presence of imperfect competition. However, this result is so sensitive to the underlying assumptions, that it is probably best regarded as a theoretical *curiosum*. The most convincing argument for either a race to the bottom or regulatory chill comes when the terms of trade Prisoners' Dilemma is accounted for. Here, even though GATT/WTO is a means to resolving this dilemma through tariff bindings, it is also necessary that countries do not retain complete sovereignty over their environmental policy. This is because they have an incentive to weaken it in order to claw back some of the increased market access they have granted through lower tariffs. The solution to this argument for a race to the bottom though, lies in the GATT/WTO rules, i.e., countries will be constrained from relaxing their environmental policies after tariffs have been bound due to the threat of non-violation complaints being made by their trading partners who stand to suffer a loss of negotiated market access. However, if a country wishes to have tougher environmental policy after tariffs have been bound, the threat of a non-violation complaint will induce regulatory chill.

The suggested way out of this problem is through the provision of more flexibility in the current GATT/WTO rules, allowing country's to renegotiate their bound tariffs if unilateral changes in their environmental policies would increase access to their market. It turns out that the principle of this argument is already being applied in GATT/WTO rules as they relate to border tax adjustment for environmental excise taxes on either intermediate or final goods. However, implementation of such rules is not simple, especially if the vertical structure of markets and imperfect competition are taken into account. Consequently, as a proposed solution to the problem of regulatory chill, it comes with an appropriate "health warning". Nevertheless, there may be some potential for extension of this type of GATT/WTO rule to other types of environmental policy.

