

# Consumption Externalities, Product Quality, and the Role of National Treatment

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## Abstract

In Article III of the WTO, National Treatment limits domestic policy in an effort to curtail protectionist discrimination against foreign products. In this paper, we examine the role of National Treatment when goods are vertically differentiated and generate consumption externalities that can be positively or negatively related to quality. In each case, we study the domestic policy choices of the two countries (first-stage problem) and quantity and price equilibria in the two product markets (second-stage problem) under Article III and compare them to the policy choices and product market equilibria prevailing in a world in which Article III does not apply. While one may expect that high externalities would lead to a greater need for discriminatory policies, we show this is often not the case and, furthermore, that National Treatment can lead to a cleaner world environment.

**Keywords:** National Treatment; non-discrimination; environmental damages; consumption externalities; environmental policy; domestic policy; WTO.

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# 1 Introduction

As a response to the incentives of individual countries to impose restrictions on foreign firms in order to give their own firms an advantage, non-discrimination is a fundamental principle of the World Trade Organization (WTO). There is a general consensus that protectionist trade policy gains in one country largely (or exclusively) come at the expense of losses in other countries. Accordingly, non-discrimination is embodied in two important articles of the WTO (and formerly in the GATT): Article I (Most Favored Nation Treatment, or MFN) and Article III (National Treatment, or NT), with the former concerned with border measures or tariffs and requiring that goods from different countries be treated equally and the latter concerned with domestic policy and requiring that imported goods be treated at least as favourably as “like” domestic goods. To date, Article I (MFN) has received a great deal of attention in the literature (i.e. Horn and Mavroidis, 2001; Saggi, 2004; Missios and Yildiz, 2006; Ferrara et al., 2009), while Article III (NT) has been largely ignored in spite of growing concerns regarding the negative implications of restricting countries’ freedom to set their domestic policies, particularly when such policies are motivated by legitimate reasons (e.g., protecting the environment or human rights).

According to Article III, internal taxes “should not be applied to imported or domestic products so as to afford protection to domestic production” and importing goods “shall not be subject, directly or indirectly, to internal taxes or other internal charges of any kind in excess of those applied, directly or indirectly, to like domestic products.” An explanatory note added to the second paragraph of Article III further clarifies that, if the imported and domestic goods are not “like” products, internal taxes still cannot be applied “as to afford protection to domestic production” as long as the goods are “directly competitive or substitutable.” Hence, if the imported and domestic goods are “like” products, the internal tax on the imported good cannot be higher than the internal tax on the domestic good; however, if the two goods are directly competitive or substitutable, the tax rate on the imported good can be higher provided that the tax differential does not exceed some *de minimis*, but yet unspecified, amount.<sup>1</sup>

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<sup>1</sup>In case law, “like” is a narrower concept than “directly competitive or substitutable” in that the former implies the latter but not the reverse. Loosely speaking, two products are “like” if they share a number of identical or similar characteristics, including but not limited to their end-uses as reflected in the elasticity of substitution, while two products are “directly competitive or substitutable” if they have common end-uses. See Table 1 for a summary of disputes (from 1995 to 2012) involving the passages in Article III which are of relevance to internal taxation (i.e., Art. III:1, Art. III:2 first sentence, and Art. III:2 second sentence).

In a world in which trade agreements explicitly specify border measures but generally do not specify internal measures, thus leaving the trade parties with unilateral control over the determination of their internal policies, it is hard to argue against the need for provisions that prevent the use of internal regulations to undo agreed upon border concessions.<sup>2</sup> The NT principle is thus intended to prohibit the application of price discrimination techniques that can interfere with the fair competition between domestically produced and imported goods in the market. As it stands, however, the principle does not allow for any consideration of the reasons motivating discriminatory taxation, even though its intended role is to prevent the use of domestic policy for protectionist purposes, and thus applies even when there exist legitimate reasons (e.g., out of environmental and health concerns) for discriminatory taxation.<sup>3</sup> Of course, countries can potentially internalize legitimate concerns they may have about imported goods in their tariff negotiations (such as excluded sectors), but NT obligations hold independently of whether tariff agreements are in place; furthermore, even in the presence of tariff agreements, concerns over imported goods, particularly as they relate to health and the environment, may evolve over time as countries have the opportunity of experiencing the goods and are thus likely to be unknown at the tariff negotiation stage.<sup>4</sup> Yet another complication arises when a country deals with two or more imported products which are similar to the domestic product, so that the NT provision applies, but impose different negative externalities; in negotiating tariffs with the trading partners, the country would be bound by MFN and would thus be unable to tariff discriminate to address the different levels of concern associated with the imported goods.

In light of the above considerations, it is important to examine the role of the NT clause more closely and look at its welfare and environmental implications in instances in which the

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<sup>2</sup>Existing formal models of the relationship between trade policy and domestic regulatory policy (e.g., Markusen, 1975; Copeland, 1990; Ederington, 2001; Bagwell and Staiger, 2002, ch. 9) highlight the concern that large countries may circumvent the restrictions of their trade policies by relaxing domestic regulatory standards in import-competing industries, thus forcing foreign suppliers to lower the prices of their products in order to remain globally competitive. The potential for a weakening of regulation (e.g., environmental and labour) to retain global competitiveness after the lowering of trade barriers is referred to in the literature as the (regulatory) race to the bottom hypothesis.

<sup>3</sup>Article XX allows for some exceptions to NT, particularly in relation to health and well-being and the environment. In practice, disputes involving these exceptions have been largely unsuccessful (see Table 2 for a summary of disputes involving Art. XX over the 1995 to 2012 period). In this paper, we assume that the qualities of the domestic and foreign goods are not sufficiently dissimilar to avoid NT provisions.

<sup>4</sup>Although Article XXVIII allows members to renegotiate tariff bindings, renegotiation is constrained in that the member seeking changes must provide compensatory concessions on other products; absent agreement, the affected members can withdraw “substantially equivalent” concessions initially negotiated with the member making the changes. Since the establishment of the WTO in 1995, there have been 39 requests to enter into renegotiations under Article XXVIII, of which 5 have been withdrawn, 22 have been concluded, and 12 are still on-going.

imported and domestically produced goods are “like” from the legislative standpoint but differ in quality which, in turn, determines how consumption affects the environment; hence, in spite of their likeness, the imported and domestic goods have different environmental effects. If, on one hand, there are aggregate gains resulting from trade liberalization (e.g., the promotion of globalization and fair competitiveness that minimize policy-induced market power and bring about a reduction in domestic prices), on the other hand, there are losses resulting from the inability to internalize the externality differences between the imported and domestic goods through discriminatory internal measures. Our paper provides a formal analysis of this trade-off both when the consumption externality is increasing in quality (e.g., cars) and when it is decreasing in quality (e.g., organic food and energy-saving appliances) and, for each case, derives conditions under which NT improves the environment and/or welfare (both locally and globally).

While, as noted above, economic analyses in much of the relevant literature have been on the role of MFN, some recent work has examined the relationship between NT and international trade (and trade agreements). One of the earliest analyses (Horn, 2006) considers, for example, the interaction between tariff liberalization and domestic tax setting under a binding NT principle. With constant tariffs, Horn shows that a marginally binding provision increases welfare, but a more restrictive provision may reduce welfare; however, when tariffs are endogenous and countries negotiate their levels before deciding upon their internal sales taxes, NT is welfare-enhancing. Horn’s analysis thus supports the position that, even when discrimination against imported goods is justifiable on the basis of a first-best solution argument, non-discrimination can enhance welfare if countries are able to take full account of how tariff agreements affect the setting of internal policy.<sup>5</sup> Our paper differs from Horn’s paper in its emphasis on the impact of NT when countries cannot target distortions in the domestic market at the tariff negotiation stage for reasons in line with those above mentioned (e.g., distortions unknown when tariffs are negotiated and re-negotiation is not viable; additional provisions such as MFN restrict extent to which distortions can be internalized in tariff agreements). Furthermore, our paper is concerned with alternative distortions in the domestic market, which relate to the external impacts of consumption, and thus considers not only the welfare implications of NT but also its public good implications.

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<sup>5</sup>For similar arguments, see Horn et al. (2010), which is about trade agreements as endogenously incomplete contracts when contracting is costly, and Staiger and Sykes (2011), which is concerned with the relationship between border instruments and domestic product standards in the presence of a purely domestic externality.

Another paper on NT of relevance to our analysis is Saggi and Sara (2008) which analyzes the decision of whether to sign a non-discrimination agreement in a two-country world in which the countries provide quality-differentiated products and differ in the size of their markets. When markets are symmetric in size, an NT agreement does not emerge in equilibrium unless the agreement includes international transfers; this result arises because the low-quality country prefers discrimination while the high-quality country prefers non-discrimination but global welfare is higher under NT so that there exist international transfers that would induce the low-producing country to sign the agreement. Under market asymmetry (i.e., the high-quality country's market is larger), on the other hand, it is possible for both countries to prefer NT, provided that the quality gap is not too large, and international transfers are thus unnecessary for an NT agreement to arise. While our paper also considers two countries producing quality-differentiated products, its focus is not on the decision of whether to form a non-discrimination agreement and how asymmetry in market size affects this decision but on the welfare and public good impacts of the NT provision when there is a negative externality associated with consumption the extent of which depends on quality.

The paper most closely related to ours in terms of objective is Gulati and Roy (2008) which investigates the welfare effects of a non-discrimination clause that governments must satisfy when introducing product standards to control consumption-generated emissions. In a general equilibrium model with two small open economies, Gulati and Roy consider the optimality of non-discrimination under different policy regimes and conclude that NT does not prevent implementation of the optimal outcome under (1) an optimal emission tax on consumers or (2) an optimal consumption tax coupled with product standards when foreign producers do not enjoy a compliance cost advantage; however, if the emission/consumption tax is suboptimal (i.e., cannot be set at the socially efficient level), NT is more likely to prevent implementation of the optimal outcome and, in fact, does not result in welfare losses only if domestic producers' compliance cost advantage is sufficiently large. Although our paper is also concerned with how NT affects countries' ability to optimally regulate environmental externalities arising at the consumption stage, its focus is on domestic taxes with asymmetry in external effects rather than on product standards with asymmetry in compliance costs.

Two other important papers that consider NT in the presence of externalities but are quite different from our paper in terms of the questions they address are Costinot (2008) and Horn

(2011). The former provides a formal analysis of how the WTO's NT principle as applied to regulatory standards performs in relation to the EU's Mutual Recognition (MR) principle when goods differ in their external effects. In comparison to a case of complete contracting, both the NT and MR provisions are inefficient, but NT is preferable to MR when the traded goods impose high externalities. This results arises because, under NT, a country chooses standards on both the domestic and foreign goods and thus tends to set standards that are too high by ignoring the foreign country's profits from exports, while, under MR, the foreign country has control over the standard on its good and thus tends to set standards that are too low by ignoring the environmental effects of its good in the export market.<sup>6</sup> The second paper (Horn, 2011) focuses on the implications of the allocation of the burden of proof in environmental disputes over the application of the NT principle. Using a two-sector model with two symmetric countries producing in both sectors but consuming only in one and facing environmental damages in the importing sector as a result of a negative consumption externality, Horn finds that NT always constrains countries with legitimate environmental concerns but not necessarily countries that use differential taxes for protectionist purposes. If environmental damages are sufficiently large, higher taxes on imports are desirable from a global efficiency point of view but, if imposed, can be challenged. Adjudicators, however, do not know with certainty whether differential taxation is based on legitimate concerns, and thus desirable from a global perspective, and can reasonably make judicial mistakes, allowing discrimination at times when it is not desirable but restricting it at other times when it is desirable. As the allocation of the burden of proof between the complainants (exporting countries) and the respondents (importing countries) influences the propensity to make mistakes, Horn then goes on to examine how shifting the burden of proof in NT disputes affects the environment and welfare through changes in the propensity for environmentally affected countries to prevail in NT disputes (direct effect) and through changes in negotiated tariffs (indirect effect).

To examine the implications of the NT principle when countries have legitimate reasons for discriminating between domestic and foreign goods which they cannot internalize at the tariff setting stage, our paper considers a two-stage model with two countries producing "like" products that differ, however, in quality and are freely traded. Consumption generates a negative exter-

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<sup>6</sup>The EU's MR principle requires that imported goods be lawfully produced to be admitted into the territory of the importing country; to be lawfully produced means to be produced according to the rules and manufacturing processes in place in the exporting country.

nality which governments attempt to control via internal taxation (first stage). As the magnitude of the externality varies with quality, governments must resort to differential taxation of the two goods to fully account for the external effects of consumption. With the internal policy determined, the two countries engage in a non-cooperative game to determine the equilibrium prices and quantities in the two product markets (second stage). If governments are constrained to adopt non-discriminatory internal measures (i.e., the NT clause applies), it is not always the case that global environmental damages increase or that global welfare decreases. In fact, some countries may be unaffected by NT rules within their borders as the consumption externality induces those countries to discriminate against their own locally produced good. In terms of results, we identify the equilibrium outcomes depending on (i) the pollution intensity level relative to the quality gap, (ii) whether environmental effects are increasing or decreasing in quality, and (iii) whether NT is effectively binding for one or both countries. In terms of global effects, some interesting differences between the high-quality polluting case (i.e., when pollution generates from consuming the high-quality good as in the car market) and the low-quality polluting case (i.e., when pollution generates from consuming the low-quality good as in the market for energy-saving appliances) are as follows: (i) at intermediate pollution intensity levels, welfare increases but the environment worsens in the former case while welfare decreases but the environment improves in the latter case; (ii) when NT is only binding for the clean-good country as pollution intensity is relatively high, welfare increases but the environment worsens in the former case while welfare decreases and the environment worsens in the latter case.

We structure the remainder of the paper in several sections. In section 2, we detail the model and derive the welfare-maximizing internal policies with and without a non-discrimination principle. In section 3, we compare the results in terms of market equilibrium (prices, sales, and market coverage), environmental taxes, national and global welfare levels, and national and global environmental damages. In section 4, we consider instances in which pollution arises from the consumption of the low-quality good as in the organic food market and, more applicable to the unit-consumption assumption of the model, in the market for energy-saving appliances. Finally, in section 5, we provide concluding remarks and comment on future research questions to consider.

## 2 The Model

To assess the theoretical implications of the NT clause on environmental policy by comparing outcomes under the NT and non-NT regimes, we adopt a two-stage game framework involving two countries, each with a single firm producing a quality-differentiated good  $x$ .<sup>7</sup> For the comparison to make sense, the two goods must generate different externalities, and we thus assume that one good generates pollution (a dirty good) but the other does not generate pollution (a clean good). In the first stage, governments choose taxes to maximize domestic welfare; in the second stage, firms compete in prices, and consumption takes place.<sup>8</sup> Letting  $s_h$  and  $s_l$  denote the high- and low-quality versions of  $x$ , with  $s_h > s_l$ , we label the country producing the high-quality version as country  $H$  and the country producing the low-quality version as country  $L$  and, for simplicity, assume that production costs are zero irrespective of which version is produced. Again, to abstract from tariff discrimination, we assume that both goods are freely traded.<sup>9</sup>

Consumers have preferences over quality, reflected in a non-negative taste parameter  $\theta$  which is uniformly distributed in each country over  $[0, 1]$  with density one. With  $p_i^j$  denoting the price of quality  $i$  in country  $j$ ,<sup>10</sup> and assuming that consumers purchase only a single unit of the good if they choose to buy, we can express the utility of a consumer in country  $j$  buying quality  $i$  as

$$u^j = \theta s_i - p_i^j, \quad \text{for } i = h, l, \quad (1)$$

and normalize the utility of purchasing neither the high-quality good nor the low-quality good to zero.<sup>11</sup> Hence, the continuum of consumers is potentially segmented into three regions consisting of those who buy nothing, those who buy the low-quality, and those who buy the high-quality. Letting  $\theta_l^j$  denote the value of  $\theta$  for the consumer in country  $j$  indifferent between buying nothing and buying the low-quality good, thus receiving zero surplus ( $u^j = 0$ ), and  $\theta_h^j$  denote the value of  $\theta$  of the consumer indifferent between buying the low-quality good and the high-quality good, we

<sup>7</sup>In Shaked and Sutton (1982), a duopoly offers only two qualities in equilibrium, provided that entry is sufficiently low cost and the gap between qualities is not overly large (see also Shaked and Sutton, 1984, or Saggi and Sara, 2008).

<sup>8</sup>In many respects, the setup of our model closely follows the national treatment modeling of Saggi and Sara (2008), in which countries differ in market size but goods do not generate externalities.

<sup>9</sup>MFN tariffs tend to be identical within a product group, independently of quality and externality considerations. For example, according to the WTO Tariff Database, the 2013 MFN tariffs on personal automobiles, either diesel or gasoline, are equal across all engine sizes.

<sup>10</sup>All prices are gross of taxes throughout the paper.

<sup>11</sup>Due to their small measure, consumers do not take into account the external impact of their consumption choice.

have that

$$\theta_l^j = \frac{p_l^j}{s_l} \quad \& \quad \theta_h^j = \frac{p_h^j - p_l^j}{s_h - s_l}, \quad (2)$$

so that consumers are partitioned into  $[0, \theta_l^j)$  buying nothing,  $[\theta_l^j, \theta_h^j)$  buying the low-quality version, and  $[\theta_h^j, 1]$  buying the high-quality version.

For country  $j$ , we can then express the demand faced by the low-quality firm as

$$x_l^j = \theta_h^j - \theta_l^j = \frac{p_h^j - p_l^j}{s_h - s_l} - \frac{p_l^j}{s_l} \quad (3)$$

and the demand faced by the high-quality firm as

$$x_h^j = 1 - \theta_h^j = 1 - \frac{p_h^j - p_l^j}{s_h - s_l}. \quad (4)$$

At given prices, total consumer surplus from the purchases of the low-quality good in country  $j$  is equal to

$$cs_l^j = \int_{\theta_l^j}^{\theta_h^j} (s_l \theta - p_l^j) d\theta = s_l \frac{\theta^2}{2} - p_l^j \theta \Big|_{\theta_l^j}^{\theta_h^j} = (\theta_h^j - \theta_l^j) \left[ \frac{s_l (\theta_h^j + \theta_l^j)}{2} - p_l^j \right], \quad (5)$$

while the consumer surplus from the purchases of the high-quality good is equal to

$$cs_h^j = \int_{\theta_h^j}^1 (s_h \theta - p_h^j) d\theta = s_h \frac{\theta^2}{2} - p_h^j \theta \Big|_{\theta_h^j}^1 = (1 - \theta_h^j) \left[ \frac{s_h (1 + \theta_h^j)}{2} - p_h^j \right]. \quad (6)$$

Total consumer surplus in country  $j$  is then simply  $cs^j = cs_l^j + cs_h^j$ .

We assume that the consumption of  $x$  generates pollution (a consumption, not production, externality, or “tailpipe” pollution) and that the amount of pollution generated depends on the quality of the good.<sup>12</sup> We could assume that both types of goods are polluting with one generating more pollution per unit than the other; for ease of exposition (and with no loss of generality), we assume instead that one quality of the good generates zero pollution while the other creates pollution. Initially, we consider the scenario in which it is the consumption of the high-quality good that generates pollution; later, however, we allow for pollution to arise from the consumption of the low-quality good, with important commonalities and differences. For the case considered first,

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<sup>12</sup>With production externalities, countries would have competing incentives to use domestic policy to push production out to other countries (to avoid the externality) on one hand and to draw production in (to benefit their local firms) on the other hand. In such a case, domestic policy may not be used to protect local firms, as envisioned in pro-NT arguments, and the impacts of NT would soften.

we can think of cars, for which unit consumption is most applicable, as the obvious example. The quality of a car consists of a bundle of characteristics such as engine displacement, acceleration, passenger roominess, and cargo capacity, which tend to be positively related with each other and with the size of the car.<sup>13</sup> We can then think of a car's size as the one-dimensional variable that appropriately measures the car's quality. But size is generally negatively related to fuel economy, and we thus have that large (or high-quality) cars are less environmentally friendly or more polluting. If pollution is purely local (i.e., pollution from consumption in country  $j$  does not spill over into the other country), we can write pollution damages in country  $j$  as an increasing function of the quantity of the high-quality good consumed in that country; specifically, we assume pollution damages in country  $j$  to be equal to

$$\varphi^j = \xi \left( x_h^j \right)^2 = \xi \left( 1 - \theta_h^j \right)^2, \quad (7)$$

where  $\xi$ , a positive parameter, represents the marginal damage of pollution (or the *intensity* of pollution damages), so that the externality is increasing in consumption at an increasing rate. We therefore take the view that individual consumers do not account for the external effects of their consumption decisions and that the government must then intervene to affect the extent of the externality via internal policy.

