Not in Your Backyard? Selective Tariff Cuts for Environmentally Preferable Products

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Not in Your Backyard? Selective Tariff Cuts for Environmentally Preferable Products

Estelle Gozlan∗ and Maria Priscila Ramos†

Abstract

Current negotiations at the WTO’s Committee on Trade and Environment have made it conceivable that WTO members agree on selective tariff cuts for certain Environmentally Preferable Products, in an attempt to combine gains from trade and from cleaner production/consumption. This raises questions on the environmental- and welfare implications of trade policy when a close substitute ("environmentally worse") exists. Using a simple partial equilibrium model with two substitutable goods (green and conventional), we analyze the rationale for large trading countries to negotiate tariff cuts upon environmental characteristics of the production process. The extent and distribution of environmental and terms-of-trade effects is compared for three policy scenarios: free trade, selective tariff cuts for the green product, domestic environmental policy. We show that if consumers in the importing country value the 'Green' product, selective tariff cuts result in lower pollution levels in both countries, due to substitutions in consumption patterns. Other policies (full liberalization / unilateral environmental tax) may allow greater environmental benefits in one country, but result in an increase in pollution in the trading partner and an ambiguous global impact.

Keywords: Commercial Policy; Eco-tariff; Trade Negotiations; Trade and Environment.

JEL Classification: F130; F180.

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1 INTRODUCTION

In recent years, the WTO has become increasingly involved in trade-related environmental issues that have convinced its members of the need to promote free trade in a way that is consistent with sustainable development. In 2001, member countries agreed to negotiate “the reduction, or as appropriate, elimination of tariff- and non-tariff barriers to environmental goods and services” (EGS) in order to enhance the mutual supportiveness of trade and environment.¹ The idea is that an expansion of the market for environmental goods shall provide gains from trade and help countries to address some pollution / resource use issues. While no clear definition of environmental goods has been agreed upon yet, several countries have raised the possibility of broadening the definition to include Environmentally Preferable Products (EPP’s), that is, goods with “high environmental performance and/or low environmental impact” or goods “causing significantly less environmental harm at some stage of their life cycle than alternative products that serve the same purpose” (WTO; ICTSD and IISD; UNCTAD). Such a definition could include goods produced with cleaner production processes and methods (PPMs, such as sustainably grown timber or organic products), in order to strengthen the “green” exporting capacities of developing countries.²

Economists are usually careful about the optimality of tariffs as an instrument of environmental policy, and there is widespread agreement that trade intervention can only be second best (Beghin et al., 1994; Whalley, 1998). Lawyers and international trade specialists are sometimes skeptical about the feasibility of lower “green tariffs” due to the impossibility to discriminate between environmentally preferable and conventional goods on the basis of the Harmonized System Custom classification. Moreover, as stated by Verbruggen (van den Bergh, 1999), in the WTO circuit, the current understanding is that a country cannot take trade measures against another country on the basis of PPM differences.³ Such objections raise questions about both the practical feasibility and the optimality of implementing a new distortion in the tariff structure, and require an in-depth examination of its welfare implications. The two classes of environmental goods under discussion in current WTO negotiations (Hamwey, 2005) cover a wide range of environmental benefits, stemming from either Class A final-use (goods produced to provide environmental service, e.g. filters) or Class B higher environmental performance, - whether in consumption (e.g. energy-efficient light bulbs) or during the production process (e.g. organic

¹Doha Ministerial Declaration, paragraph 31(iii).
²Although this position is supported by UNCTAD as a challenging opportunity for developing countries, the ICTSD (2005) recalls that developing countries fear production method distinctions could be misused for ‘green protectionism’ through the requirements of standards or eco-labels.
³In WTO jargon, unilateral measures with extraterritorial impact are not allowed."
agricultural products or chlorine-free paper). Moreover, because the reduced externality may be local, transboundary, or global, the distribution of environmental benefits from selective tariff cuts in EGS is not trivial.

The aim of this paper is to analyze the nature and distribution of welfare gains expected under the present negotiations, for the family of EPPs characterized by a reduced local pollution during the production process. We focus on EPPs because by definition, close substitutes (“Environmentally worse” products) exist, which can be valued differently by consumers, and the question of a substitution of green for conventional products has received little attention in the non-strategic trade-and-environment literature. Using a simple North-South trade partial-equilibrium model with two substitutable goods (resp. ‘conventional’ and ‘environmentally preferable’), we seek to address the two following questions: first, what are the environmental and welfare consequences of selective tariff cuts for EPPs for large importing and exporting countries, and how does such a “green” liberalization scenario perform compared to a general, non-selective cut in tariffs? and second, should (large exporting) developing countries rely on such selective tariff cuts, or rather implement whenever feasible a strategic environmental policy aimed at improving their terms of trade while reducing local pollution?