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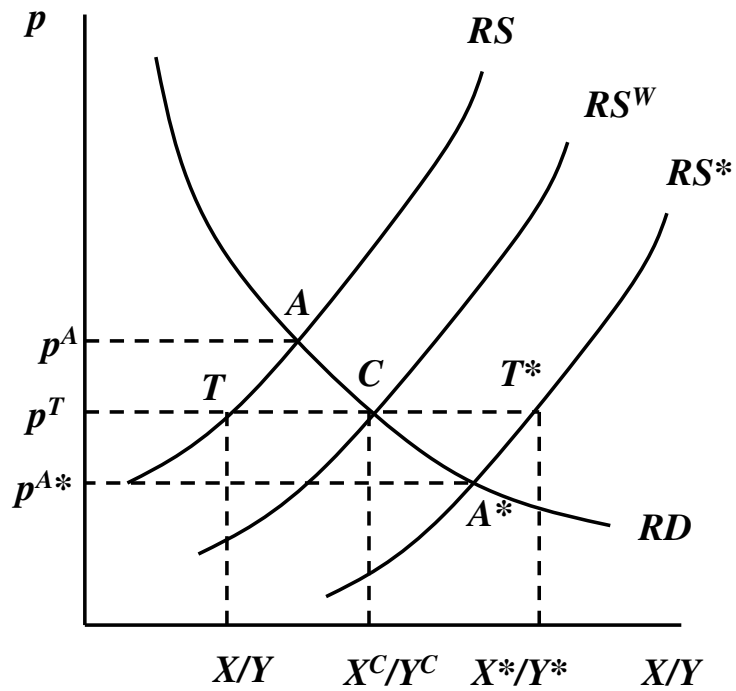
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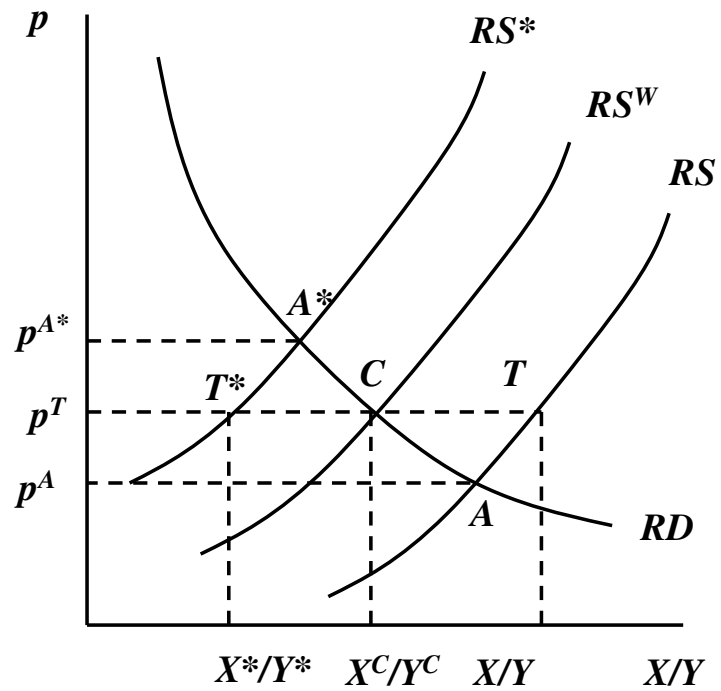