Given the above setup, we look at the two firms' profit-maximizing decisions in market/country  $j$ , solving for the equilibrium prices of the two types of the good as functions of qualities and tax rates, the latter being restricted to be identical under NT but allowed to differ under non-NT. Hence, firm  $i$  chooses the price of its  $i$ -quality good in country  $j$  ( $p_i^j$ ) to maximize profits in that market, given the tax rate  $t_i^j$  faced, namely,

$$\pi_h^j \left( p_h^j, p_l^j \right) = \left( p_h^j - t_h^j \right) x_h^j \left( p_h^j, p_l^j \right) = \left( p_h^j - t_h^j \right) \left( 1 - \frac{p_h^j - p_l^j}{s_h - s_l} \right), \quad (8)$$

if firm  $i$  is the high-quality firm, and

$$\pi_l^j \left( p_h^j, p_l^j \right) = \left( p_l^j - t_l^j \right) x_l^j \left( p_h^j, p_l^j \right) = \left( p_l^j - t_l^j \right) \left( \frac{p_h^j - p_l^j}{s_h - s_l} - \frac{p_l^j}{s_l} \right), \quad (9)$$

if firm  $i$  is the low-quality firm. From the profit-maximizing conditions, we then obtain the reaction

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<sup>13</sup>Fuel efficiency is an important characteristic for many car buyers, but we abstract from this possibility in this example. If fuel efficiency were the dominant feature in the buying decision, cars would fall into the second case considered in this paper with the externality decreasing in quality.

functions of the two firms, namely,

$$p_l^j = \frac{p_h^j s_l + t_l^j s_h}{2s_h} \quad \& \quad p_h^j = \frac{p_l^j + t_h^j + (s_h - s_l)}{2}, \quad (10)$$

and can solve for the two equilibrium prices as

$$p_l^j = \frac{s_l(s_h - s_l) + 2s_h t_l^j + s_l t_h^j}{4s_h - s_l} \quad \& \quad p_h^j = \frac{s_h [2t_h^j + t_l^j + 2(s_h - s_l)]}{4s_h - s_l}. \quad (11)$$

Upon inspection of the above equilibrium conditions, here we note that the “laissez-faire” equilibrium (i.e.,  $t_l^j = t_h^j = 0$ ) in each country is characterized by (i) the sales of the high-quality good being twice as large as the sales of the low-quality good, (ii) the price of the high-quality good being more than twice as large as the price of the low-quality good ( $p_h^j = 2\frac{s_h}{s_l}p_l^j$ ), and (iii) the market being partially covered (i.e.,  $\theta_l^j > 0$ ). This equilibrium is inefficient because of underproduction (i.e., market not being fully covered) which results from firms exploiting their market power, as in Saggi and Sara, but not necessarily because of allocative inefficiency. In fact, in the presence of external (environmental) effects that are increasing in quality, allocative efficiency does not require that only the high-quality good be offered in the market; instead, social optimality requires that both goods be provided and that more consumers buy the high-quality good for  $\xi < \frac{s_h - s_l}{2}$ .<sup>14</sup> We next turn to the determination of the optimal taxes in each country without NT restrictions as a comparison point for the later results under NT.

## 2.1 No National Treatment

When the NT rules do not apply, country  $j$  chooses taxes  $t_l^j$  and  $t_h^j$  to maximize its welfare, defined as the sum of consumer surplus from the domestic consumption of both goods, producer surplus of country  $j$ 's firm from the sales in the two markets, and tax revenues, less environmental damages, that is,

$$w^j(t_l^j, t_h^j) = cs^j(t_l^j, t_h^j) + \pi_d^j(t_l^j, t_h^j) + \pi_e^j(t_l^{-j}, t_h^{-j}) + t_h^j x_h^j(t_l^j, t_h^j) + t_l^j x_l^j(t_l^j, t_h^j) - \varphi^j(t_l^j, t_h^j), \quad (12)$$

where  $\pi_d^j(t_l^j, t_h^j)$  and  $\pi_e^j(t_l^{-j}, t_h^{-j})$  represent the profits of country  $j$ 's firm in the domestic market and from exports to the other country (i.e., country  $-j$ ).<sup>15</sup> The welfare-maximizing taxes are then

$$t_h^H = \frac{3s_h(s_h - s_l)[2\xi - (s_h - s_l)]}{3s_h(s_h - s_l) + 2\xi(3s_h - 2s_l)} \quad \& \quad t_l^H = \frac{2s_l(s_h - s_l)\xi}{3s_h(s_h - s_l) + 2\xi(3s_h - 2s_l)} > 0 \quad (13)$$

<sup>14</sup>In terms of market shares, the socially optimal market share of the high-quality good is higher than the laissez-faire market share for  $\xi < \frac{s_h - s_l}{4}$  and lower for  $\xi > \frac{s_h - s_l}{4}$ .

<sup>15</sup>As in Saggi and Sara, markets are segmented so profits depend only on local taxes.

in the high-quality country and

$$t_h^L = \frac{(s_h - s_l)(s_h - s_l + 2\xi)}{3(s_h - s_l) + 2\xi} > 0 \quad \& \quad t_l^L = -\frac{2s_l(s_h - s_l + \xi)(s_h - s_l)}{s_h[3(s_h - s_l) + 2\xi]} < 0 \quad (14)$$

in the low-quality country. We thus obtain the following:

**Proposition 1** *Without NT, both countries tax the imported good but, while the low-quality country always subsidizes the locally produced good, the high-quality country's choice of whether to tax or subsidize the locally produced good depends on the intensity of pollution damages relative to the quality difference between the two versions of the good, with a tax (subsidy) prevailing when pollution intensity is high (low) relative to the quality difference.*

To facilitate the discussion about the various incentives the two countries face in setting their policies, we can express country  $j$ 's welfare function as

$$\underbrace{\left[1 - (\theta_h^j)^2\right] \frac{s_h}{2}}_{GS_h^j} + \underbrace{\left[(\theta_h^j)^2 - (\theta_l^j)^2\right] \frac{s_l}{2}}_{GS_l^j} - \underbrace{(p_{-i}^j - t_{-i}^j) x_{-i}^j}_{NS_{-i}^j} + \underbrace{(p_i^{-j} - t_i^{-j}) x_i^{-j}}_{NS_i^{-j}} - \underbrace{d(x_h^j)^2}_{ED}, \quad (15)$$

where  $i$  denotes the local good,  $-i$  the foreign good, and  $-j$  the foreign country. In the above expression,  $GS_h^j$  represents the gross surplus from the consumption of the high-quality good,  $GS_l^j$  is the gross surplus from the consumption of the low-quality good,  $NS_{-i}^j$  is the surplus from country  $j$ 's consumers of good  $-i$  which flows out of country  $j$  into country  $-j$ ,  $NS_i^{-j}$  is the surplus from country  $-j$ 's consumers of good  $i$  which flows out of country  $-j$  into country  $j$ , and  $ED$  represents damages from pollution. In setting its policies ( $t_i^j$  and  $t_{-i}^j$ ), country  $j$  has no control over  $NS_i^{-j}$  but can affect the other welfare components, of which  $NS_{-i}^j$  and  $ED$  are key in explaining policy differences between the two countries, with the latter decreasing in the tax on the high-quality good and increasing in the tax on the low-quality good in both countries and the former increasing (decreasing) in  $t_h^j$  and decreasing (increasing) in  $t_l^j$  when  $j = H$  ( $j = L$ ). While a tax increase in market  $h$  and a tax decrease in market  $l$  benefit both countries through  $ED$ , the increase in  $t_h^j$  is beneficial to country  $L$  but costly to country  $H$  and the increase in  $t_l^j$  is beneficial to country  $H$  but costly to country  $L$  through  $NS_{-i}^j$ . As for the policy effects on  $GS_h^j + GS_l^j$ , we can conveniently express them in terms of the effects on the gross surplus from the consumption of the low-quality good over the entire pool of active consumers, which we refer to as base surplus, and the effects

on the incremental gross surplus from the consumption of the high-quality good over the pool of consumers of the high-quality good, namely,

$$- \underbrace{\theta_l^j s_l \frac{\partial \theta_l^j}{\partial t_i^j}}_{\text{base surplus}} - \underbrace{\theta_h^i (s_h - s_l) \frac{\partial \theta_h^j}{\partial t_i^j}}_{\text{incremental surplus}}, \quad (16)$$

for  $i = l, h$  and  $j = L, H$ , where the first term represents the effect of  $t_i^j$  on  $\int_{\theta_l^j}^1 \theta s_l d\theta = \left[1 - (\theta_l^j)^2\right] \frac{s_l}{2}$  and the second term represents the effect of  $t_i^j$  on  $\int_{\theta_h^H}^1 \theta s_h d\theta - \int_{\theta_h^H}^1 \theta s_s d\theta = \left[1 - (\theta_h^H)^2\right] \frac{(s_h - s_l)}{2}$ . In both countries, the base surplus is decreasing in both taxes, whereas the incremental surplus decreases with the tax on the high-quality good and increases with the tax on the low-quality good. The effects on the incremental surplus weaken country  $L$ 's incentives, while strengthening country  $H$ 's incentives, to subsidize the local good and tax the imported good.

In the low-quality country, local production and environmental concerns align such that that promoting the consumption of the locally produced good, thus limiting  $NS_h^L$ , also coincides with producing less pollution. In the high-quality country, on the other hand, greater consumption of the local good to limit  $NS_l^H$  comes at the expense of more pollution, and there is thus a trade-off between promoting the local good (via a subsidy) and containing pollution damages (via a tax): the more damaging pollution is (i.e., the higher  $\xi$  is), the more likely the country is to opt for a tax on the locally produced good. Specifically, environmental concerns dominate and a tax prevails when  $\xi > \frac{s_h - s_l}{2}$ , which depends positively on the quality difference. When the quality gap widens, the surplus benefit from the high-quality good over and above the surplus benefit from the low-quality good increases, and taxing the high-quality good thus becomes more costly. For the imported good, a country has an additional incentive to tax the good produced abroad as, by so doing, it curtails the amount of surplus the foreign producer is able to extract from its consumers in the form of profits which flow out into the other country.

A corollary of the above proposition is that, in the absence of a non-discrimination principle, the low-quality country always opts for preferential treatment of the domestic good in setting its internal policy, unlike the high-quality country which may decide to discriminate against its own good (that is, to tax the domestic good at a higher rate than the foreign good). Interestingly, NT requirements would not be binding in the high-quality country at high pollution intensity levels relative to the quality gap. Using (13), we can readily see that  $t_l^H - t_h^H \leq 0$  (i.e., the foreign good

is treated at least as favorably as the domestic good) if  $\xi \geq \xi_c = \frac{3s_h(s_h-s_l)}{2(3s_h-s_l)}$ , a threshold level that is increasing in  $s_h$  and decreasing in  $s_l$  and thus increasing in the quality gap. Put differently, the greater the quality gap is, the more damaging pollution must be before the high-quality country opts for an internal policy that actually favors the foreign good and renders NT restrictions irrelevant there. Under no circumstances, however, would an NT restriction in the low-quality producing country be non-binding.

Looking more closely at the effects of pollution intensity and quality gap through a comparative static analysis, we can establish the following: as either the marginal damage of pollution increases or the quality gap increases, the low-quality country responds to the change by implementing an internal policy that treats the domestic good increasingly more favorably than the foreign good. The high-quality country, on the other hand, reduces the extent to which it favors its own good relative to the imported good in response to an increase in the marginal damage of pollution but increases it in response to an increase in the quality gap.<sup>16</sup>

Using the above welfare-maximizing taxes, and denoting the quality gap as  $a = s_h - s_l$ , country  $H$ 's equilibrium prices are

$$p_h^H = \frac{6\xi s_h a}{\Delta_h} \quad \& \quad p_l^H = \frac{4\xi s_h a}{\Delta_l}, \quad (17)$$

with  $p_h^H > p_l^H$ , and equilibrium sales are

$$x_h^H = \frac{3s_h a}{\Delta_h} \quad \& \quad x_l^H = \frac{2\xi s_h}{\Delta_h}, \quad (18)$$

with  $x_h^H > x_l^H$  if  $\xi < \frac{3a}{2}$ , where

$$\Delta_h = 3s_h a + 2\xi(3s_h - 2s_l) > 0 \quad \& \quad \Delta_l = 3a + 2\xi > 0. \quad (19)$$

The corresponding market shares of the two products are then equal to

$$MS_h^H = \frac{3a}{\Delta_l} \quad \& \quad MS_l^H = \frac{2\xi}{\Delta_l}. \quad (20)$$

At low  $\xi$  values, the high-quality country subsidizes its own firm and the market share of the high-quality good exceeds that of the low-quality good. However, as  $\xi$  increases, the subsidy falls and eventually becomes a tax, so that the market share of the high-quality good falls while the market

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<sup>16</sup>More technical and intuitive details about the effects of a change in pollution intensity or the quality gap on the extent of discrimination are available in the Appendix (6.1.1).

share of the low-quality good increases. Furthermore, the more differentiated the two products are, the larger the proportion of consumers purchasing the high-quality good is. To complete the equilibrium characterization in country  $H$ , we compute the  $\theta$  values of the consumer indifferent between buying the high-quality good and the low-quality good and the consumer indifferent between buying the low-quality good and buying nothing as

$$\theta_h^H = \frac{2\xi(3s_h - 2s_l)}{\Delta_h} \quad \& \quad \theta_l^H = \frac{4\xi a}{\Delta_h}. \quad (21)$$

The fact that  $\theta_l^H > 0$  implies that the market is not completely covered (i.e., some individuals with very low valuations of quality are priced out of the market). Both cutoff values are increasing in  $\xi$  but, as the quality gap increases,  $\theta_h^H$  always decreases while  $\theta_l^H$  decreases if  $\xi \in \left(0, \frac{3a^2}{2s_l}\right)$  and increases if  $\xi > \frac{3a^2}{2s_l}$ .<sup>17</sup> The total market coverage thus shrinks in response to an increase in  $\xi$  but may increase in response to an increase in  $s_h$ .

In country  $L$ , equilibrium prices are

$$p_h^L = \frac{2a(a + \xi)}{\Delta_l} \quad \& \quad p_l^L = 0, \quad (22)$$

equilibrium sales are

$$x_h^L = \frac{a}{\Delta_l} \quad \& \quad x_l^L = \frac{2(a + \xi)}{\Delta_l}, \quad (23)$$

and equilibrium cutoff or threshold  $\theta$  values are

$$\theta_h^L = \frac{2(a + \xi)}{\Delta_l} \quad \& \quad \theta_l^L = 0, \quad (24)$$

so that the entire market is covered and the equilibrium market shares of the two products coincide with the equilibrium sales. The market share of the high-quality good is then increasing in the quality gap but decreasing in pollution intensity; correspondingly, the market share of the low-quality good is decreasing in the quality gap but increasing in pollution intensity.

## 2.2 National Treatment

In this sub-section, we consider the case when NT rules apply: countries face the constraint that foreign products be treated at least as favorably as domestic products. As we note above, the presence of a consumption externality gives rise to a possibility not encountered in previous NT

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<sup>17</sup>Specifically,  $\theta_l^H$  decreases (increases) when  $t_l^H$  is decreasing (increasing) in  $s_h$ .

studies (e.g., Saggi and Sara, 2008), that is, the high-quality producing country may opt to actively promote the foreign good, thus discriminating against its own good, a differential treatment that is not precluded under Article III. Hence, we separate between a binding NT which applies when, in its absence, both countries would favour the domestic good (i.e., when  $\xi < \xi_c$ ) and a unidirectionally binding NT which applies when, in its absence, the high-quality producing country would favour the foreign good so that the implementation of NT rules would not alter the country's discriminatory policy.<sup>18</sup> Under a binding NT, the constraint then becomes that foreign and domestic products be treated *equally* in policy setting, so that quality-differentiated versions of the same good must be subjected to the same tax rate within each country, although taxes can differ across countries (that is, NT does not require harmonization of domestic policies across borders). To facilitate exposition and be able to separate easily between the non-NT and NT solutions, we use capital letters to denote choice variables under NT rules (e.g.,  $T^j$  represents the NT tax in country  $j$ ).

Under NT, country  $j$  chooses a single tax,  $T^j$ , to maximize its individual welfare, namely,

$$W^j(T^j) = cs^j(T^j) + \pi_d^j(T^j) + \pi_e^j(T^{-j}) - \varphi^j(T^j), \quad (25)$$

where  $\pi_d^j(T^j)$  denotes the domestic firm's profits from domestic sales, which depend only on country  $j$ 's tax,  $T^j$ , and  $\pi_e^j(T^{-j})$  denotes the domestic firm's profits from foreign sales, which depend only on country  $-j$ 's tax,  $T^{-j}$ . Using the two countries' welfare-maximizing conditions, we obtain the equilibrium taxes as

$$T^H = \frac{4\xi s_h s_l}{\Delta_H} > 0 \quad \& \quad T^L = \frac{4\xi s_h s_l}{\Delta_L} > 0, \quad (26)$$

where

$$\Delta_H = 12s_h^2 - 3s_h s_l + 2\xi s_l > 0 \quad \& \quad \Delta_L = 4s_h^2 + 7s_h s_l - 2s_l^2 + 2\xi s_l > 0. \quad (27)$$

We summarize the results in the following:

**Proposition 2** *Under binding NT rules, both countries choose to tax the two quality-differentiated products, tightening their policies as pollution intensity increases and/or the quality gap decreases, but the tax in the low-quality country is always larger than the tax in the high-quality country.*

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<sup>18</sup> As we show below, the possibility of a unidirectionally binding NT also arises when the consumption externality is declining in quality. In such a case, the NT rules may not be binding for the low-quality producing country. In general, NT rules are always binding for the producer of the clean version of the good and may not be for the producer of the dirty good. We leave the analysis of a unidirectionally binding NT to the Appendix (6.3).

It is straightforward to show that country  $L$  opts for more aggressive taxation than country  $H$  as

$$T^L - T^H = \frac{8\xi s_h s_l (4s_h - s_l) a}{\Delta_H \Delta_L} > 0, \quad (28)$$

that both taxes are always increasing in pollution intensity as

$$\frac{dT^H}{d\xi} = \frac{12s_l s_h^2 (4s_h - s_l)}{\Delta_H^2} > 0 \quad \& \quad \frac{dT^L}{d\xi} = \frac{4s_l s_h (s_h + 2s_l) (4s_h - s_l)}{\Delta_L^2} > 0, \quad (29)$$

and that both taxes are decreasing in the quality gap over the relevant range of  $\xi$  values as

$$\frac{dT^H}{ds_h} = -\frac{8s_l \xi (6s_h^2 - s_l \xi)}{\Delta_H^2} < 0 \quad \& \quad \frac{dT^L}{ds_h} = -\frac{8s_l \xi (2s_h^2 + s_l^2 - s_l \xi)}{\Delta_L^2} < 0. \quad (30)$$

The effects of  $s_h$  can be positive at high  $\xi$  values but are always negative for  $\xi < \xi_c$ .

In setting their policies, the two countries face similar incentives: on one hand, a higher tax reduces gross consumer surplus (both base surplus and incremental surplus); on the other hand, it reduces pollution damages and the amount of surplus flowing out into the other country. That the tax in the low-quality country is always larger than the tax in the high-quality country follows from the fact that, in the absence of taxation, the high-quality good enjoys both a higher price and a larger share of the market than the low-quality good in both countries. As profits from the consumption of the high-quality good represent surplus that flows out of country  $L$  and the profits from the consumption of the low-quality good represent surplus that flows out of country  $H$ , the benefit of taxation is greater in the low-quality country which thus opts for a stricter policy. When pollution intensity increases, the benefit of taxation through the effect on pollution damages increases in both countries, and both taxes increase; when the quality gap increases, the cost of taxation through the effect on the incremental surplus increases in both countries, and both taxes decrease.