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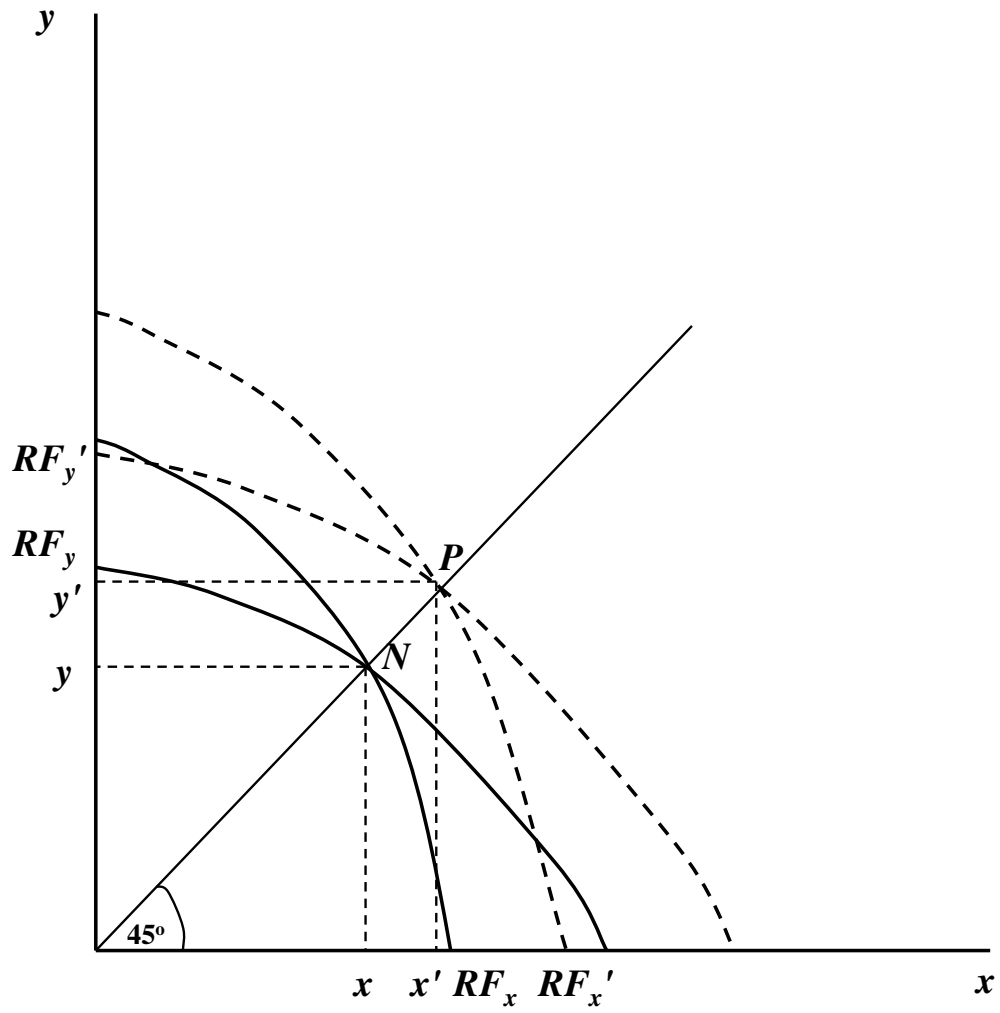
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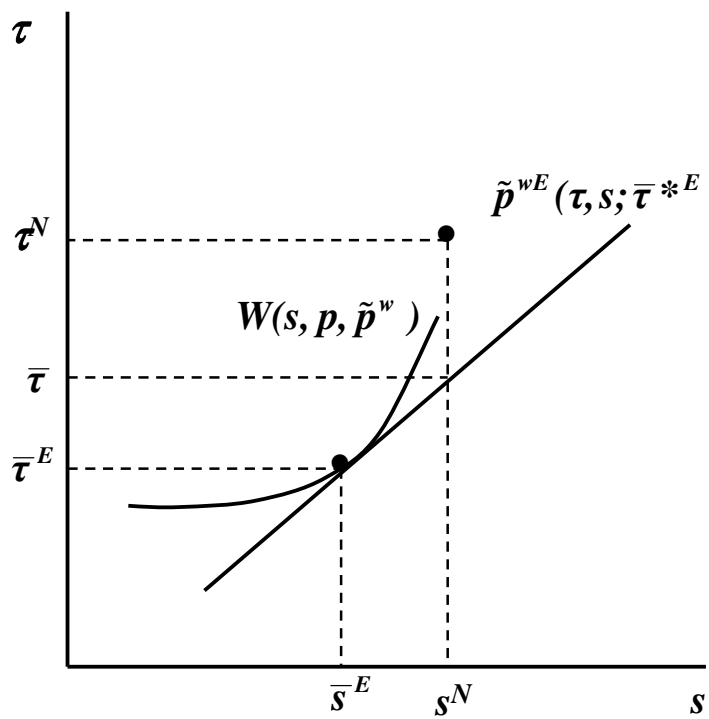
**Figure 1: Pollution Haven**