With the equilibrium taxes determined, we can then compute the equilibrium prices as

$$P_h^H = \frac{2s_h [3s_h a + 2\xi s_l]}{\Delta_H} \quad \& \quad P_h^L = \frac{2s_h [(s_h + 2s_l) a + 2\xi s_l]}{\Delta_L} \quad (31)$$

for the high-quality good and

$$P_l^H = \frac{s_l [2\xi (s_h + s_l) + 3s_h a]}{\Delta_H} \quad \& \quad P_l^L = \frac{s_l [(s_h + 2s_l) a + 2\xi (s_h + s_l)]}{\Delta_L} \quad (32)$$

for the low-quality good, and note that  $P_h^L > P_h^H$ ,  $P_l^L > P_l^H$ , and  $P_h^L - P_l^L > P_h^H - P_l^H > 0$ . Equilibrium sales are then

$$X_h^H = \frac{6s_h^2}{\Delta_H} \quad \& \quad X_h^L = \frac{2s_h(s_h + 2s_l)}{\Delta_L} \quad (33)$$

for the high-quality good and

$$X_l^H = \frac{s_h(3s_h - 2\xi)}{\Delta_H} \quad \& \quad X_l^L = \frac{s_h(s_h + 2s_l - 2\xi)}{\Delta_L} \quad (34)$$

for the low-quality good, with  $X_l^H > 0$  for  $\xi < \frac{3s_h}{2} > \xi_c$ ,  $X_l^L > 0$  for  $\xi < \frac{s_h + 2s_l}{2} > \xi_c$ ,  $X_h^H > X_h^L$ ,  $X_l^H > X_l^L$ , and  $0 < X_h^H - X_l^H < X_h^L - X_l^L$ . Finally, the equilibrium cutoff  $\theta$  values are

$$\Theta_h^H = \frac{3s_h(2s_h - s_l) + 2\xi s_l}{\Delta_H} \quad \& \quad \Theta_h^L = \frac{2(s_h^2 - s_l^2) + 3s_h s_l + 2\xi s_l}{\Delta_L} \quad (35)$$

for the consumer indifferent between buying the high-quality good and the low-quality good and

$$\Theta_l^H = \frac{3s_h a + 2\xi(s_h + s_l)}{\Delta_H} \quad \& \quad \Theta_l^L = \frac{s_h^2 + s_h s_l - 2s_l^2 + 2\xi(s_h + s_l)}{\Delta_L} \quad (36)$$

for the consumer indifferent between buying the low-quality good and buying nothing, with  $\Theta_h^H > \Theta_l^H$  for  $\xi < \frac{3s_h}{2} > \xi_c$  and  $\Theta_h^L > \Theta_l^L$  for  $\xi < \frac{s_h + 2s_l}{2} > \xi_c$ . Unlike the non-NT case, when NT rules apply, market coverage in the low-quality country is not only incomplete (i.e.,  $\Theta_l^L > 0$ ) but is also less complete than in the high-quality country (i.e.,  $\Theta_l^H < \Theta_l^L$ ). Hence, while country  $H$ 's sales exceed country  $L$ 's sales in the local market and fall short of country  $L$ 's sales in the foreign market in the absence of NT rules, they are greater in both markets in the presence of NT rules. In both countries, the two critical  $\theta$  values increase with  $\xi$ , which implies that, at high pollution intensity levels, more consumers with low valuations of quality are priced out of the market and fewer consumers with high valuations of quality buy the high-quality good.

### 3 Comparing National Treatment with No National Treatment

In this section, we compare the NT and non-NT cases with respect to environmental taxes, sales of the two products in each country, market coverage, national and global welfare, and national and global environmental damages. As the focus of the paper is on the implications of a binding NT clause, which only excludes preferential treatment of the domestic good (therefore allowing for preferential treatment of the *foreign* good), we constrain the comparative analysis that follows to

situations in which  $\xi < \xi_c$ ; for completeness, however, we consider the welfare and environmental implications of a unidirectionally binding NT (i.e., when NT is only binding for the clean-good country) in the Appendix and incorporate the results in the Figures.

### 3.1 Environmental Taxes

**Proposition 3** *With the adoption of NT, both countries raise the tax on the domestic good and reduce the tax on the foreign good.*

In the high-quality country, the tax effects of switching from NT to non-NT are reflected in

$$T^H - t_h^H = \frac{s_h [2\xi (3s_h - s_l) - 3s_h a] [2\xi s_l - 3(4s_h - s_l) a]}{\Delta_h \Delta_H}, \quad (37)$$

which is positive for  $\xi < \xi_c$ , and

$$T^H - t_l^H = \frac{2\xi s_l (2s_h - s_l) [2\xi (3s_h - s_l) - 3s_h a]}{\Delta_h \Delta_H}, \quad (38)$$

which is negative for  $\xi < \xi_c$ . For the low-quality country, the tax difference in the low-quality market, that is,  $T^L - t_l^L$ , is always positive as the country opts for a tax under NT but a subsidy under non-NT; the tax difference in the high-quality market, namely,

$$T^L - t_h^L = \frac{[2\xi s_l - (4s_h - s_l) a] [2\xi (s_h + s_l) + (s_h + 2s_l) a]}{\Delta_l \Delta_L}, \quad (39)$$

depends on  $\xi$  but is negative for  $\xi < \xi_c$ . Overall, both countries react to the application of NT rules by taxing, as opposed to subsidizing, or increasing the tax on the domestic good while decreasing the tax on the foreign good. To understand the intuition of this result, it may be useful to think of a country's objective under NT as choosing taxes on the two goods in order to maximize its welfare subject to the constraint that the two taxes are equal. Hence, the country's choice is such that the sum of the individual marginal welfare effects of the two taxes is equal to zero and the equality constraint is satisfied. Being restricted to imposing the same tax on the two goods, the country cannot subsidize the domestic good or tax it at a lower rate and must instead choose a tax such that the marginal welfare effect of taxing the foreign good is positive and offsets the negative marginal welfare effect of taxing the domestic good; the NT tax on the foreign good is thus lower than the corresponding non-NT tax. The extent to which a binding NT clause affects the two tax rates in each country varies with both pollution intensity and the quality gap: as the pollution

intensity increases, the impact of NT on the taxation of the foreign good increases (decreases) at low (high)  $\xi$  values in both countries, while the impact of NT on the taxation of the domestic good always increases (decreases) in the low-quality (high-quality) country; as the quality gap increases, the impact of NT increases for both goods and in both countries.

We graph the above results in Figures 1a and 1b. In Figure 1a, we select specific values of  $s_h$  and  $s_l$  and look at the tax differences over the relevant range of  $\xi$  values; in Figure 1b, we select specific values of  $s_l$  and  $\xi$  and look at the tax differences over the relevant range of  $s_h$ . In the absence of NT, as the externality becomes more of a concern (i.e., as  $\xi$  increases), country  $L$  curbs the additional environmental damages through increases in both the tax on good  $h$  and the subsidy on its own good. Under NT, however, country  $L$  has no choice but to increase the common tax, balancing the benefit of reducing pollution through a higher tax on good  $h$  with the cost of reducing producer's surplus through a higher tax on good  $l$ . When we consider the comparative effects of a change in the quality gap, we know that an increase in  $s_h$  raises country  $L$ 's concern over local production which, if it is able to discriminate, it addresses by increasing both the subsidy on the local good and the tax on the imported good; under non-discrimination, the country reduces the common tax, balancing the benefit of increasing producer's surplus through a lower tax on good  $l$  with the cost of increasing pollution through a lower tax on good  $h$ .

The story is somewhat different for country  $H$ , which, in the absence of NT, raises both the tax on good  $h$  (or reduces the subsidy on good  $h$ ) and the tax on good  $l$  when  $\xi$  increases: the more concerned about the environment the country is (i.e., the higher  $\xi$  is), the larger the increase in the tax that targets the source of pollution is (i.e., good  $h$ ) relative to the increase in the tax on the clean good. Such an adjustment is not feasible under NT as the tax increase in response to an increase in  $\xi$  applies equally to both goods, and the country has to then rely on the offsetting effect of the tax increase in market  $l$  to a greater extent than in the absence of NT. The implication of the above is that the NT tax increases in response to an increase in  $\xi$  by a smaller amount than the non-NT tax for good  $h$ , so that the difference between the two taxes is decreasing in  $\xi$ . For good  $l$ , the NT tax increase is smaller at low  $\xi$  values but larger at high  $\xi$  when environmental concern becomes more relevant, but the country has to rely more on the tax change in market  $l$  to make up for the lack of incremental taxation of the source of pollution. The difference between the NT and non-NT taxes in market  $l$  is thus declining at low  $\xi$  levels and rising at high levels. As for the

profiles of the tax differences over  $s_h$ , the rationale is similar to that of  $\xi$ : under NT, the country cannot rely on adjustments of the two tax rates in response to an increase in  $s_h$ , decreasing the tax more on good  $h$  (the source of gain), and thus decreases the NT tax by a smaller amount than the non-NT tax for good  $h$ .

[Insert Figures 1a and 1b here]

### 3.2 Prices, Market Coverage, and Output

Combining the optimal taxes with the equilibrium market outcomes from the second stage, we can show that NT increases the prices of both goods in country  $H$ , increases the price of the low-quality good in country  $L$ , and may increase or decrease the price of the high-quality good in country  $L$  if the quality gap is sufficiently small. Specifically, NT always increases the price of  $h$  in  $L$  if the quality gap is large but may decrease it otherwise if pollution intensity is sufficiently low. Given these price effects, in the low-quality producing country, NT results in (i) fewer consumers buying a good (either quality), (ii) more consumers buying the high quality good, and (iii) fewer consumers buying the low-quality good. In the high-quality producing country, NT also results in market coverage shrinkage but with more consumers buying the low-quality good and fewer consumers buying the high quality good. Although market coverage shrinks in both countries, more consumers are driven out of the market by NT in country  $L$ .<sup>19</sup>

### 3.3 Welfare

In the absence of NT rules, equilibrium welfare, which includes domestic welfare (i.e., the sum of consumer surplus, local profits, and tax revenues minus environmental damages) and profits from sales in the foreign market, is

$$w^L = w_l^L + \pi_l^H = \frac{(s_h + 2s_l)a + 2\xi s_l}{2\Delta_l} + \frac{4\xi^2 s_h s_l a}{\Delta_h^2} \quad (40)$$

in country  $L$  and

$$w^H = w_h^H + \pi_h^L = \frac{s_h [3s_h a + 2\xi s_l]}{2\Delta_h} + \frac{a^3}{\Delta_l^2} \quad (41)$$

in country  $H$ . Under NT rules, equilibrium welfare is instead

$$W^L = W_l^L + \Pi_l^H = \frac{s_h (s_h + 2s_l - 2\xi) (s_h + 2s_l)}{2\Delta_L} + \frac{s_h s_l a (2\xi - 3s_h)^2}{\Delta_H^2} \quad (42)$$

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<sup>19</sup>For more details on these comparisons, see the Appendix (6.1.2).

in country  $L$  and

$$W^H = W_h^H + \Pi_h^L = \frac{3s_h^2(3s_h - 2\xi)}{2\Delta_H} + \frac{4s_h^2(s_h + 2s_l)^2 a}{\Delta_L^2} \quad (43)$$

in country  $H$ .

We can then show, with more details available in the Appendix, that

$$w^L - W^L = \underbrace{w_l^L - W_l^L}_{>0} + \underbrace{\pi_l^H - \Pi_l^H}_{\leq 0} > 0, \quad (44)$$

that is, country  $L$ 's welfare is always lower under NT. For country  $L$ , by preventing discrimination against the competing firm, NT also prevents discrimination against the polluting good. However, NT also prevents the foreign country (i.e., country  $H$ ) from discriminating against its non-domestic good (i.e., good  $l$ ), which means that country  $L$ 's firm's profits from the sales in the foreign market increase at low  $\xi$  levels, for a given quality gap, when the foreign country's NT tax on good  $l$  falls short of the non-NT tax. When we remove NT rules, the increase in domestic welfare always outweighs the decrease in profits from the foreign market so that, overall, country  $L$ 's welfare is always larger in the absence of NT rules.

In country  $H$ , we also have an increase in domestic welfare but profits from foreign sales always decrease when we move away from NT, that is,

$$w^H - W^H = \underbrace{w_h^H - W_h^H}_{>0} + \underbrace{\pi_h^L - \Pi_h^L}_{<0}. \quad (45)$$

As country  $L$  imposes a lower tax on the foreign good under NT for a wider range of  $\xi$  values than country  $H$  does, the increase in profits from foreign sales that NT brings about is more sustainable, and turns out to hold over the entire range of feasible  $\xi$  values, in country  $H$ , although the incremental profits decline at high  $\xi$  values when country  $L$ 's NT tax on good  $h$  increases above the non-NT level. The stronger effect on profits from foreign sales serves to more than offset the negative effect on domestic welfare so that country  $H$ 's welfare is greater under NT. We summarize the welfare effects of NT in the following:

**Proposition 4** *With the adoption of NT, welfare in the low-quality country decreases while welfare in the high-quality country increases. The positive welfare change in country  $H$  tends to outweigh the negative welfare change in country  $L$ , so that world welfare increases, but it is possible for global welfare to decrease at combinations of low pollution intensity and quality gap values.*

In Figure 2, we illustrate the possible global welfare changes by means of two isovalue curves: a welfare isovalue curve and a tax isovalue curve. The welfare isovalue curve  $s(\xi|_{w^W - W^W})$ ,<sup>20</sup> gives combinations of  $\xi$  and  $s_h$  (for  $s_l = 1$ ) such that global welfare is equal with and without NT (that is,  $w^W - W^W = w^H - W^H + w^L - W^L = 0$ ). The positive slope of this curve reflects the negative effect of pollution intensity and the positive effect of the quality gap on NT welfare relative to non-NT welfare: for a given quality gap as reflected in  $s_h$  under normalization of  $s_l$  to unity, NT welfare decreases relatively to non-NT welfare when pollution becomes more damaging (since NT rules prevent discrimination against the polluting good). Alternately, for a given pollution intensity, NT welfare decreases relatively to non-NT welfare when the quality gap increases since NT rules prevent countries from capitalizing on the quality differences between the two goods via differential taxes. The tax isovalue curve  $s(\xi|_{t_h^H - t_l^H})$  gives, instead, combinations of  $\xi$  and  $s_h$  (for  $s_l = 1$ ) such that non-NT taxes in country  $H$  are equal (that is,  $t_l^H - t_h^H = 0$ ); this curve thus bounds from below the area relevant for our analysis of the impacts of the NT clause, with the area below this curve representing combinations of  $\xi$  and  $s_h$  for which NT is not binding for one of the two countries. In the area above  $s(\xi|_{w^W - W^W})$ , welfare under NT is always lower in country  $L$  but higher in country  $H$ ; as for global welfare, it is positive in area  $B_1$  but negative in area  $B_2$ .

[Insert Figure 2 here]

In region  $B_1$ , for a given quality differential, a zero externality implies that country  $L$  is worse off as local losses from not discriminating against the high-quality competition dominate the gains from NT in market  $h$ . As damages increase, but the quality gap remains unchanged, country  $L$  wants to discriminate more against the dirty good produced abroad and thus experience a welfare decrease absent the legal ability to discriminate. At the same time, country  $H$  chooses a higher tax on its own good, benefitting country  $L$  in market  $h$ , even in the absence of NT. In a sense, there are two conflicting effects following the implementation of NT rules: a quality discrimination effect which favours NT (that is, NT restricts “bad” discrimination against the foreign good) and a damage effect which works against NT (that is, NT restricts “good” discrimination against the dirty good). These effects are muted in the high-quality producing country which is able to internalize both to a greater extent than the low-quality producing country. So, for a given quality gap, as

<sup>20</sup>We omit the section of the curve that lies in the region where NT rules are non-binding for country  $H$ .

we move to the right in Figure 2 (i.e., damages increase), the losses from discrimination rise for country  $L$  faster than the gains rise for country  $H$  to the point where the total losses in the former exceed the gains in the latter and world welfare falls (region  $B_2$ ). Damages are then sufficiently high that the damage effect of NT dominates the quality effect of NT. However, further increases in damages move us to area  $B_3$  where country  $H$  is no longer bound by NT since it chooses a higher tax on its own good, and all the effects of NT come from country  $L$ . In region  $B_3$ , country  $L$  cannot discriminate against the foreign product or the dirty good, tempered by the fact that its consumers prefer the foreign good, and the gains to country  $H$  exceed again the losses to country  $L$ .<sup>21</sup>

This analysis confirms and extends the results in Saggi and Sara (2008): with no consumption externality, NT increases world welfare under symmetry as the gains of NT in the high-quality producing country exceed the losses in the low-quality producing country. Along our vertical axis, the consumption externality is zero, and the results thus hold. We show, however, that it is possible for NT to increase world welfare even in the presence of a consumption externality (areas  $D_1$ ,  $D_3$ , and  $D_4$ ). In the  $D_4$  region, where country  $L$  bears all of the NT effects, the implications are extreme: NT can also improve global welfare even at high levels of the externality.

### 3.4 Environmental Damages

The difference in environmental damages between the NT and the non-NT regimes in country  $H$  is given by

$$\varphi^H - \Phi^H = \frac{9\xi s_h^2 (a^2 \Delta_H^2 - 4s_h^2 \Delta_h^2)}{\Delta_h^2 \Delta_H^2}, \quad (46)$$

which is positive if  $(s_h - s_l) \Delta_H - 2s_h \Delta_h = (2s_h - s_l) [3s_h (s_h - s_l) - 2\xi (3s_h - s_l)] > 0$  or, in terms of  $\xi$ , if  $\xi < \xi_c$ ; the corresponding difference in country  $L$  is

$$\varphi^L - \Phi^L = \frac{\xi [a^2 \Delta_L^2 - 4s_h^2 (s_h + 2s_l)^2 \Delta_l^2]}{\Delta_l^2 \Delta_L^2}, \quad (47)$$

which is always negative as

$$a\Delta_L - 2s_h (s_h + 2s_l) \Delta_l = -(2s_h + s_l) [a (s_h + 2s_l) + 2\xi (s_h + s_l)] < 0. \quad (48)$$

Accordingly, we can describe the overall environmental effects of NT in the following:

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<sup>21</sup>We should note that world welfare would be lower with NT in area  $B_3$  if Article III required complete non-discrimination (i.e., true equal treatment).

**Proposition 5** *NT results in greater environmental damages in country  $L$  but leads to lower damages in country  $H$ . Globally, the environment improves (worsens) with the implementation of NT at sufficiently low (high) pollution intensity levels.*

Under NT rules, the low-quality country cannot differentiate between the polluting good and the non-polluting good and cannot use domestic policy to increase the competitiveness of its own product in its own market. Hence, the market share of the polluting good produced abroad increases, thus causing pollution to increase as consumption shifts away from the clean good produced domestically. The high-quality country, on the other hand, experiences a decrease in the local market share of its own polluting good, which decreases pollution. Hence, environmental damages increase in country  $L$  but decrease in country  $H$ .

In Figure 4, we illustrate changes in environmental damages. In area  $C_1$ , NT decreases damages in country  $H$  by inducing the country to raise its tax on its own dirty good while lowering the tax on the clean good; these gains more than offset the extra damages in country  $L$ , where NT results in a lower tax on the dirty good, and world damages thus decrease. In another way, discrimination allows less of the dirty good into country  $L$  and more of the dirty good in country  $H$ . However, as pollution intensity increases for a given quality gap (i.e., area  $C_2$ ), country  $H$ 's savings in environmental damages shrink so that, although pollution under NT remains below its non-NT level in country  $H$ , global pollution is higher under NT. Further increases in damages into the area where NT is not binding for country  $H$  imply that damages are identical in country  $H$  with and without NT but higher in country  $L$  with NT so that world damages again increase under NT.

[Insert Figure 3 here]

Overall, then, with a high-quality polluting good, NT can lead to an increase in world welfare and a cleaner world environment when pollution intensity is low relative to the quality gap (area  $D_1$  in Figure 4), can improve world welfare but at the cost of a dirtier environment at intermediate  $\xi$  values for a given quality gap (area  $D_2$  in Figure 4), or can reduce world welfare and lead to a dirtier environment when pollution intensity is high (area  $D_3$  in Figure 4). Hence, NT has generally negative consequences for the environment (areas  $D_1$ ,  $D_3$ , and  $D_4$ ) but positive consequences for world welfare (areas  $D_1$ ,  $D_2$ , and  $D_4$ ). In a sense, the ideal outcome of higher welfare and a cleaner

environment requires a low externality and a high quality gap under NT (area  $D_1$ ) but a high externality and a low quality gap under discrimination (area  $D_3$ ).

[Insert Figure 4 here]

## 4 Low-Quality Polluting Goods

In the above analysis, we consider situations in which the consumption of the high-quality good imposes a negative environmental externality as in the car market. But what if one of the dimensions encompassed in the quality parameter is environmental friendliness so that consuming the high-quality good is better for the environment? Under the existing pressures to reduce pollution, firms have increasingly been incorporating environmental considerations in their products' design and consumers have increasingly become more sensitive to the environmental attributes of what they consume, partly because of health considerations (e.g., organic products). While there may be instances in which environmental friendliness may not be positively correlated with the other dimensions captured in the quality parameter and we may thus need a multidimensional measure of quality, we confine our attention to instances in which such correlation does exist or, more narrowly, to instances in which goods differ in their environmental friendliness/quality and individuals prefer more to less environmental friendliness (e.g., energy-saving appliances).

A key difference between this case (pollution from consuming the low-quality good) and the previous case (pollution from consuming the high-quality good) is the absence in the former of the tradeoff between pollution and quality. In fact, when it is the consumption of good  $l$  that generates pollution, consumers prefer good  $h$  because it is of higher quality, and governments prefer, *ceteris paribus*, the same good because it produces less pollution.

The problem of the firms remains the same as in the previous case, with (11) representing the equilibrium prices, for given taxes and cut-off quality parameters. With pollution damages arising from the consumption of the low-quality good and thus equal to

$$\tilde{\varphi}^i = \xi (x_l^i)^2 = \xi (\theta_h^i - \theta_l^i)^2, \quad (49)$$

the non-NT optimal taxes in the low-quality country are

$$\tilde{t}_h^L = \frac{a(2\xi s_h + s_l a)}{\tilde{\Delta}_l} > 0 \quad \& \quad \tilde{t}_l^L = \frac{2s_l a(2\xi s_h - s_l a)}{s_h \tilde{\Delta}_l}, \quad (50)$$

where

$$\tilde{\Delta}_l = 3s_l a + 2\xi(3s_h - 2s_l) > 0. \quad (51)$$

Like the high-quality country in the previous case, country  $L$  always taxes the clean good produced abroad and subsidizes its own dirty good provided that the marginal damage of pollution is sufficiently low relative to the quality gap but, when taxing both goods, may tax its own good at a higher rate than the foreign good if the quality gap is sufficiently small. However, when external effects are associated with the consumption of the low-quality good, the dirty-good country is less likely to subsidize the local good but also less likely to tax the local good at a higher rate than the imported good, so that the need for a non-discrimination clause is more likely to arise. Specifically, subsidization of the local good occurs for  $\xi < \frac{s_l a}{2s_h}$ , which is smaller than the corresponding range when good  $h$  is the dirty good ( $\xi < \frac{a}{2}$ ); the incentive to subsidize the domestically produced dirty good is thus stronger when pollution generates from consuming the high-quality good. Discrimination against the local good occurs instead when  $s_l < s_h < 2s_l$  for  $\xi > \tilde{\xi}_c = \frac{s_l a(s_h + 2s_l)}{2s_h(2s_l - s_h)}$ , which is smaller than the corresponding range when good  $h$  is the dirty good ( $\xi > \xi_c$ ). If we take the range of  $\xi$  values such that NT is binding as a measure of the need for a non-discrimination cause, we then have that, when  $s_h \geq 2s_l$ , there is always a need for NT in the low-quality polluting good case but not in high-quality polluting good case; when  $s_l < s_h < 2s_l$ , the critical  $\xi$  value above which NT is not binding for the dirty-good country is larger if the low-quality good is polluting ( $\tilde{\xi}_c > \xi_c$ ), which implies that the need for NT is greater in the low-quality polluting good case. Hence, NT is more likely to be binding when pollution generates from the consumption of the low-quality good. Both policy instruments are increasing in the extent of the externality, while the tax on the high-quality good is also increasing in the quality gap and the tax on the low-quality good may decrease or increase in response to an increase in  $s_h$ .<sup>22</sup>

In the absence of NT rules, the high-quality country, on the other hand, always finds it optimal to subsidize the domestic good to the point of driving the low-quality good out of the market, so that consumers purchase only the clean, locally produced, high-quality good. To achieve this, country  $H$  sets the optimal tax on its good to be

$$\tilde{t}_h^H = -a, \quad (52)$$

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<sup>22</sup>For more details on the comparative statics and other results in this section, see the Appendix (6.2).

that is, it chooses a subsidy equal to the quality gap; the subsidy is thus independent of the marginal damage of pollution and increasing in the quality gap.<sup>23</sup>

Discrimination thus implies full market coverage, zero prices, and no pollution (from no consumption of good  $l$ ) in country  $H$ . With both goods priced at the same level, consumers choose to purchase only the high-quality good, and, at least in this market, there is allocative efficiency. In country  $L$ , however, there are consumers who are priced out of the market as  $\theta_l^L = \frac{p_l^L}{s_l} > 0$ , and the overall market size is decreasing in both  $\xi$  and  $s_h$ , but more consumers buy the high-quality good as  $\xi$  increases while more consumers buy the low-quality good as  $s_h$  increases.

Under NT, the optimal taxes are instead

$$\tilde{T}^L = \frac{4\xi s_l s_h^2}{\tilde{\Delta}_L} > 0 \quad (53)$$

in country  $L$ , where

$$\tilde{\Delta}_L = s_h (8\xi s_h + 4s_h s_l + 7s_l^2) - 2s_l^3, \quad (54)$$

and

$$\tilde{T}^H = \frac{4\xi s_l s_h}{\tilde{\Delta}_H} > 0 \quad (55)$$

in country  $H$ , where

$$\tilde{\Delta}_H = 8\xi s_h + 12s_h s_l - 3s_l^2, \quad (56)$$

with

$$\tilde{T}^L - \tilde{T}^H = \frac{8s_h s_l^2 \xi (4s_h - s_l) a}{\tilde{\Delta}_L \tilde{\Delta}_H} > 0. \quad (57)$$

Country  $L$ 's tax is increasing in both  $\xi$  and  $s_h$ , while country  $H$ 's tax is increasing in  $\xi$  but decreasing in  $s_h$ . Under NT, neither country opts for full market coverage, but country  $H$  prices out of the market fewer consumers than country  $L$  as  $0 < \tilde{X}_h^L + \tilde{X}_l^L < \tilde{X}_h^H + \tilde{X}_l^H < 1$ . Both countries respond to an increase in  $\xi$  or an increase in  $s_h$  by reducing market coverage, driving more consumers out of the market, and pricing more consumers out of purchasing the high-quality good in favour of the low-quality good. Before moving on to comparing taxes, welfare, and environmental damages under the two policy regimes, it is worthwhile underscoring the effects of NT on sales and market coverage: in country  $H$ , these effects are clear from the above analysis and amount to a contraction

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<sup>23</sup>There is no need to tax good  $l$  as consumers do not buy it ( $t_l^H = 0$ ). While a high tax on good  $l$  could achieve the same outcome (i.e., no consumption of good  $l$ ), country  $H$  also wants its consumers to buy the high-quality good and must thus choose to subsidize its own firm.

of the market accompanied by a decrease in the sales of good  $h$  and an increase in the sales of good  $l$ ; in country  $L$ , NT increases sales of good  $h$ , decreases sales of good  $l$ , and increases market coverage for  $\xi > \frac{3s_l a}{4s_h}$ .

In comparison to the non-NT policy, the NT policy is always stricter in country  $H$  but can be laxer in country  $L$ ; the relevant tax differences are given by

$$\tilde{t}_h^L - \tilde{T}^L = \frac{a [4\xi s_h + s_l (4s_h - s_l)] [s_l a (2s_l + s_h) - 2\xi s_h (2s_l - s_h)]}{\tilde{\Delta}_l \tilde{\Delta}_L} \quad (58)$$

and

$$\tilde{t}_l^L - \tilde{T}^L = \frac{2s_l [2\xi s_h^2 - s_l a (4s_h - s_l)] [s_l a (2s_l + s_h) - 2\xi s_h (2s_l - s_h)]}{s_h \tilde{\Delta}_l \tilde{\Delta}_L}, \quad (59)$$

which can be negative or positive depending on the value of  $\xi$  relative to the values of  $s_h$  and  $s_l$ . If  $s_h \geq 2s_l$ , the NT tax on good  $h$  is always smaller and the NT tax on good  $l$  is smaller if  $\xi > \frac{s_l a (4s_h - s_l)}{2s_h^2} > \frac{s_l a}{2s_h}$ . If  $s_h < 2s_l$ , both NT taxes are smaller for  $\frac{s_l a (4s_h - s_l)}{2s_h^2} < \xi < \tilde{\xi}_c = \frac{s_l a (2s_l + s_h)}{2s_h (2s_l - s_h)}$  but the NT tax on good  $h$  is smaller and the NT tax on good  $l$  is larger for  $\xi < \frac{s_l a (4s_h - s_l)}{2s_h^2}$ . We summarize and illustrate the above possibilities in Figure 5; for a given quality gap, we thus have that the tax on the foreign good decreases while the tax on the domestic good increases at low pollution intensity levels (area  $E_1$ ) and both taxes decrease at intermediate pollution intensity levels if  $s_h < 2s_l$  and at high pollution intensity levels if  $s_h \geq s_l$  (area  $E_2$ ).

[Insert Figure 5 here]

#### 4.1 NT versus non-NT: Welfare and Environmental Damages

When pollution generates from the consumption of the low-quality good, country  $H$  suffers unambiguously from higher pollution damages under NT (damages are zero in the non-NT case), in spite of higher taxes on both goods.<sup>24</sup> In the absence of NT, every consumer in country  $H$  participates in the market but buys only good  $h$ ; under NT rules, consumers with the lowest valuations of quality withdraw from the market and only consumers with the highest valuations of quality buy the high-quality good, so that a segment of the market purchases the low-quality good; hence, with the adoption of NT rules, consumption of the clean good  $h$  decreases while consumption of the

<sup>24</sup>In the absence of NT rules, country  $H$  always prices the low-quality good out of the market through a subsidy on good  $h$ , and there is thus no tax on good  $l$ . We could then say that country  $H$  can choose *any* tax on good  $l$  without affecting the equilibrium. In this sense, we could argue that the tax on good  $l$  does not increase. We take the view that requiring “no tax” implies a zero tax.

dirty good  $l$  increases in country  $H$ , and the environment thus worsens. Welfare, however, does not necessarily decrease in country  $H$  following the NT adoption: as long as the marginal damage of pollution is sufficiently small and the quality gap sufficiently high, NT increases country  $H$ 's welfare. This increase comes about as a result of the increased profits from greater sales of good  $h$  and lower taxes in country  $L$  which outweighs the reduction in domestic welfare upon entry of good  $l$  into country  $H$ .<sup>25</sup>

Environmental damages and welfare in country  $L$  depend on pollution intensity and the quality gap but in different ways than in country  $H$ . Damages are lower in country  $L$  when pollution intensity is low relative to the quality gap and higher otherwise; in particular, damages are higher when the NT tax falls short of both non-NT taxes (area  $E_1$  in Figure 5) and lower otherwise. When the pollution intensity is low, allowing additional sales of good  $h$  through common taxation reduces the market size of the dirty good, and damages thus fall. As pollution intensity increases, NT can cause an increase in the market size of the dirty good, which increases pollution. Welfare, on the other hand, is higher in country  $L$  under NT if (i) the quality gap is sufficiently high and pollution intensity is sufficiently low or (ii) the quality gap is sufficiently low and pollution intensity is sufficiently high. For intermediate values of both pollution intensity and the quality gap, NT reduces country  $L$ 's welfare. We illustrate the welfare and damage effects in Figures 6a, 6b and 7, but we also summarize them in the following proposition:

**Proposition 6** *When pollution is generated by the consumption of the low-quality good, NT results in*

- (i) *unambiguously higher environmental damages in country  $H$  but leads to lower (higher) damages in country  $L$  when  $\xi$  is sufficiently low (high) relative to the quality gap*
- (ii) *higher welfare in country  $H$  when  $\xi$  is sufficiently low and the quality gap is sufficiently high but higher welfare in country  $L$  only if damages are neither too low nor too high relative to the quality gap.*

[Insert Figures 6 and 7 here]

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<sup>25</sup>If NT did not reduce domestic welfare, country  $H$  would be able to increase its welfare by choosing the NT tax even in the absence of NT rules. As country  $H$  does not choose a common tax, it must be that domestic welfare is lower.

From Figure 6, we can see that country  $H$  prefers NT when the quality gap is high relative to pollution intensity, as its high-quality good enjoys greater protection in the foreign market and the inability to discriminate against the dirty good does not generate significant negative external effects. For the most part, country  $L$  prefers the opposite: NT raises the welfare of country  $L$  at low relative values of the quality gap, as consumers perceive less of a difference between its good and the high-quality good and NT prevents discrimination against its dirty product. It is now possible, though, that both countries gain from NT (area  $F_3$  in Figure 6), when the externality is small and the quality gap is moderate, a possibility which does not arise when pollution results from the consumption of the high-quality good.

In another way, for a given externality  $\xi$ , higher quality levels imply lower consumption of the dirty good. As long as the externality is not too high relative to the quality gap, discrimination leads to greater consumption of the dirty good and therefore higher damages. This is offset in other cases by the fact that discrimination means zero damages in country  $H$ , and thus discrimination always results in lower damages there.

In Figure 7, we illustrate the combined effects of NT on both world welfare and world environmental damages. When pollution is not very damaging (area  $G_1$ ), the inability to discriminate against the dirty good does not have important effects, and NT raises world welfare and improves the world environment. Unlike the high-quality polluting case when governments have incentives to temper their discrimination against the dirty good (since consumers prefer the high-quality good), such moderating incentives are not present when the environmental externality arises out of consuming the low-quality good. Accordingly, NT often leads to a decrease in world welfare (areas  $G_2$ ,  $G_3$ , and  $G_4$ ), as equal treatment implies that countries take relatively larger quantities of both the low-quality good and the dirty good (which are the same good). At intermediate values of the quality gap relative to pollution intensity (area  $G_2$ ), environmental improvements in country  $L$  can more than offset the increased damages in country  $H$ , leading to a possibility that does not arise in the high-quality good polluting case: NT lowers world welfare but improves the world environment. At relatively very high pollution intensity values (area  $G_3$ ), NT decreases world welfare and results in a worsening of the world environment.

As in the high-quality externality case, the ideal outcome of higher welfare and a cleaner environment occurs under NT with a low externality and a significant quality difference (area  $G_1$ ).

Again, this confirms and extends the analysis in Saggi and Sara (2008) to the case when the consumption externality is sufficiently small. However, beyond this area, NT has negative consequences for world welfare (areas  $G_2$ ,  $G_3$ , and  $G_4$ ). On the other hand, NT has better prospects for a cleaner environment (areas  $G_1$  and  $G_2$ ) when the low-quality good is polluting. Further, whenever NT improves world welfare, NT also improves the environment, a result that does not hold when the high-quality good generates the externality.

## 5 Conclusion

Previous work on externalities and NT have primarily focused on the costs of achieving an environmental standard, comparing different treatment regimes, and the role of the burden of proof in NT disputes. In this paper, we propose a model in which countries produce a product with differing qualities and pollution is generated at the consumption level in order to provide countries with incentives to impose differential taxes (that is, to discriminate in the absence of NT rules). In this way, we can analyze the impact of NT along several dimensions, including taxes, product prices, market shares, market coverage, and individual and global welfare levels and environmental damages.

When pollution decreases with quality and NT is binding for both countries, the adoption of NT always leads to a stricter policy in the high-quality country but may decrease both taxes or increase the tax on the domestic good and decrease the tax on the foreign good in the low-quality country. These tax effects amount to fewer consumers buying the domestic good and more consumers buying the imported good, with market coverage contracting in the high-quality country but expanding in the low-quality country at low pollution intensity levels. In terms of environmental damages, NT results in a worse environment in the high-quality country and, provided that pollution intensity is sufficiently high, in the low-quality country. In terms of national welfare, the set of possible changes is richer than when pollution generates from the consumption of the high-quality good: both country can experience a welfare decrease upon adoption of NT, a welfare increase, or one country can gain while the other loses and vice versa, depending on the pollution intensity level relative to the quality gap. Globally, welfare can increase or decrease as environmental damages can increase or decrease. However, unlike in the high-quality pollution good case, it is no longer possible for NT to increase global welfare but worsen the world environment. Instead, a new possibility

arises: NT can lower world welfare but improve the world environment.<sup>26</sup>

In both cases, it is possible for the country producing the dirty good to become so concerned about the damaging effects of pollution to decide to tax its good at a higher rate than the imported good, and NT becomes then only binding for the country producing the clean good. The level of environmental concern triggering the switch from less to more stringent policy in the domestic market is however not independent of how differentiated the two goods are, with greater differentiation requiring pollution to be more damaging before the dirty country engages in policy discrimination against its own product. As the surplus benefit of greater quality differentiation does not fall evenly on the two countries but favours the high-quality country which retains the surplus the producer of the high-quality good is able to extract from consumers, the positive relationship between the quality gap and the threshold pollution intensity level above which the dirty country taxes its good at a higher rate than the imported good always holds when the high-quality country is the producer of the dirty good but ceases to hold at a sufficiently high quality gap when the low-quality country is the producer of the dirty good. Two important implications then follow: (i) there is greater need for a non-discrimination clause in internal policy setting when pollution is associated with the consumption of the low-quality good; (ii) global welfare is more likely to fall, independently of whether NT is binding for both countries or only for the clean country, when pollution is associated with the consumption of the low-quality good.

More generally, an important conclusion of this paper, which is novel in the literature that examines the welfare effects of NT in the presence of differing environmental effects giving rise to legitimate internal policy discrimination incentives, is that NT needs not lower global welfare even when environmental concerns are quite pressing and, more importantly, even when there is no opportunity for countries to internalize legitimate internal policy discrimination motives at the tariff setting stage. However, as we note above, the applicability of this result rests upon the link between the environmental externality that consumption generates and quality and, to the extent that this link is different for different consumption goods (e.g., cars versus energy-saving appliances), is likely to vary across sectors. While our choice of a quality model with unit consumption may seem restrictive, it is a choice that most effectively, and with no loss on the reality front, allows us to characterize a world in which NT applies, with products that, in spite of being differentiated, are

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<sup>26</sup>We provide a summary of the key results in the two cases in Table 3.

like, at a minimum by virtue of sharing their end uses, and in which consumption externalities can differ as they can be tied to quality differences creating legitimate (non-protectionist) incentives for discriminatory internal policies.

In terms of overall implications, when the high quality good is polluting, the increase in world welfare in most cases suggests that countries could agree to the imposition of NT rules as long as there are international transfers. In fact, without international transfers, the country producing the low-quality good would never agree to NT as its welfare is always higher under discrimination. If instead the low-quality good generates the externality, NT may be acceptable to both countries even without transfers, although cooperation over NT is more likely to be unattainable. In such a case, however, an improvement in the public good (a cleaner environment) often mitigates the negative impact of NT on welfare.

Some interesting extensions of the analysis we present in this paper are worth mentioning. First, considering the case of multiple exporters (i.e., competing importers) with differing externalities can lead to more nuanced (and stronger) NT effects. Second, recent increased use of anti-dumping and countervailing duties suggests a potential welfare-improving alternative to NT, particularly for the producer of the clean good. Third, one could examine how NT impacts innovation incentives of either clean or dirty industries. We leave these extensions to future research.

## 6 Appendix

### 6.1 High-Quality Polluting Good Case

In a world without NT, the welfare-maximizing conditions in country  $j$  are

$$\frac{dw^j(t_l^j, t_h^j)}{dt_i^j} = -(s_h - s_l)\theta_h^j \frac{d\theta_h^j}{dt_i^j} - s_l\theta_l^j \frac{d\theta_l^j}{dt_i^j} - (p_{-i}^j - t_{-i}^j) \frac{dx_{-i}^j}{dt_i^j} - x_{-i}^j \frac{dp_{-i}^j}{dt_i^j} - 2\xi x_h^j \frac{dx_h^j}{dt_i^j} = 0 \quad (60)$$

for the tax on the domestic good (i.e., for  $i = h$  and  $-i = l$  when  $j = H$  or  $i = l$  and  $-i = h$  when  $j = L$ ) and

$$\frac{dw^j(t_l^j, t_h^j)}{dt_i^j} = -(s_h - s_l)\theta_h^j \frac{d\theta_h^j}{dt_i^j} - s_l\theta_l^j \frac{d\theta_l^j}{dt_i^j} - (p_i^j - t_i^j) \frac{dx_i^j}{dt_i^j} - x_i^j \underbrace{\left( \frac{dp_i^j}{dt_i^j} - 1 \right)}_{<0} - 2\xi x_h^j \frac{dx_h^j}{dt_i^j} = 0 \quad (61)$$

for the tax on the foreign good (i.e., for  $i = l$  when  $j = H$  and  $i = h$  when  $j = L$ ), where

$$\frac{d\theta_h^j}{dt_h^j} = -\frac{dx_h^j}{dt_h^j} = \frac{2s_h - s_l}{(s_h - s_l)(4s_h - s_l)} > 0, \quad \frac{d\theta_h^j}{dt_l^j} = -\frac{dx_h^j}{dt_l^j} = -\frac{s_h}{(s_h - s_l)(4s_h - s_l)} < 0, \quad (62)$$

$$\frac{d\theta_l^j}{dt_h^j} = \frac{1}{s_l} \frac{dp_l^j}{dt_h^j} = \frac{1}{s_l} \left( \frac{s_l}{4s_h - s_l} \right) > 0, \quad \frac{d\theta_l^j}{dt_l^j} = \frac{1}{s_l} \frac{dp_l^j}{dt_l^j} = \frac{1}{s_l} \left( \frac{2s_h}{4s_h - s_l} \right) > 0, \quad (63)$$

$$\frac{dp_h^j}{dt_h^j} = \frac{2s_h}{4s_h - s_l} > 0, \quad \frac{dp_h^j}{dt_l^j} = \frac{s_h}{4s_h - s_l} > 0, \quad (64)$$

$$\frac{dx_l^j}{dt_h^j} = \frac{s_h}{(s_h - s_l)(4s_h - s_l)} > 0, \quad \& \quad \frac{dx_l^j}{dt_l^j} = \frac{s_h(s_l - 2s_h)}{s_l(s_h - s_l)(4s_h - s_l)} < 0. \quad (65)$$

Using the above conditions, we obtain the equilibrium non-NT taxes in (13) and (14).