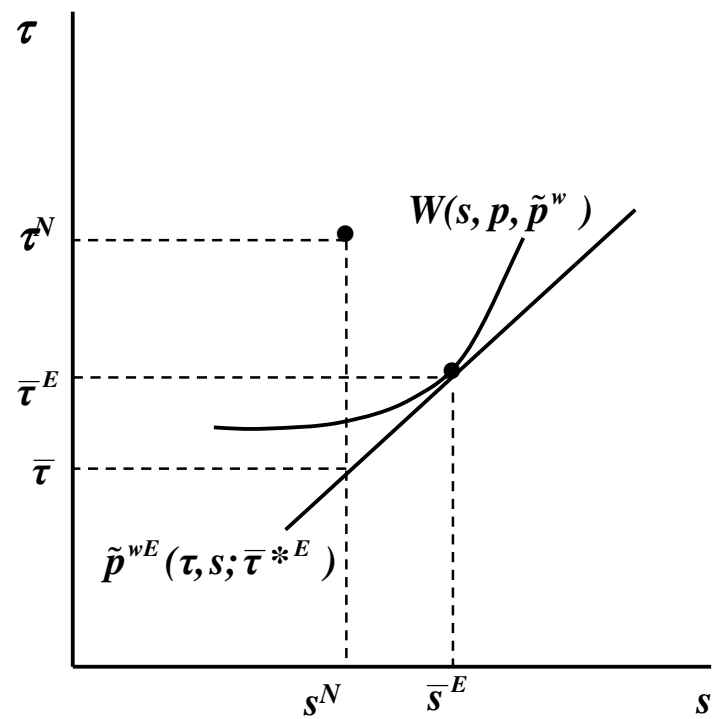
**Figure 2: Factor Endowments**



**Figure 3: Ecological Dumping**

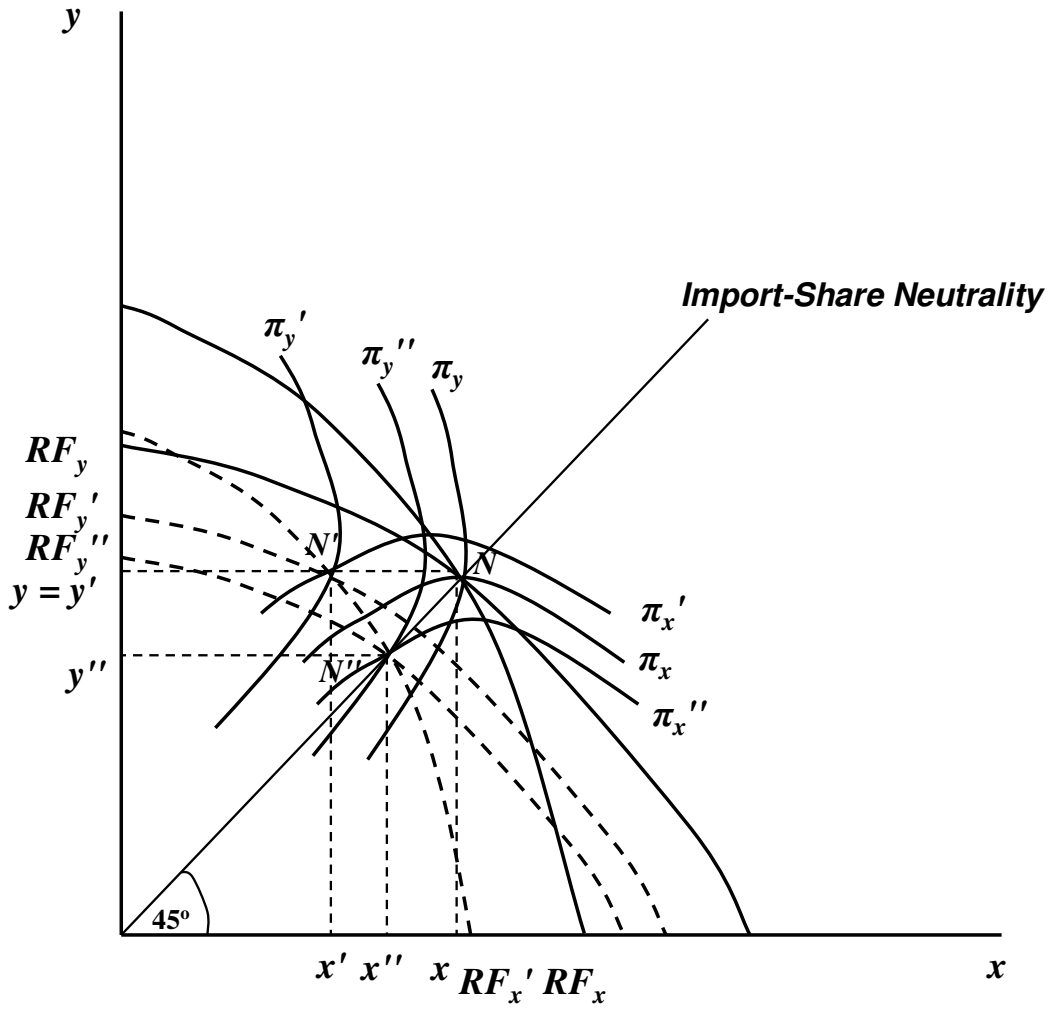


(a)



(b)

Figure 4: Tariffs and Non-Violation Complaints



**Figure 5: Effects of Neutral Border Tax Adjustments**