The NT-constrained welfare-maximizing condition in country  $j$  is instead

$$\frac{dw^j(T^j)}{dT^j} = -(s_h - s_l) \Theta_h^j \frac{d\Theta_h^j}{dT^j} - s_l \Theta_l^j \frac{d\Theta_l^j}{dT^j} - \underbrace{\left( P_i^j - T^j \right) \frac{dX_i^j}{dT^j} - X_i^j \left( \frac{dP_i^j}{dT^j} - 1 \right)}_{< 0} - 2\xi X_h^j \frac{dX_h^j}{dT^j} = 0, \quad (66)$$

for  $i = l$  when  $j = H$  and  $i = h$  when  $j = L$ , where

$$\frac{d\Theta_h^j}{dT^j} = -\frac{dX_h^j}{dT^j} = \frac{1}{4s_h - s_l} > 0, \quad \frac{d\Theta_l^j}{dT^j} = \frac{1}{s_l} \frac{dP_l^j}{dT^j} = \frac{1}{s_l} \left( \frac{2s_h + s_l}{4s_h - s_l} \right) > 0, \quad (67)$$

$$\frac{dP_h^j}{dT^j} = \frac{3s_h}{4s_h - s_l}, \quad \& \quad \frac{dX_l^j}{dT^j} = -\frac{1}{s_l} \left( \frac{2s_h}{4s_h - s_l} \right) < 0, \quad (68)$$

which gives the equilibrium NT tax in (26).

### 6.1.1 Effects of $\xi$ and $s_h$ on Discrimination

That the internal policy advantage awarded to the domestic good, absent a non-discrimination principle, increases in the low-quality country but decreases in the high-quality country when pollution intensity increases follows directly from the effects of  $\xi$  on domestic policy, that is,

$$\frac{dt_h^L}{d\xi} = \frac{1}{3} \left( \frac{a}{a + \xi} \right)^2 > 0 \quad \& \quad \frac{dt_l^L}{d\xi} = -\frac{s_l}{s_h} \left( \frac{a}{3a + 2\xi} \right)^2 < 0 \quad (69)$$

in the low-quality country and

$$\frac{dt_l^H}{d\xi} = \frac{6s_h s_l a^2}{[3s_h a + 2\xi(s_h + 2a)]^2} > 0 \quad \& \quad \frac{dt_h^H}{d\xi} = \frac{12s_h(2s_h + a)a^2}{[3s_h a + 2\xi(s_h + 2a)]^2} > 0 \quad (70)$$

in the high-quality country. It is immediate from the above expressions that  $t_h^L - t_l^L$  increases while  $t_l^H - t_h^H$  decreases when  $\xi$  increases. When a unit of pollution becomes more damaging, the marginal (environmental) cost of consuming the less environmentally friendly good increases, and the low-quality country intensifies its efforts to discourage consumption of the foreign good by

increasing both the subsidy on the local good and the tax on the foreign good. Consistently with the low-quality country's reaction to a higher  $\xi$ , the high-quality country reduces (increases) the subsidy (tax) on the less environmentally sound good (i.e., the local good), but it also increases the tax on the foreign (low-quality) good, which decreases the consumption of the local (high-quality) good, to counter, in essence, the effects of the change in the subsidy/tax on the local good. A higher  $t_h^H$  decreases  $x_h^H$ , reducing environmental damages and thus the cost of taxing the foreign good, and increases  $x_l^H$ , raising the surplus flowing out into the other country and thus the benefit of taxing the foreign good; the incentive to increase  $t_l^H$  from these combined (indirect) changes outweighs the incentive to decrease  $t_l^H$  arising out of the increase in the cost of taxing the low-quality good that originates directly from a higher  $\xi$ .

The quality gap effects are less straightforward, and we derive them by computing the effects of an increase in  $s_h$ , namely,

$$\frac{dt_h^L}{ds_h} = \frac{4\xi(a + \xi) + 3a^2}{(3a + 2\xi)^2} > 0 \quad \& \quad \frac{dt_l^L}{ds_h} = -\frac{2s_l [2s_l(a + \xi)^2 - a^2(\xi - s_l)]}{[s_h(3a + 2\xi)]^2} < 0 \quad (71)$$

in the low-quality country, that is, the tax on the foreign good and the subsidy on the local good are increasing in the quality gap,<sup>27</sup> and

$$\frac{dt_l^H}{ds_h} = \frac{2\xi s_l (2\xi s_l - 3a^2)}{[3s_h a + 2\xi(3s_h - 2s_l)]^2} \quad (72)$$

and

$$\frac{dt_h^H}{ds_h} = \frac{3\{4(2a^2 + s_h^2)\xi^2 - 4a[a^2 + s_h(2s_h - s_l)]\xi - 3a^2 s_h^2\}}{[3s_h a + 2\xi(3s_h - 2s_l)]^2} \quad (73)$$

in the high-quality country, that is, the tax on the foreign good is decreasing in the quality gap for  $\xi \in \left(0, \frac{3a^2}{2s_l}\right)$  and increasing for  $\xi > \frac{3a^2}{2s_l}$ , the subsidy on the local good (if  $\xi < \frac{a}{2}$ ) is always increasing in the quality gap, and the tax on the local good (if  $\xi > \frac{a}{2}$ ) is decreasing in the quality gap for  $\xi \in \left(\frac{a}{2}, \gamma \frac{a}{2}\right)$  and increasing for  $\xi > \gamma \frac{a}{2}$ , with  $\gamma > 1$ .<sup>28</sup> Hence, the low-quality country adjusts to an increase in the quality gap by strengthening the domestic policy advantage of its

<sup>27</sup>It is possible for the subsidy to be decreasing in  $s_h$ , that is,  $\frac{dt_h^L}{ds_h} > 0$ , but a necessary, although not sufficient, condition for this to happen is for  $a$  to be very large ( $a \geq 8.901s_l$ ). The critical  $\xi$  above which  $\frac{dt_h^L}{ds_h} > 0$  is in fact equal to  $\xi = \frac{a[(s_h - 5s_l) + \sqrt{a^2 - 8s_l s_h}]}{4s_l}$ , which requires that  $a^2 - 8s_l s_h > 0$  or  $s_h \geq 9.901s_l$ .

<sup>28</sup>Specifically,  $\gamma = \frac{a^2 + s_h(2s_h - s_l) + \sqrt{[a^2 + s_h(2s_h - s_l)]^2 + 3s_h^2(2a^2 + s_h^2)}}{(2a^2 + s_h^2)} > 1$ . We note here that  $\gamma \frac{a}{2} > \xi_c$ ,  $\frac{3a^2}{2s_l} > \xi_c$  if  $s_h > \left(\frac{5 + \sqrt{13}}{6}\right)s_l \approx 1.4343s_l$ ,  $\frac{3a^2}{2s_l} > \gamma \frac{a}{2}$  if  $s_h > 2s_l$ , and  $\frac{3a^2}{2s_l} > \frac{a}{2}$  if  $s_h > \frac{4}{3}s_l \approx 1.3333s_l$ .

good relative to the foreign good; on the other hand, the high-quality country's response in terms of preferential tax treatment does not follow directly from the directions of the two effects in (72) and (73) but, upon a formal comparison of the two effects, we can conclude that, if the high-quality country discriminates against the imported good (i.e.,  $\xi < \xi_c$  so that  $t_l^H - t_h^H > 0$ ), it responds to an increase in the quality gap by implementing a policy that is increasingly more discriminatory.

An increase in the quality gap via an increase in  $s_h$  raises the surplus benefit of consuming the high-quality good over and above the benefit of consuming the low-quality good and thus raises the surplus the producer of the high-quality good can extract from its consumers. As profits in the high-quality market enter the low-quality country's welfare negatively, the change intensifies the country's concern over local production or, equivalently, over the surplus flowing out into the other country, increasing the benefits of subsidizing the domestic (low-quality) good and taxing the imported (high-quality) good; hence, the low-quality country adopts a larger subsidy on the domestic good and a larger tax on the foreign good in response to an increase in the quality gap. For the high-quality country, the additional surplus that a unit of the high-quality good generates stays within the country independently of how it is shared between the consumer and the producer, and, to the extent that taxing the high-quality good negatively affects surplus, the increase in  $s_h$  amounts to a higher marginal cost of taxation. The high-quality country thus relaxes its policy in the domestic market, increasing the subsidy or lowering the tax on the domestic good, unless pollution intensity is sufficiently high that environmental concerns, which are associated with the consumption of the high-quality good, dominate and induce the country to increase the tax on the local good in order to curb pollution.<sup>29</sup> To understand the policy change in the foreign market, it is useful to recall that, unlike the low-quality country for which each of the two internal policy instruments addresses both the country's concern over the environment (or environmental motive) and its concern over local production (or protectionist motive), the high-quality country faces a trade-off between the two motives in that addressing its environmental concern via taxing the local good comes at the expense of discounting its local production concern. In dealing with this trade-off in response to an increase in the quality gap, the country can (*i*) increase the tax on the foreign good when increasing the tax on the domestic good to offset the latter's negative effect on local

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<sup>29</sup>For this to occur, the country must be taxing its domestic good at a higher rate than the imported good as  $\xi > \gamma \frac{\alpha}{2} > \xi_c$ .

production (equivalently, the country can reduce the tax on the foreign good when decreasing the tax or increasing the subsidy on the domestic good as there is less of a need for an offsetting effect) or (ii) increase the tax on the foreign good when decreasing the tax (or increasing the subsidy) on the domestic good to offset the latter's negative effect on the environment. Which option the country chooses depends on the pollution intensity level relative to the quality gap: at low and high pollution intensity levels, the country opts for (i), reducing both taxes at low pollution intensity and increasing both taxes at high pollution intensity; at intermediate pollution intensity levels, the country opts for (ii). Option (ii) thus prevails when the country starts experiencing the negative welfare effects of the pollution from the additional consumption of the high-quality good that comes about as the country keeps reducing the tax on the domestic good in order to exploit the positive welfare effects of the increase in  $s_h$ ; at intermediate pollution intensity levels, the country is able to counter the negative pollution-related welfare effects by reducing the amount of surplus flowing out of the country via a tax on the imported good. What defines the ranges of low, intermediate, and high pollution intensity levels does, however, depend on the quality gap in that the gap determines how important the environmental concern is relative to the local production concern; hence, the larger the quality gap is, the higher the pollution intensity levels that fall within the intermediate range.<sup>30</sup>

### 6.1.2 National Treatment versus Discrimination

**Prices, Market Coverage, and Output** The price changes resulting from adopting NT rules are

$$P_h^H - p_h^H = \frac{2s_h [2\xi (3s_h - s_l) - 3s_h a] [\xi s_l - 3s_h a]}{\Delta_h \Delta_H} \quad (74)$$

and

$$P_l^H - p_l^H = \frac{s_h s_l [2\xi (3s_h - s_l) - 3s_h a] (2\xi - 3a)}{\Delta_h \Delta_H}, \quad (75)$$

both of which are positive for  $\xi < \xi_c$ , in country  $H$  and

$$P_h^L - p_h^L = \frac{(\xi s_l - a^2) [(s_h + 2s_l) a + 2\xi (s_h + s_l)]}{\Delta_l \Delta_L}, \quad (76)$$

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<sup>30</sup>The intermediate range is  $\xi \in \left(\frac{3a^2}{2s_l}, \gamma \frac{a}{2}\right)$  if  $s_h < 2s_l$  and  $\xi \in \left(\gamma \frac{a}{2}, \frac{3a^2}{2s_l}\right)$  if  $s_h > 2s_l$ . Both bounds are increasing in  $s_h$ .

which is always negative at high quality gap levels (i.e.,  $s_h \geq 1.63s_l$ ) but, for  $s_h \leq 1.62s_l$ , is negative for  $0 < \xi < \frac{a^2}{s_l}$  and positive for  $\frac{a^2}{s_l} < \xi < \xi_c$ , and

$$P_l^L - p_l^L = \frac{s_l[(s_h + 2s_l)a + 2\xi(s_h + s_l)]}{\Delta_L} > 0 \quad (77)$$

in country  $L$ .

In the high-quality country, the quality valuation differences for the consumer indifferent between the two goods and the consumer indifferent between buying the low-quality good and buying nothing are

$$\Theta_h^H - \theta_h^H = \frac{3s_h(2s_h - s_l)[3s_h a - 2\xi(3s_h - s_l)]}{\Delta_h \Delta_H} \quad (78)$$

and

$$\Theta_l^H - \theta_l^H = -\frac{s_h[3s_h a - 2\xi(3s_h - s_l)](2\xi - 3a)}{\Delta_h \Delta_H}; \quad (79)$$

in country  $H$ , the high-quality good market thus shrinks (i.e.,  $X_h^H - x_h^H = \theta_h^H - \Theta_h^H < 0$ ) for  $\xi < \xi_c$  and market coverage contracts (i.e.,  $X_h^H + X_l^H - x_h^H - x_l^H = \theta_l^H - \Theta_l^H < 0$ ) if  $\xi < \xi_c < \frac{3a}{2}$ . What happens to the size of the low-quality good market also depends on  $\xi$  and, in fact, the difference in sales in market  $l$  is

$$X_l^H - x_l^H = \frac{s_h(3s_h + 2\xi)[3s_h a - 2\xi(3s_h - s_l)]}{\Delta_h \Delta_H}, \quad (80)$$

which is positive (and thus market  $l$  expands) if  $\xi < \xi_c$ . To sum up, at  $\xi$  values such that NT is binding, that is, for  $\xi < \xi_c$ , market coverage contracts at the expense of market  $h$  in that sales of good  $h$  decrease while sales of good  $l$  increase.

In the low-quality country, the same quality valuation differences are

$$\Theta_h^L - \theta_h^L = -\frac{(2s_h + s_l)[2\xi(s_h + s_l) + a(s_h + 2s_l)]}{\Delta_l \Delta_L} < 0 \quad (81)$$

and

$$\Theta_l^L - \theta_l^L = \frac{[2\xi(s_h + s_l) + a(s_h + 2s_l)]}{\Delta_L} > 0; \quad (82)$$

in country  $L$ , independently of the  $\xi$  value, the high-quality good market grows (i.e.,  $X_h^L - x_h^L > 0$ ) and market coverage contracts (i.e.,  $X_h^L + X_l^L < x_h^L + x_l^L$ ) so that the low-quality good market shrinks (i.e.,  $X_l^L - x_l^L < 0$ ). While the impact of a binding NT clause on market coverage is qualitatively the same in both countries, more consumers are completely driven out of the market in country  $L$  than in country  $H$  as  $\Theta_l^L - \theta_l^L > \Theta_l^H - \theta_l^H$ .

**Welfare and Environmental Damages** In country  $L$ ,

$$w^L - W^L = \underbrace{w_l^L - W_l^L}_{>0} + \underbrace{\pi_l^H - \Pi_l^H}_{\leq 0} > 0, \quad (83)$$

where

$$w_l^L - W_l^L = \frac{[(s_h - s_l)(s_h + 2s_l) + 2\xi(s_h + s_l)]^2}{2\Delta_l\Delta_L} > 0 \quad (84)$$

and

$$\pi_l^H - \Pi_l^H = -\frac{3s_h s_l (s_h - s_l) (3s_h + 2\xi) M_1 M_2}{\Delta_h^2 \Delta_H^2}, \quad (85)$$

with

$$M_1 = -3s_h (s_h - s_l) + 2\xi (3s_h - s_l), \quad (86)$$

which is negative for  $\xi < \xi_c$ , and

$$M_2 = -3s_h^2 (s_h - s_l) + 4\xi^2 (s_h - s_l) - 4s_h \xi (3s_h - s_l), \quad (87)$$

which is negative for  $\xi < \frac{s_h(3s_h - s_l + 2\sqrt{3s_h^2 - 3s_h s_l + s_l^2})}{2(s_h - s_l)} > \xi_c$  so that  $\pi_l^H - \Pi_l^H < 0$ . Using that  $\frac{d(\pi_l^H - \Pi_l^H)}{d\xi} > 0$  for  $\xi < \xi_c$  and  $\frac{d(w_l^L - W_l^L)}{d\xi} > 0$  for any  $\xi$  value, we know that  $\pi_l^H - \Pi_l^H$  reaches its lowest (negative) level and  $w_l^L - W_l^L$  reaches its lowest (positive) level when  $\xi = 0$ ; we can then conclude that  $w^L - W^L > 0$  for any feasible  $\xi$  value by showing that the welfare difference is positive when  $\xi = 0$ , that is,

$$w^L - W^L = \frac{(s_h - s_l)(4s_h^2 - 2s_l^2 + s_h s_l)}{6(4s_h - s_l)^2} > 0. \quad (88)$$

In country  $H$ ,

$$w^H - W^H = \underbrace{w_h^H - W_h^H}_{>0} + \underbrace{\pi_h^L - \Pi_h^L}_{<0} < 0, \quad (89)$$

where

$$w_h^H - W_h^H = \frac{[-3s_h (s_h - s_l) + 2\xi (3s_h - s_l)]^2}{2\Delta_h\Delta_H} > 0, \quad (90)$$

and

$$\pi_h^L - \Pi_h^L = -\frac{(s_h - s_l)(2s_h + s_l) N_1 N_2}{\Delta_l^2 \Delta_L^2} < 0, \quad (91)$$

with

$$N_1 = (s_h - s_l)(s_h + 2s_l) + 2\xi(s_h + s_l) > 0 \quad (92)$$

and

$$N_2 = (s_h - s_l)(10s_h - s_l)(s_h + 2s_l) + \xi[s_l(10s_h - s_l) + (4s_h^2 - s_l^2)] > 0. \quad (93)$$

Using that (i) both  $w_h^H - W_h^H$  and  $\pi_h^L - \Pi_h^L$  are convex functions of  $\xi$ , with the former difference reaching its lowest level when  $\xi = \xi_c$  and the latter at some  $\xi > \xi_c$ , (ii) the relevant range of  $\xi$  values being  $(0, \xi_c)$ , and (iii)  $w^H - W^H < 0$  when  $\xi = 0$ , we conclude that  $w^H - W^H$  is negative for any feasible  $\xi$  value.

## 6.2 Low-Quality Polluting Good Case

### 6.2.1 Discrimination: Comparative Statics

Both policy instruments are increasing in the extent of the externality,

$$\frac{d\tilde{t}_h^L}{d\xi} = \frac{4s_l^2 a^2}{\tilde{\Delta}_l^2} > 0 \quad \& \quad \frac{d\tilde{t}_l^L}{d\xi} = \frac{8s_l^2 a^2 (3s_h - s_l)}{s_h \tilde{\Delta}_l^2} > 0, \quad (94)$$

but, while the tax on the high-quality good is also increasing in the quality gap as

$$\frac{d\tilde{t}_h^L}{ds_h} = \frac{4\xi^2 (s_h^2 + 2a^2) + 4s_l (3s_h - 2s_l) a\xi + 3as_l^2}{\tilde{\Delta}_l^2} > 0, \quad (95)$$

the tax on the low-quality good may decrease or increase in response to an increase in  $s_h$  as

$$\frac{d\tilde{t}_l^L}{ds_h} = \frac{2s_l^2 [4\xi^2 s_h^2 - 4\xi a s_l (2s_h - s_l) - 3a^2 s_l^2]}{s_h^2 \tilde{\Delta}_l^2}, \quad (96)$$

which is negative for  $\xi < \frac{as_l}{2s_h^2} \left[ (2s_h - s_l) + \sqrt{3s_h^2 + (2s_h - s_l)^2} \right] > \frac{2as_l(2s_h - s_l)}{2s_h^2} > \frac{s_l a}{2s_h}$ . Hence, the more quality differentiated the two goods are, the stronger country  $L$ 's incentive to subsidize (tax) its domestic good at low (high) pollution intensity levels (at intermediate pollution intensity levels, that is, for  $\frac{s_l a}{2s_h} < \xi < \frac{as_l}{2s_h^2} \left[ (2s_h - s_l) + \sqrt{3s_h^2 + (2s_h - s_l)^2} \right]$ , country  $L$ 's incentive to tax its dirty good thus weakens).<sup>31</sup>

Equilibrium sales are

$$\tilde{x}_h^L = \frac{2\xi s_h + s_l a}{\tilde{\Delta}_l} \quad \& \quad \tilde{x}_l^L = \frac{2s_l a}{\tilde{\Delta}_l} \quad (97)$$

in country  $L$  and

$$\tilde{x}_h^H = 1 \quad \& \quad \tilde{x}_l^H = 0 \quad (98)$$

in country  $H$ . As  $\theta_l^H = \theta_h^H = 0$ , the market in country  $H$  is completely covered, with every consumer buying good  $h$ , and remains completely covered for any change in pollution intensity or quality gap. In country  $L$ , however, there are consumers who are priced out of the market as

<sup>31</sup>For  $s_h < 2s_l$ ,  $\frac{as_l}{2s_h^2} \left[ (2s_h - s_l) + \sqrt{3s_h^2 + (2s_h - s_l)^2} \right] < \tilde{\xi}_c$ .

$\theta_l^L = \frac{\tilde{p}_l^L}{s_l} > 0$ , and the overall market size is decreasing in both  $\xi$  and  $s_h$ , but more consumers buy the high-quality good as  $\xi$  increases while more consumers buy the low-quality good as  $s_h$  increases, that is,

$$\frac{d\tilde{x}_h^L}{d\xi} = \frac{4s_l^2 a}{\tilde{\Delta}_l^2} > 0 \quad \& \quad \frac{d\tilde{x}_l^L}{d\xi} = -\frac{4s_l a (3s_h - 2s_l)}{\tilde{\Delta}_l^2} < 0, \quad (99)$$

with  $\frac{d\tilde{x}_h^L}{d\xi} + \frac{d\tilde{x}_l^L}{d\xi} < 0$ , and

$$\frac{d\tilde{x}_h^L}{ds_h} = -\frac{4\xi s_l (s_l + 2\xi)}{\tilde{\Delta}_l^2} < 0 \quad \& \quad \frac{d\tilde{x}_l^L}{ds_h} = \frac{4\xi s_l^2}{\tilde{\Delta}_l^2} > 0, \quad (100)$$

with  $\frac{d\tilde{x}_h^L}{ds_h} + \frac{d\tilde{x}_l^L}{ds_h} < 0$ .

### 6.2.2 National Treatment: Comparative Statics

Country  $L$ 's tax is increasing in both  $\xi$  and  $s_h$ , that is,

$$\frac{d\tilde{T}^L}{d\xi} = \frac{4s_l^2 s_h^2 (s_h + 2s_l) (4s_h - s_l)}{\tilde{\Delta}_L^2} > 0 \quad \& \quad \frac{d\tilde{T}^L}{ds_h} = \frac{4\xi s_l^3 s_h (7s_h - 4s_l)}{\tilde{\Delta}_L^2} > 0; \quad (101)$$

country  $H$ 's tax is instead increasing in  $\xi$  but decreasing in  $s_h$ , that is,

$$\frac{d\tilde{T}^H}{d\xi} = \frac{12s_l^2 s_h (4s_h - s_l)}{\tilde{\Delta}_H^2} > 0 \quad \& \quad \frac{d\tilde{T}^H}{ds_h} = -\frac{12\xi s_l^3}{\tilde{\Delta}_H^2} < 0. \quad (102)$$

Equilibrium sales are

$$\tilde{X}_h^L = \frac{2s_h (2\xi s_h + s_h s_l + 2s_l^2)}{\tilde{\Delta}_L} \quad \& \quad \tilde{X}_l^L = \frac{s_l s_h (s_h + 2s_l)}{\tilde{\Delta}_L} \quad (103)$$

in country  $L$  and

$$\tilde{X}_h^H = \frac{2s_h (3s_l + 2\xi)}{\tilde{\Delta}_H} \quad \& \quad \tilde{X}_l^H = \frac{3s_h s_l}{\tilde{\Delta}_H} \quad (104)$$

in country  $H$ . Under NT, neither country opts for full market coverage, but country  $H$  prices out of the market fewer consumers than country  $L$  as  $0 < \tilde{X}_h^L + \tilde{X}_l^L < \tilde{X}_h^H + \tilde{X}_l^H < 1$ . Both countries respond to an increase in  $\xi$  or an increase in  $s_h$  by reducing market coverage, driving more consumers out of the market, and pricing more consumers out of purchasing the high-quality good in favour of the low-quality good; the relevant effects are

$$\frac{d\tilde{X}_l^H}{d\xi} = -\frac{24s_l s_h^2}{\tilde{\Delta}_H^2} < \frac{d\tilde{X}_h^H}{d\xi} = -\frac{12s_l^2 s_h}{\tilde{\Delta}_H^2} < 0 \quad (105)$$

and

$$\frac{d\tilde{X}_h^H}{ds_h} = -\frac{6s_l^2 (3s_l + 2\xi)}{\tilde{\Delta}_H^2} < \frac{d\tilde{X}_l^H}{ds_h} = -\frac{9s_l^3}{\tilde{\Delta}_H^2} < 0 \quad (106)$$

in country  $H$  and

$$\frac{d\tilde{X}_l^L}{d\xi} = -\frac{8s_l s_h^3 (s_h + 2s_l)}{\tilde{\Delta}_L^2} < \frac{d\tilde{X}_h^L}{d\xi} = -\frac{4s_l^2 s_h^2 (s_h + 2s_l)}{\tilde{\Delta}_L^2} < 0, \quad (107)$$

$$\frac{d\tilde{X}_h^L}{ds_h} = -\frac{2s_l^2 [s_l (s_h + 2s_l)^2 + 2\xi s_h (s_h + 4s_l)]}{\tilde{\Delta}_L^2} < 0, \quad (108)$$

and

$$\frac{d\tilde{X}_l^L}{ds_h} = -\frac{s_l^2 [s_l (s_h + 2s_l)^2 + 16\xi s_h^2]}{\tilde{\Delta}_L^2} < 0, \quad (109)$$

in country  $L$ , with  $\frac{d\tilde{X}_h^L}{ds_h} < \frac{d\tilde{X}_l^L}{ds_h}$  if  $s_h < \frac{7+\sqrt{21}}{7} \approx 1.6547$  but, for  $s_h > \frac{7+\sqrt{21}}{7}$ ,  $\frac{d\tilde{X}_h^L}{da} < \frac{d\tilde{X}_l^L}{da}$  if  $\xi < \frac{s_l(s_h+2s_l)^2}{4s_h(3s_h-4s_l)}$  and  $\frac{d\tilde{X}_h^L}{da} > \frac{d\tilde{X}_l^L}{da}$  otherwise.

### 6.2.3 National Treatment versus Discrimination

Before moving on to comparing taxes, welfare, and environmental damages under the two policy regimes, it is worthwhile underscoring the effects of NT on sales and market coverage: in country  $H$ , these effects are clear from the above analysis and amount to a contraction of the market accompanied by a decrease in the sales of good  $h$  and an increase in the sales of good  $l$ ; in country  $L$ , the effects are also straightforward once we report the differences, namely,

$$\tilde{x}_h^L - \tilde{X}_h^L = -\frac{[4s_h\xi + s_h(2s_h + s_l)][2s_h(s_h - 2s_l)\xi + s_l a(s_h + 2s_l)]}{\tilde{\Delta}_L}, \quad (110)$$

which is always negative under a jointly binding NT (i.e., for  $s_h \geq 2s_l$  or for  $s_h < 2s_l$  and  $\xi < \tilde{\xi}_c$ ),

$$\tilde{x}_l^L - \tilde{X}_l^L = \frac{s_l(5s_h - 2s_l)[2s_h(s_h - 2s_l)\xi + s_l a(s_h + 2s_l)]}{\tilde{\Delta}_L}, \quad (111)$$

which is always positive under a jointly binding NT, and

$$\tilde{x}_h^L + \tilde{x}_l^L - (\tilde{X}_h^L + \tilde{X}_l^L) = -\frac{[2s_h(s_h - 2s_l)\xi + s_l a(s_h + 2s_l)](4s_h\xi - 3s_l a)}{\tilde{\Delta}_L \tilde{\Delta}_L}, \quad (112)$$

which is positive for  $\xi < \frac{3s_l a}{4s_h}$  and negative otherwise.

In both countries, domestic welfare worsens as

$$\tilde{w}_h^H - \tilde{W}_h^H = \frac{1}{2} \frac{s_h [3s_l (s_h - s_l) + 2\xi s_h]}{\tilde{\Delta}_H} > 0 \quad (113)$$

and

$$\tilde{w}_l^L - \tilde{W}_l^L = \frac{1}{2} \frac{[-2s_l (s_l^2 + 2\xi s_h) + s_l s_h (s_l + s_h^2 + 2\xi s_h)]^2}{\tilde{\Delta}_l \tilde{\Delta}_L} > 0, \quad (114)$$

but profits from exports increase as

$$\tilde{\pi}_h^L - \tilde{\Pi}_h^L = -\frac{(s_h - s_l) [2s_l (s_h + s_l) + 2\xi s_h] R_1 R_2}{\tilde{\Delta}_l^2 \tilde{\Delta}_L^2}, \quad (115)$$

where

$$R_1 = 2s_h (s_h - 2s_l) \xi + s_l (s_h - s_l) (s_h + 2s_l), \quad (116)$$

which is positive for  $\xi < \tilde{\xi}_c = -\frac{s_l(s_h - s_l)(s_h + 2s_l)}{2s_h(s_h - 2s_l)}$ , and

$$R_2 = 8s_h^2 (5s_h - 2s_l) \xi^2 + 10s_l s_h (4s_h^2 - 2s_l^2 + s_l s_h) \xi + s_l^2 (s_h - s_l) (s_h + 2s_l) (10s_h - s_l) > 0, \quad (117)$$

and

$$\tilde{\pi}_l^H - \tilde{\Pi}_l^H = -\frac{9s_l^3 s_h (s_h - s_l)}{\tilde{\Delta}_H^2} < 0. \quad (118)$$

Environmental damages decrease in country  $L$  and increase in country  $H$  as

$$\tilde{\varphi}^L - \tilde{\Phi}^L = \frac{s_l^2 (5s_h - 2s_l) \xi [2s_h (11s_h^2 - 4s_l s_h - 4s_l^2) \xi + s_l (s_h - s_l) (s_h + 2s_l)] R_1}{\tilde{\Delta}_l^2 \tilde{\Delta}_L^2} > 0 \quad (119)$$

and

$$\tilde{\varphi}^H - \tilde{\Phi}^H = -\frac{9s_l^2 s_h^2 \xi}{\tilde{\Delta}_H^2} < 0. \quad (120)$$

### 6.3 A Unidirectionally Binding NT

For completeness, we consider instances in which NT is only binding for the country producing the clean good. In the absence of NT, the country producing the dirty good may choose to tax the domestic good at a higher rate than the imported good if pollution intensity is high. Specifically, when pollution arises from the consumption of the high-quality good, country  $H$  discriminates against its own good if  $\xi > \xi_c = \frac{3s_h a}{2(3s_h - s_l)}$ ; alternatively, when pollution arises from the consumption of the low-quality good, country  $L$  discriminates against its own good if  $s_h < 2s_l$  and  $\xi > \tilde{\xi}_c = \frac{s_l a (s_h + 2s_l)}{2s_h (2s_l - s_h)}$ . In such cases, NT is not binding for the country producing the dirty good; hence, under NT, the clean-good country chooses the NT tax while the dirty-good country chooses the non-NT taxes.

Under a unidirectionally binding NT, national welfare, which we denote as  $W_{ub}^j$  when good  $h$  is dirty and  $\tilde{W}_{ub}^j$  when good  $l$  is dirty, for  $j = H, L$ , is equal to the non-NT domestic welfare plus the (jointly binding) NT profits from foreign consumption for the country producing the dirty

good and is equal to the NT domestic welfare plus the non-NT profits from foreign consumption for the country producing the clean good. The national welfare differences between non-NT and a unidirectionally binding NT are then equal to

$$w^H - W_{ub}^H = (w_h^H + \pi_h^L) - (w_h^H + \Pi_h^L) = \pi_h^L - \Pi_h^L < 0 \quad (121)$$

and

$$w^H - W_{ub}^H = (w_l^L + \pi_l^H) - (W_l^L + \pi_l^H) = w_l^L - W_l^L > 0 \quad (122)$$

when good  $h$  is polluting and equal to

$$\tilde{w}^H - \tilde{W}_{ub}^H = (\tilde{w}_h^H + \tilde{\pi}_h^L) - (\tilde{W}_h^H + \tilde{\pi}_h^L) = \tilde{w}_h^H - \tilde{W}_h^H > 0 \quad (123)$$

and

$$\tilde{w}^L - \tilde{W}_{ub}^L = (\tilde{w}_l^L + \tilde{\pi}_l^H) - (\tilde{w}_l^L + \tilde{\Pi}_l^H) = \tilde{\pi}_l^H - \tilde{\Pi}_l^H < 0 \quad (124)$$

when good  $l$  is polluting. Globally, we then have that a unidirectionally binding NT increases global welfare when good  $h$  is polluting but decreases it when good  $l$  is polluting; we can in fact easily show that

$$w_l^L - W_l^L + \pi_h^L - \Pi_h^L = -\frac{N_1 [2(s_h - s_l)(2s_h + s_l)N_2 - N_1\Delta_l\Delta_L]}{2\Delta_l^2\Delta_L^2} \quad (125)$$

is negative as  $2(s_h - s_l)(2s_h + s_l)N_2 - N_1\Delta_l\Delta_L$  is increasing in  $\xi$  and positive for  $\xi = \xi_c$  and

$$\tilde{w}_h^H - \tilde{W}_h^H + \tilde{\pi}_l^H - \tilde{\Pi}_l^H = \frac{s_h \left\{ [3s_l(s_h - s_l) + 2\xi s_h] \tilde{\Delta}_H - 18s_l^3(s_h - s_l) \right\}}{2\tilde{\Delta}_H^2} \quad (126)$$

is positive as  $[3s_l(s_h - s_l) + 2\xi s_h] \tilde{\Delta}_H - 18s_l^3(s_h - s_l)$  is increasing in  $\xi$  and positive for  $\xi = \xi_c$ .

The level of environmental pollution under a unidirectionally binding NT, which we denote as  $\Phi_{ub}^j$  and  $\tilde{\Phi}_{ub}^j$  for  $j = H, L$  depending on which good is dirty, is the same as the non-NT level for the dirty-good country and the same as the (jointly binding) NT level for the clean-good country. Global environmental damages under a unidirectionally binding NT ( $\Phi_{ub}^W$ ) are then equal to  $\varphi^H + \Phi^L$  when good  $h$  is polluting and  $\tilde{\Phi}^H + \tilde{\varphi}^L$  when good  $l$  is polluting, and it thus follows that the difference in global pollution between non-NT and a unidirectionally binding NT corresponds to the difference in country  $L$ 's environmental damages as in (47) in the former case and to the difference in country  $H$ 's environmental damages (i.e.,  $-\tilde{\Phi}^H$ ) in the latter case.

We illustrate the welfare and environmental effects of moving to a unidirectionally binding NT when pollution originates from consuming good  $h$ , under normalization of  $s_l$  to unity, in Figure 2 with the area  $B_3$  where welfare decreases in country  $L$ , increases in country  $H$ , and increases globally, in Figure 3 with the area  $C_3$  where pollution increases in country  $L$ , does not change in country  $H$ , and increases globally, and in Figure 4 with the area  $D_4$  where both global welfare and global pollution increase. We sum up the results for the low-quality polluting case in Figure 6a with the area  $F_5$  where welfare increases in country  $L$  and decreases in country  $H$  and in Figure 7 with the area  $G_4$  where global welfare decreases and global pollution increases.

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**TABLE 1. Summary of Article III (GATT) Disputes from 1995 to 2012.**

DISPUTE Short Title (Year) (Dispute No.)	MEASURE AT ISSUE	KEY FINDINGS
<i>Japan – Alcoholic Beverages II</i> (1995) (DS8, 10, 11)	Japanese Liquor Tax Law that established a system of internal taxes applicable to all liquors at different tax rates depending on which category they fell within. The tax law at issue taxed shochu at a lower rate than the other products.	The Appellate Body upheld the Panel's findings that <ul style="list-style-type: none"> <li>vodka was taxed in excess of shochu, in violation of Art. III:2, first sentence;</li> <li>shochu and whisky, brandy, rum, gin, genever, and liqueurs were not similarly taxed so as to afford protection to domestic production, in violation of Art. III:2, second sentence.</li> </ul>
<i>US – Gasoline</i> (1995) (DS2)	The Gasoline Rule under the US Clean Air Act that set out the rules for establishing baseline figures for gasoline sold on the US market (different methods for domestic and imported gasoline), with the purpose of regulating the composition and emission effects of gasoline to prevent air pollution.	The Panel considered it unnecessary to examine the consistency of the Gasoline Rule with Art. III:1, given that a finding of violation of Art III:4 (i.e., more specific provision than Art. III:1) had already been made.
<i>Canada – Periodicals</i> (1996) (DS31)	(i) Tariff Code 9958, which prohibited the importation into Canada of any periodical that was a "special edition"; (ii) the Excise Tax Act, which imposed, in respect of each split-run edition of a periodical, a tax equal to 80 per cent of the value of all the advertisements contained in the split-run edition; (iii) the postal rate scheme under which different postal rates were applied to domestic and foreign periodicals.	The Appellate Body reversed the Panel's finding that imported split-run periodicals and domestic non-split run periodicals were "like products" (Art. III:2, first sentence). The Appellate Body concluded that the Excise Tax Act was inconsistent with Art. III:2, second sentence, because <ul style="list-style-type: none"> <li>imported split-run periodicals were "directly competitive or substitutable" with domestic non-split-run periodicals;</li> <li>imported and domestic products were not similarly taxed;</li> <li>the tax was applied so as to afford protection to domestic products.</li> </ul>
<i>Indonesia – Autos</i> (1997) (DS54, 55, 59, 64)	(i) "The 1993 Programme" that provided import duty reductions or exemptions on imports of automotive parts based on the local content percent; (ii) "The 1996 National Car Programme" that provided various benefits such as luxury tax exemption or import duty exemption to qualifying (local content and etc.) cars or Indonesian car companies.	The Panel found that the sales tax benefits under the measures violated both Art. III:2, first and second sentences. The Panel noted that, under the Indonesian car programmes, <ul style="list-style-type: none"> <li>an imported motor vehicle would be taxed at a higher rate than a like domestic vehicle;</li> <li>any imported vehicle would not be taxed similarly to a directly competitive or substitutable domestic car.</li> </ul>
<i>Korea – Alcoholic Beverages</i> (1997) (DS75, 84)	Korea's tax regime for alcoholic beverages, which imposed different tax rates for various categories of distilled spirits.	The Appellate Body upheld the Panel's conclusion that Korean tax measures at issue were inconsistent with Art. III:2, second sentence. More specifically, the Appellate Body upheld the Panel's findings that, within the meaning of Art. III:2, second sentence, <ul style="list-style-type: none"> <li>the products at issue were "directly competitive or substitutable";</li> <li>Korea's tax measures on alcoholic beverages were applied "so as to afford protection" to domestic production.</li> </ul>
<i>Chile – Alcoholic Beverages</i> (1998) (DS87, 110)	Chile's tax measures that imposed an excise tax at different rates – depending on the type of product (pisco, whisky, etc.) under the "Transitional System" and according to the degree of alcohol content (35%, 36%, ..., 39%) under the "New Chilean System".	The Appellate Body upheld the Panel's finding that Chile's new tax regime for alcoholic beverages violated the national treatment principle under Art. III:2, second sentence. The Appellate Body agreed with the Panel that imported distilled spirits and Chilean pisco, as directly competitive and substitutable products, were not similarly taxed since the tax burden (47 per cent) on most of imported products (95 per cent of imports) would be heavier than the tax burden (27 per cent) on most of the domestic products (75 per cent of domestic production).
<i>Argentina – Hides and Leather</i> (1999) (DS155)	(i) Argentine regulations by which representatives of the Argentine leather tanning industry were present during the customs clearance process for bovine hides export; (ii) advance tax payments that allegedly imposed a higher tax burden on imports.	The Panel concluded that the requirements were in violation of Art. III:2, first sentence, as advance tax payment requirements were financial burdens that taxed imports in excess of domestic products, in the form of an opportunity cost (interest lost) and a debt financing (interest paid).
<i>Mexico – Taxes on Soft Drinks</i> (2004) (DS308)	Mexico's tax measures under which soft drinks using non-cane sugar sweeteners were subject to 20 per cent taxes on (i) their transfer and importation and (ii) specific services provided for the purpose of transferring soft drinks and bookkeeping requirements.	The Panel found that <ul style="list-style-type: none"> <li>the tax measures for soft drinks sweetened with HFCS were inconsistent with Art. III:2, first sentence, as these drinks were subject to internal taxes (20 per cent transfer and services taxes) in excess of taxes imposed on like domestic products (i.e., soft drinks sweetened with cane sugar);</li> <li>the tax measures for non-cane sugar sweeteners such as HFCS were inconsistent with Art. III:2, second sentence, as "the dissimilar taxation (i.e., 20 per cent transfer and services taxes)" imposed on "directly competitive or substitutable imports (HFCS) and domestic products (cane sugar)" was applied in a way that afforded protection to domestic production.</li> </ul>
<i>China – Auto Parts</i> (2006) (DS339, 340, 342)	Three legal instruments enacted by China which impose a 25% "charge" on imported auto parts "characterized as complete motor vehicles" based on specified criteria and prescribe administrative procedures associated with the imposition of that charge.	The Appellate Body upheld the Panel's findings that the measures violated Art. III:2 because they imposed an internal charge on imported auto parts that was not imposed on like domestic auto parts.
<i>Thailand – Cigarettes</i>	Thailand's customs and tax measures.	The Appellate Body upheld the Panel's finding that Thailand acted inconsistently with Art. III:2, first sentence. Thailand's measure subjected resellers of imported cigarettes to VAT if they did not satisfy conditions for

<i>(Philippines)</i> (2008) (DS371)		obtaining input tax credits necessary to achieve zero VAT liability; resellers of like domestic cigarettes were not subject to VAT liability by reason of a complete exemption from VAT. The fact that resellers of imported cigarettes could take action to achieve zero VAT liability under Thailand's measure did not preclude a finding of inconsistency.
<i>Philippines – Distilled Spirits</i> (2010) (DS396, 403)	Philippines excise tax on distilled spirits, which imposed different tax rates depending on the raw material used to make the spirit.	<p>The Appellate Body upheld the Panel's findings that</p> <ul style="list-style-type: none"> <li>• each type of imported distilled spirit at issue in this dispute (gin, brandy, vodka, whisky, and tequila) made from non-designated raw materials was "like" the same type of domestic distilled spirit made from designated raw materials, within the meaning of Art. III:2, first sentence;</li> <li>• the Philippines, through its excise tax, had subjected specific types of imported distilled spirits to internal taxes in excess of those applied to like domestic spirits of the same type made from designated raw materials in violation of Art. III:2, first sentence;</li> <li>• the Philippines, through its excise tax, had applied dissimilar internal taxes on domestic and imported distilled spirits in a manner so as to afford protection to the domestic production of distilled spirits in violation of Art. III:2, second sentence (domestic distilled spirits made from designated raw materials and imported distilled spirits made from other raw materials were found to constitute directly competitive or substitutable products).</li> </ul>

**Relevant Sections of Article III:** **Art. III:1** – “The contracting parties recognize that internal taxes and other internal charges, and laws, regulations and requirements affecting the internal sale, offering for sale, purchase, transportation, distribution or use of products, and internal quantitative regulations requiring the mixture, processing or use of products in specified amounts or proportions, should not be applied to imported or domestic products so as to afford protection to domestic production.” **Art. III: 2 1<sup>st</sup>** (first sentence) – “The products of the territory of any contracting party imported into the territory of any other contracting party shall not be subject, directly or indirectly, to internal taxes or other internal charges of any kind in excess of those applied, directly or indirectly, to like domestic products.” **Art. III: 2 2<sup>nd</sup>** (second sentence) – “Moreover, no contracting party shall otherwise apply internal taxes or other internal charges to imported or domestic products in a manner contrary to the principles set forth in paragraph 1.”

**Sources:** (1) [http://www.wto.org/english/res\\_e/booksp\\_e/gatt\\_ai\\_e/art3\\_e.pdf](http://www.wto.org/english/res_e/booksp_e/gatt_ai_e/art3_e.pdf); (2) [http://www.wto.org/english/res\\_e/booksp\\_e/dispu\\_settl\\_1995\\_2012\\_e.pdf](http://www.wto.org/english/res_e/booksp_e/dispu_settl_1995_2012_e.pdf).

**TABLE 2. Summary of Article XX (GATT) Disputes from 1995 to 2012.**

DISPUTE Short Title (Year) (Dispute No.)	MEASURE AT ISSUE	KEY FINDINGS
<i>US – Gasoline</i> (1995) (DS2)	The “Gasoline Rule” under the US Clean Air Act that set out the rules for establishing baseline figures for gasoline sold on the US market (different methods for domestic and imported gasoline), with the purpose of regulating the composition and emission effects of gasoline to prevent air pollution.	The Appellate Body modified the Panel’s reasoning and found that the measure was “related to” (i.e., “primarily aimed at”) the “conservation of exhaustible natural resources” and thus fell within the scope of Art. XX(g). However, the measure was still not justified by Art. XX because the discriminatory aspect of the measure constituted “unjustifiable discrimination” and a “disguised restriction on international trade” under the chapeau of Art. XX.
<i>Canada – Periodicals</i> (1996) (DS31)	(i) Tariff Code 9958, which prohibited the importation into Canada of any periodical that was a “special edition”; (ii) the Excise Tax Act, which imposed, in respect of each split-run edition of a periodical, a tax equal to 80 per cent of the value of all the advertisements contained in the split-run edition; (iii) the postal rate scheme under which different postal rates were applied to domestic and foreign periodicals.	The Panel found that Tariff Code 9958, which prohibited the importation of certain periodicals, violated Art. XI, and was not justified under Art. XX(d) because it could not be regarded as a measure to secure compliance with Canada’s Income Tax Act.
<i>US – Shrimp; US – Shrimp</i> (1997) (DS58)	US import prohibition of shrimp and shrimp products from non-certified countries (i.e., countries that had not used a certain net in catching shrimp).	The Appellate Body held that, although the US import ban was related to the conservation of exhaustible natural resources and, thus, covered by Art. XX(g) exception, it could not be justified under Art. XX because the ban constituted “arbitrary and unjustifiable” discrimination under the chapeau of Art. XX.
<i>EC – Asbestos</i> (1998) (DS135)	France’s ban on asbestos (Decree No. 96-1133).	The Appellate Body agreed with the Panel that the measure protected “human life or health” and that “no reasonably available alternative measure” existed and upheld the finding that the ban was justified as an exception under Art. XX(b). The Panel also found that the measure satisfied the conditions of the Art. XX chapeau, as the measure neither led to arbitrary or unjustifiable discrimination nor constituted a disguised restriction on international trade.
<i>Argentina – Hikes and Leather</i> (1999) (DS155)	(i) Argentine regulations by which representatives of the Argentine leather tanning industry were present during the customs clearance process for bovine hides export; (ii) advance tax payments that allegedly imposed a higher tax burden on imports.	Although the Panel found that the measures were necessary to secure compliance with Argentina’s tax law and, thus, fell within the terms of Art. XX(d), it concluded that they could not be justified because they resulted in “unjustifiable discrimination” under the chapeau of Art. XX when they were not “unavoidable” for the operation of Argentina’s tax law and when there were several alternative measures available.
<i>Korea – Various Measures on Beef</i> (1999) (DS161, 169)	(i) Korea’s measures affecting the importation, distribution, and sale of beef; (ii) Korea’s “dual retail system” for sale of domestic imported beef; (iii) Korea’s agricultural domestic support programmes.	The Appellate Body upheld the Panel’s finding that the dual retail system was not justified as a measure necessary to secure compliance with Korea’s Unfair Competition Act because the dual retail system was not “necessary” within the meaning of Art. XX(d). The Appellate Body agreed with the Panel that Korea failed to demonstrate that it could not achieve its desired level of enforcement using alternative measures.
<i>US – Shrimp (Article 21.5 Malaysia)</i> (2000) (DS58)	Revised Guidelines for the Implementation of Section 609, under which certain countries were exempt from the import prohibition on shrimp pursuant to the criteria provided therein.	The Appellate Body upheld the Panel’s finding that Section 609, as implemented by the revised guidelines and as applied by the United States, was justified under Art. XX(g) as (i) it related to the conservation of exhaustible natural resources as set out in Art. XX(g) and (ii) it met the conditions of the chapeau of Art. XX when applied in a manner that no longer constituted a means of arbitrary discrimination as a result of (i) the serious, good faith efforts made by the United States to negotiate an international agreement and (ii) the new measure allowing “sufficient flexibility” by requiring that other Members’ programmes simply be “comparable in effectiveness” to the US programme, as opposed to the previous standard that they be “essentially the same”. In this regard, the Appellate Body rejected Malaysia’s contention and agreed with the Panel that the United States had only an obligation to make best efforts to negotiate an international agreement regarding the protection of sea turtles, not an obligation to actually conclude such an agreement because all that was required of the United States to avoid “arbitrary or unjustifiable discrimination” under the chapeau was to provide all exporting countries “similar opportunities to negotiate” an international agreement.
<i>Canada – Wheat Exports and Grain Imports</i> (2003) (DS276)	Canadian Wheat Board (“CWB”) Export Regime and requirements related to the import of grain into Canada.	The Panel found that Sections 57(c) and 56(1) of the Canada Grain Act were inconsistent with Art. III:4 and were not justified under Art. XX(d) as a measure necessary to secure compliance with Canada’s laws and regulations.
<i>Dominican Republic – Import and Sale of Cigarettes</i> (2004)	Dominican Republic’s general measures relating to import charges and fees and other measures specific to import and sale of cigarettes.	The Appellate Body upheld the Panel’s finding that the tax stamp requirement was not “necessary” within the meaning of Art. XX(d) and was thus not justified under the provision.

(DS302)		
<i>Mexico – Taxes on Soft Drinks</i> (2004) (DS308)	Mexico's tax measures under which soft drinks using non-cane sugar sweeteners were subject to 20 per cent taxes on (i) their transfer and importation and (ii) specific services provided for the purpose of transferring soft drinks and bookkeeping requirements.	The Appellate Body upheld the Panel's finding that Mexico's measures, which sought to secure compliance by the United States with its obligations under the NAFTA, did not constitute measures "to secure compliance with laws or regulations" within the meaning of Art. XX(d).
<i>Brazil – Retreaded Tyres</i> (2005) (DS332)	(i) Brazil's import prohibition on retreaded tyres ("Import Ban"); (ii) fines on importing, marketing, transportation, storage, keeping or warehousing of retreaded tyres; (iii) Brazilian state law restrictions on the marketing of imported retreaded tyres; (iv) exemptions of retreaded tyres imported from Mercosur countries from the Import Ban and fines ("MERCOSUR exemption").	The Appellate Body upheld the Panel's findings that the Import Ban was provisionally justified as "necessary" within the meaning of Art. XX(b) and that none of the less trade-restrictive alternatives suggested by the European Communities constituted "reasonably available" alternatives to the Import Ban. The Appellate Body reversed the Panel's findings that the MERCOSUR exemption and imports of used tyres through court injunctions (i) would not result in the Import Ban being applied in a manner that constituted "arbitrary discrimination" and (ii) would lead to "unjustifiable discrimination" and a "disguised restriction on international trade" only to the extent that they resulted in import volumes that would significantly undermine the achievement of the objective of the Import Ban. The Appellate Body found that the MERCOSUR exemption, as well as the imports of used tyres under court injunctions, had resulted in the Import Ban being applied in a manner that constituted arbitrary or unjustifiable discrimination and a disguised restriction on international trade within the meaning of the chapeau of Art. XX. The Appellate Body thus upheld, albeit for different reasons, the Panel's finding that the Import Ban was not justified under Art. XX. Having found that the Import Ban could not be justified by Art. XX(b), the Panel also found that the fines could not be justified under Art. XX(d) since they did not fall within the scope of measures that were designed to secure compliance with "laws or regulations that are <i>not themselves inconsistent with</i> " some provision of the GATT.
<i>China – Auto Parts</i> (2006) (DS339, 340, 342)	Three legal instruments enacted by China which impose a 25% "charge" on imported auto parts "characterized as complete motor vehicles" based on specified criteria and prescribe administrative procedures associated with the imposition of that charge.	The Panel rejected China's defence of its measures under Art. XX(d) because China had not proven that the measures were "necessary to secure compliance" with its Schedule.
<i>US – Shrimp (Thailand), US – Custom Bond Directive</i> (2006) (DS343, 345)	The enhanced continuous bond requirement (the "EBR").	The Appellate Body upheld the Panel's finding that the EBR was not "necessary" to secure compliance with certain United States "laws and regulations" governing the final collection of anti-dumping duties since the United States had not demonstrated that the margins of dumping were likely to increase resulting in significant additional unsecured liability. Consequently, the Appellate Body did not find it necessary to express a view whether a defence under Art. XX(d) was available in respect of a measure that had been found to be inconsistent with ADA Art. 18.1 and GATT Ad Art. VI, paras. 2 and 3.
<i>China – Publications and Audiovisual Products</i> (2007) (DS363)	A series of Chinese measures regulating activities relating to the importation and distribution of certain publications and audiovisual entertainment products.	The Appellate Body found that, by virtue of the introductory clause of para. 5.1 of China's Accession Protocol, China could, in this dispute, invoke Art. XX(a) to justify provisions found to be inconsistent with China's trading rights commitments under its Accession Protocol and Working Party Report. The Appellate Body upheld the Panel's conclusion that China had not demonstrated that the relevant provisions were "necessary" to protect public morals and that, as a result, China had not established that these provisions were justified under Art. XX(a).
<i>China – Raw Materials</i> (2009) (DS394, 395, 398)	Export restraints imposed on the different raw materials: (i) export duties; (ii) export quotas; (iii) export quotas management; (iv) minimum export price requirements; (v) export licensing requirements; (vi) administration and publication of trade regulations. The complainants identified 40 specific Chinese measures in connection with their claims.	The Appellate Body upheld the Panel's finding that there was no basis in China's Accession Protocol to allow the application of Art. XX to China's obligations under para. 11.3 of the Protocol. The Panel had concluded that China's export restraints were not justified pursuant to Arts. XX(b) and (g).

**Relevant Sections of Article XX: Art. XX (Chapeau, a, b, d, and g)** – "Subject to the requirement that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade, nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures: (a) necessary to protect public morals; (b) necessary to protect human, animal or plant life or health; (d) necessary to secure compliance with laws or regulations which are not inconsistent with the provisions of this Agreement, including those relating to customs enforcement, the enforcement of monopolies operated under paragraph 4 of Article II and Article XVII, the protection of patents, trade-marks and copyrights, and the prevention of deceptive practices; (g) relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption;"

**Sources:** (1) [http://www.wto.org/english/res\\_e/booksp\\_e/gatt\\_ai\\_e/art20\\_e.pdf](http://www.wto.org/english/res_e/booksp_e/gatt_ai_e/art20_e.pdf); (2) [http://www.wto.org/english/res\\_e/booksp\\_e/dispu\\_settl\\_1995\\_2012\\_e.pdf](http://www.wto.org/english/res_e/booksp_e/dispu_settl_1995_2012_e.pdf).

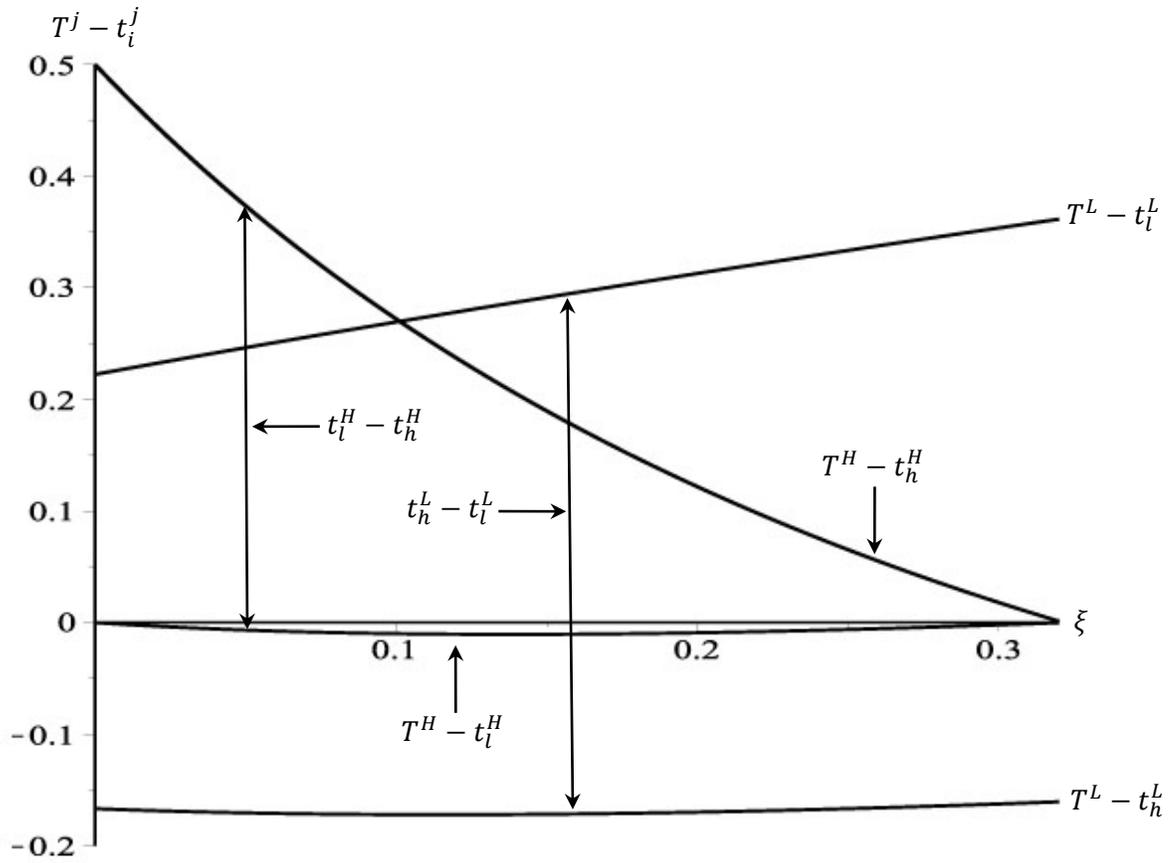


Figure 1a. Taxes: NT versus No NT (high-quality polluting case),  $s_l = 1$  and  $s_h = 1.5$ .

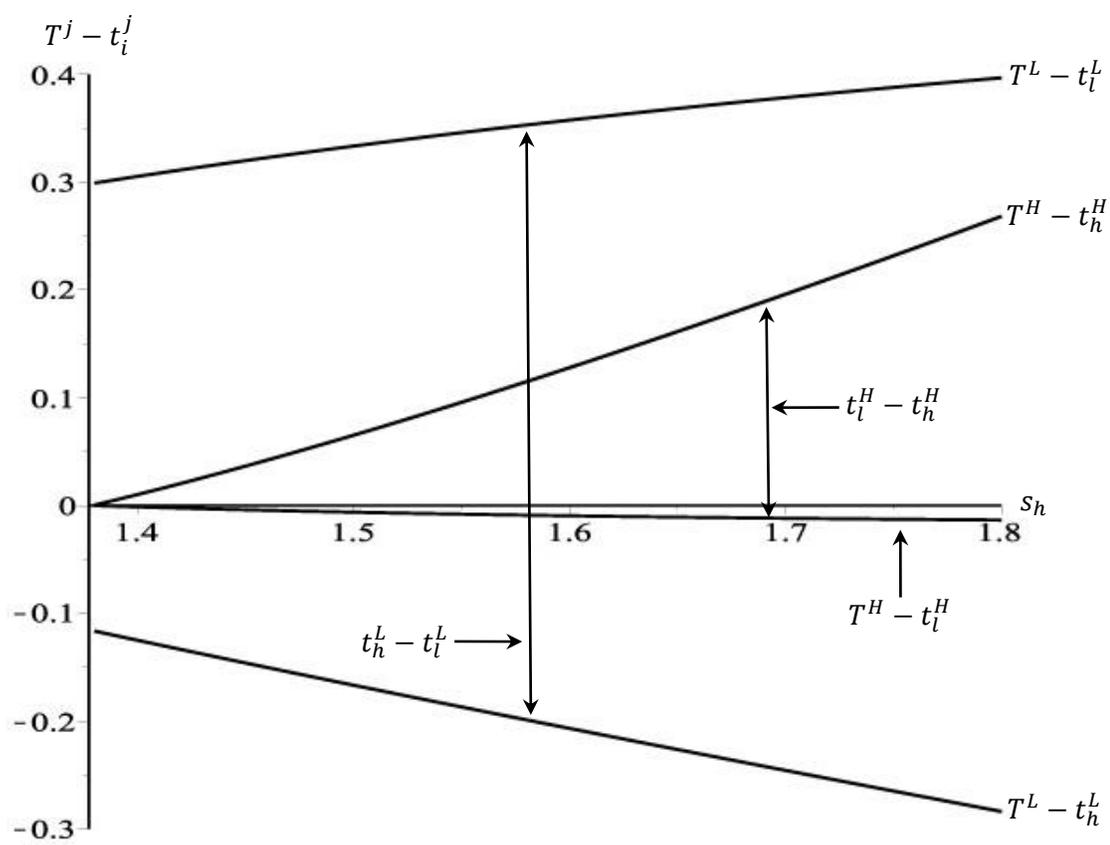


Figure 1b. Taxes: NT versus No NT (high-quality polluting case),  $s_l = 1$  and  $\xi = 0.25$ .

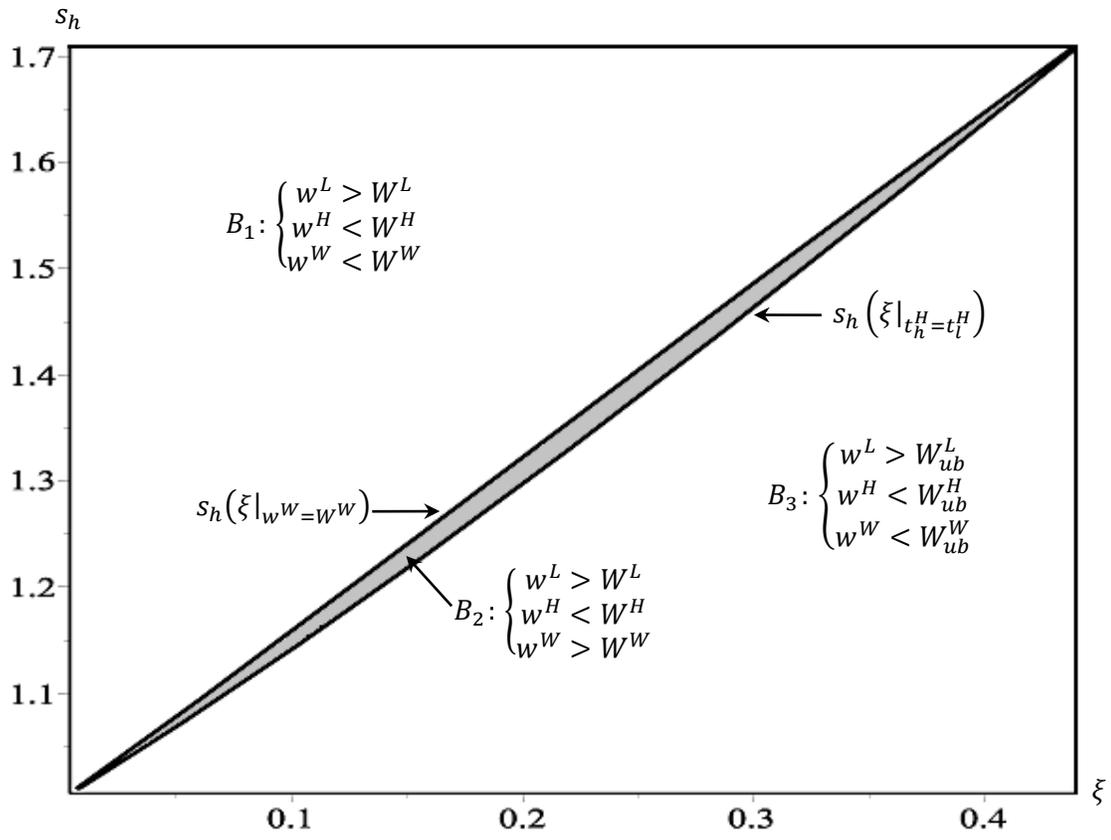


Figure 2. Welfare: NT versus No NT (high-quality polluting case),  $s_l = 1$ .

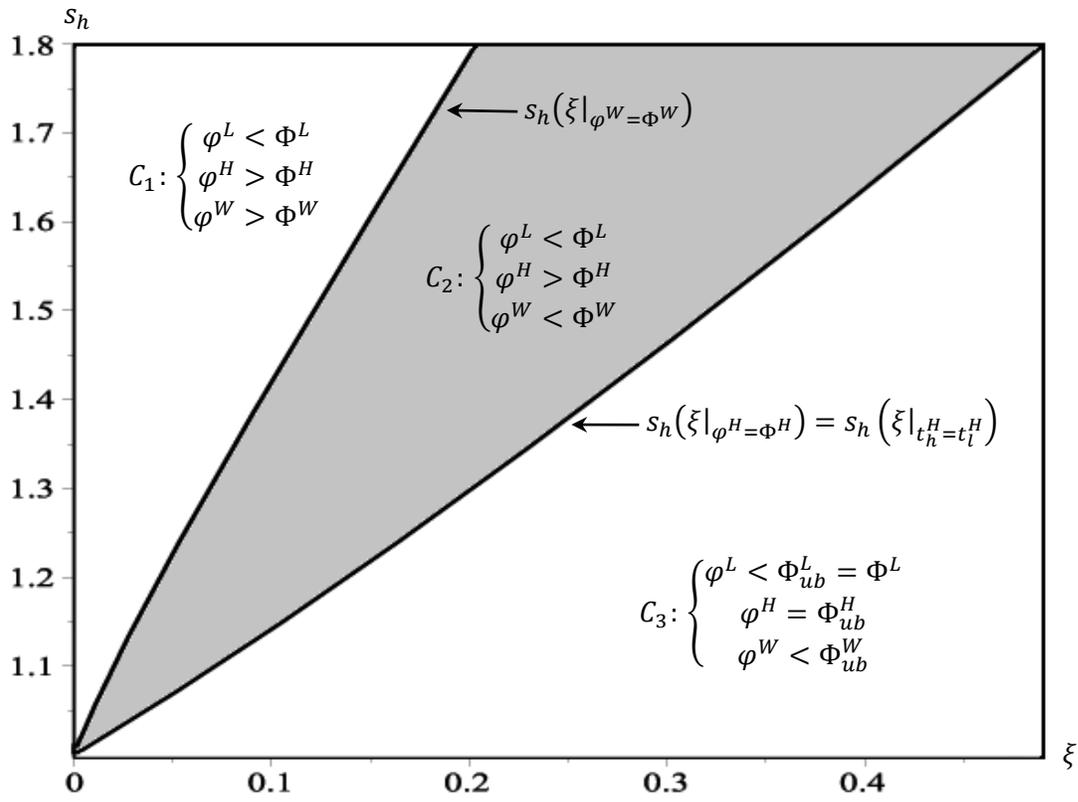


Figure 3. Environmental Damages: NT versus No NT (high-quality polluting case),  $s_l = 1$ .

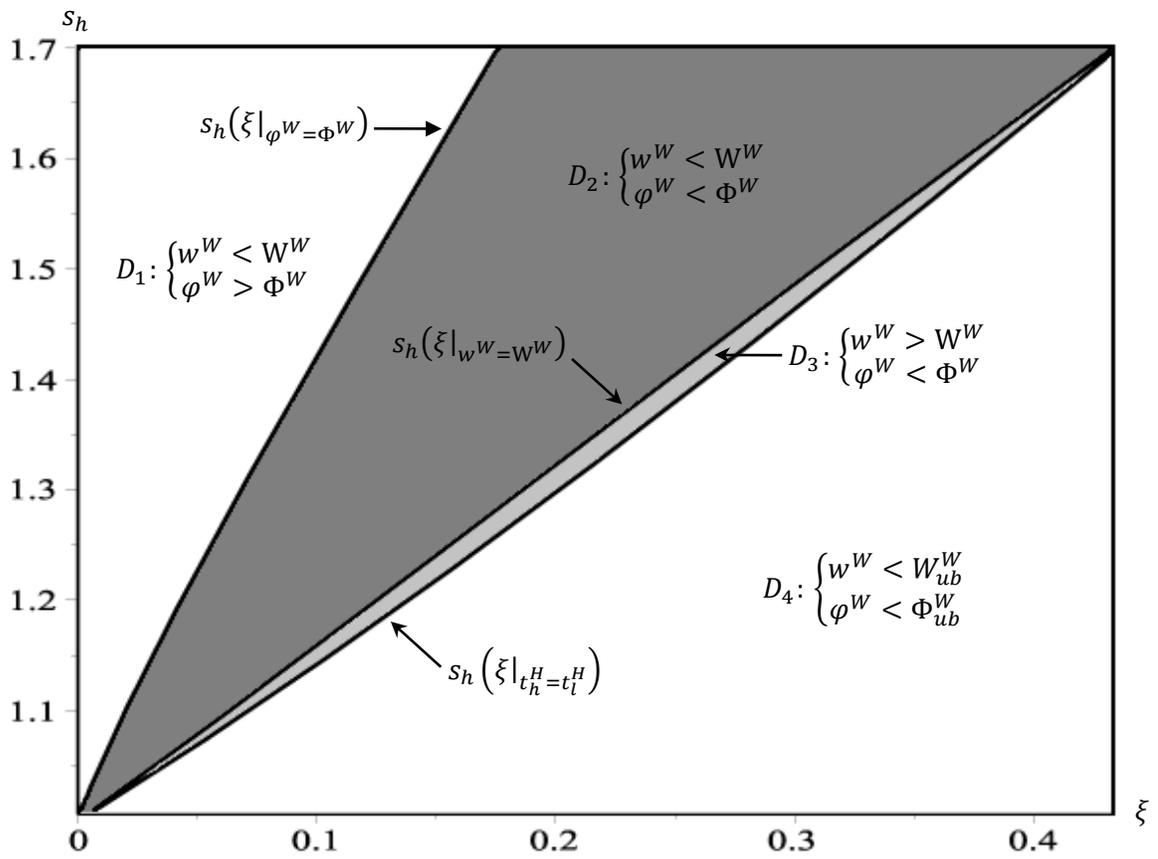


Figure 4. Global Welfare and Environmental Damages: NT versus No NT (high-quality polluting case),  $s_l = 1$ .

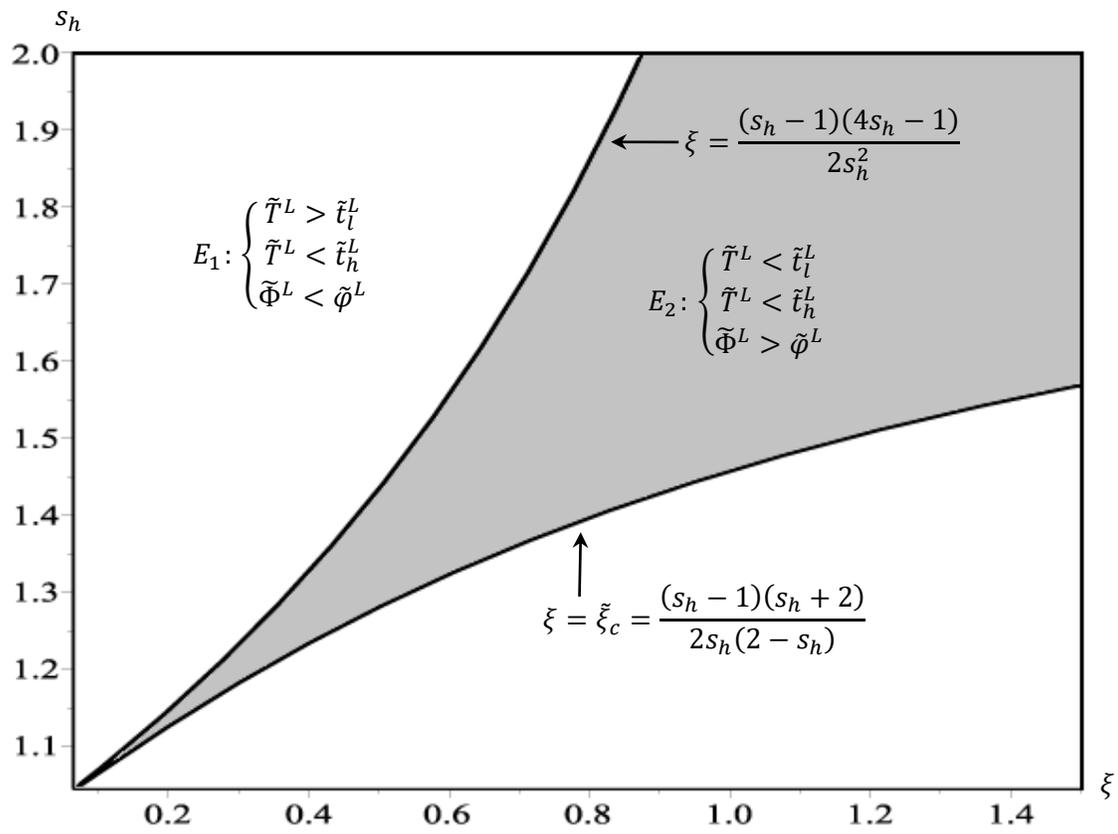


Figure 5. Taxes: NT versus No NT (low-quality polluting case),  $s_l = 1$  ( $\tilde{T}^H > \tilde{t}_l^H > \tilde{t}_h^H$  everywhere).

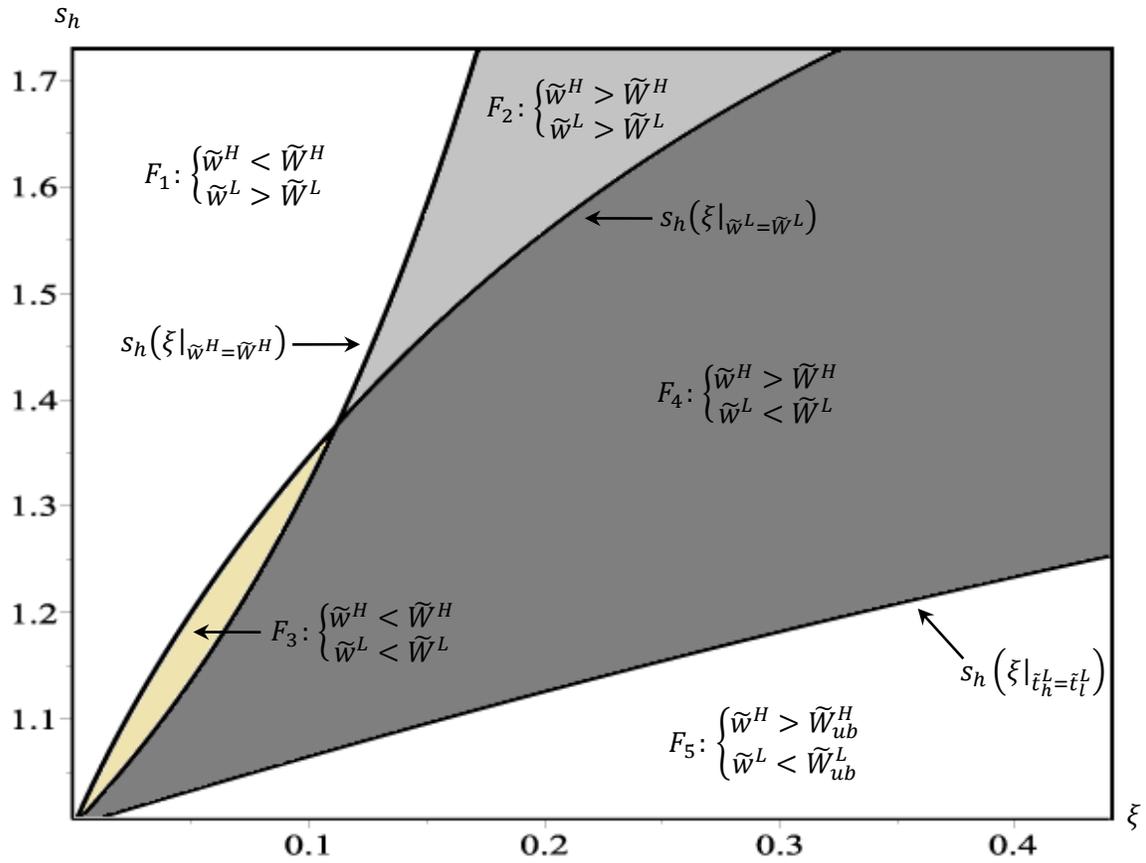


Figure 6. Welfare: NT versus No NT (low-quality polluting case),  $s_l = 1$  and  $s_h < 2s_l$ .

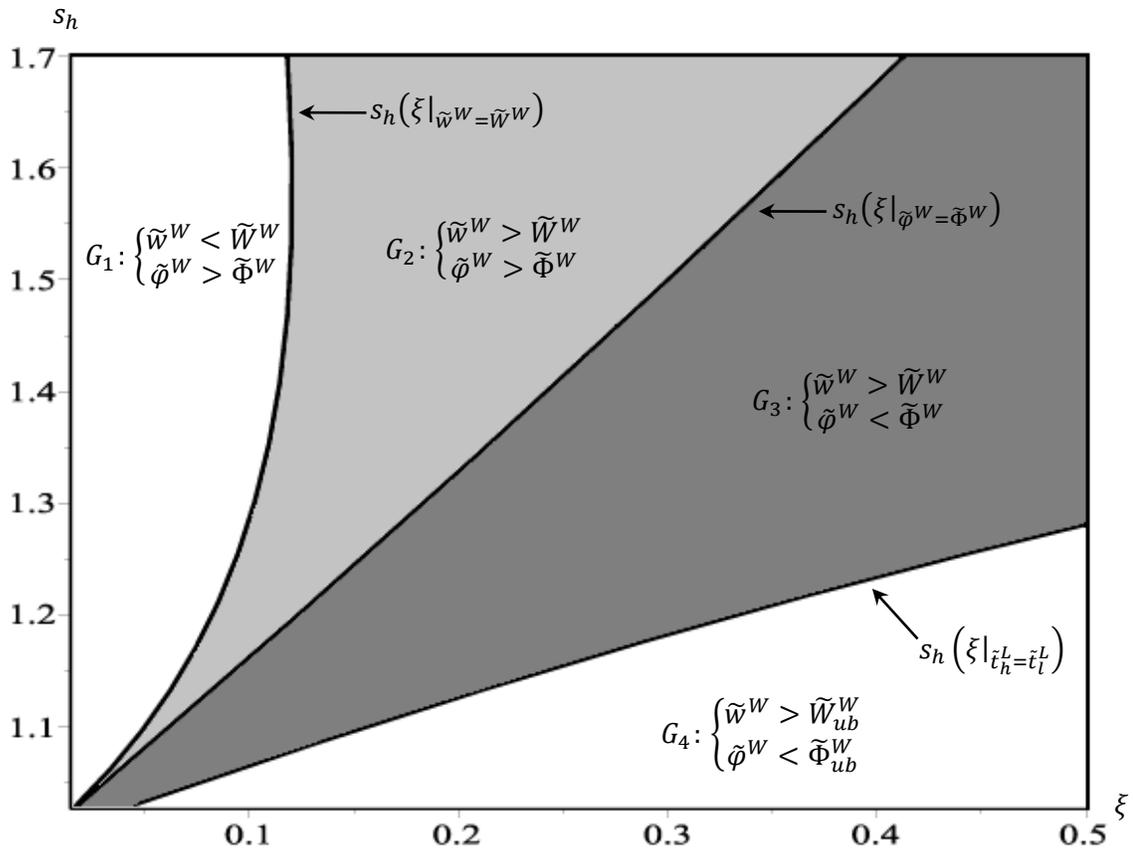


Figure 7. Global Welfare and Environmental Damages: NT versus No NT (low-quality polluting case),  $s_l = 1$ .

**TABLE 3. Summary of the Effects of National Treatment.**

		<b>good <math>h</math> is dirty</b>	<b>good <math>l</math> is dirty</b>
tax on good $h$	country $H$	+	+
tax on good $l$		-	+
market coverage		-	-
sales of good $h$		-	-
sales of good $l$		+	+
welfare		+	+ at low $\xi$ ; - otherwise
environmental damages		-	+
tax on good $h$	country $L$	-	-
tax on good $l$		+	+ at low $\xi$ ; - otherwise
market coverage		-	+ at low $\xi$ ; - otherwise
sales of good $h$		+	+
sales of good $l$		-	-
welfare		-	+ at intermediate $\xi$ ; - otherwise
environmental damages		+	- at low $\xi$ ; + otherwise
welfare	world	+ at low $\xi$ ; - at high $\xi$	+ at low $\xi$ ; - at high $\xi$
environmental damages		- at low $\xi$ ; + at high $\xi$	- at low $\xi$ ; + at high $\xi$
welfare ( $W$ ) & environment ( $E$ )		<ul style="list-style-type: none"> <li>• both improve at low <math>\xi</math></li> <li>• both worsen at high <math>\xi</math></li> <li>• <math>W</math> improves while <math>E</math> worsens at intermediate <math>\xi</math></li> <li>• <math>W</math> improves while <math>E</math> worsens at high <math>\xi</math> under partially binding NT</li> </ul>	<ul style="list-style-type: none"> <li>• both improve at low <math>\xi</math></li> <li>• both worsen at high <math>\xi</math></li> <li>• <math>W</math> worsens while <math>E</math> improves at intermediate <math>\xi</math></li> <li>• both worsen at high <math>\xi</math> under partially binding NT</li> </ul>