Surveys and economic papers dealing with current Doha negotiations in environmental goods have focused on (i) the right definition for EGS/EPPs (Vikhlyaev, 2004; Howse and van Bork, 2005) and the various implications of negotiating tariff cuts upon criteria (more flexible when technology changes) vs. a list of products (more realistic if an agreement has to be reached); (ii) whether extending the scope of environmental goods to include EPPs will provide new export opportunities for developing countries (Singh, 2004; Hamwey, 2005)- highlighting some non-tariff concerns; (iii) the practical and legal feasibility of discriminating between otherwise similar products based on their PPM’s within the WTO framework (Carpentier et al., 2005; Steenblik, 2005; Howse and van Bork, 2005): these contributions suggest that though complicated, the EGS preferential liberalization is not impossible (tariff cuts need not to rely on the HS custom classification), and that multilateral negotiations aimed at lowering tariffs, even upon PMM’s, cannot be compared with (inadmissible) unilateral trade restrictions; (iv) the potential benefits

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4Discussions at a recent meeting of the WTO Committee on Trade and the Environment (CTE) focused mainly on environmental requirements and market access issues, particularly standards in organic agriculture. During the brief meeting on 2 May, 2007, many Members said they saw organic standards as an opportunity, but also recognised the difficulties sometimes faced by developing countries in particular in achieving conformity with organic standards. Discussions, according to one trade source, took place in a ‘solutions-oriented’ mode. The WTO secretariat provided an informal document containing a list of environmental impact assessments of trade liberalization under multilateral, regional and bilateral initiatives being carried out in a number of developing countries. The document was submitted to Members for comments, and will be further discussed in the future.
or adverse impacts of early EGS liberalization (Hamwey, 2005; Carpentier et al., 2005; Howse and van Bork, 2005; Alavi, 2007): despite the many interesting arguments provided in these studies, they consider a range of products that is too wide to allow a sound assessment of economic mechanisms.

Theoretical literature on trade and the environment has extensively explored the links between trade and environmental policy with important contributions in both a strategic- and a non-strategic trade framework. Indeed, the presence of externalities modifies the optimality of policy instruments. The scale (global, transboundary or local pollution) and the source (consumption/production) of the externality, and also the size (large/ small countries) and the status of trade partners (net exporting/ importing countries) constrain the optimal policy choice.

When countries have no influence on world prices (small country assumption), free trade is always the first-best solution if paired with the appropriate environmental policy instrument (Krutilla, 1991). However, trade policy may become a second-best solution when it is not possible to implement an optimal regulation (e.g. a Pigouvian tax) aimed at internalizing environmental damages (Anderson, 1992; Krutilla, 1999; Gozlan and Ramos, 2006). For example, when a country is harmed by transboundary emissions generated by a trading partner, Copeland (1996) has demonstrated the optimality of a “pollution-content tariff” that taxes imports according to the pollution generated.

For large countries, the optimality of tariffs and environmental regulations is complicated by terms of trade effects (TOT), since their policies have an impact on world prices. Therefore, even when efficient environmental regulations are possible, a large importing country always has an incentive to set a non-zero tariff. Focusing on a bilateral production externality between two trading countries, Markusen (1975) has built on the idea that monopoly power in trade can influence foreign production. With a simple general equilibrium model, he compares a first-best policy menu (combining consumption taxes, production taxes, and import tariffs) with second-best policies (when one of the instruments is constrained): the optimal tariff differs under the first best and second best settings, reflecting the TOT consequences of the internalization of the domestic externality. However in both cases, the optimal tariff contains a positive term aimed at addressing foreign pollution, which does not depend upon the domestic environmental policy.

The TOT consequences of environmental policy have also been addressed in a partial equilibrium framework. In the absence of trade instruments (which can be constrained by multilateral negotiations), Krutilla (1991) shows that large countries have an incentive to distort their domestic environmental policy in order to improve their terms of trade: the optimal environmental tax is greater (lower) than the standard Pigouvian tax in the case of an exporting (importing)
country. This strategic over-internalization (under-internalization) mechanism is used by Kraus (2000) as the very definition of “Not in my backyard” (NIMBY) and eco-dumping strategies: eco-dumping then refers to the “environmental policy whose level (...) is lower than the Pigouvian tax because of open economy reasons” and NIMBY to a more stringent environmental regulation than optimal under autarky. Such unilateral policies may degenerate into an "environmental race towards the bottom" when countries retaliate, and thus reduce welfare for both partners (Rauscher, 1991, 1995).

Pigouvian taxes may not always be an available instrument for the domestic policy maker, due to political reasons or pressures. This is especially true when it comes to agriculture, where the strict implementation of the polluter-pays-principle should be translated e.g. into a tax on polluting inputs (fertilizers, pesticides...), while many European governments are reluctant to face farmers’ hostile reactions.6

Most related to our framework are the contributions of Krutilla (1991) (partial equilibrium model with trade a single polluting good), Kraus (2000) on eco-tariffs, i.e. “import tariffs levied on the goods whose PPM pollutes the environment”,7 and LeClair and Franceschi (2006), analyzing the rationale behind differential tariffs as a means to address externalities embedded in traded goods. The originality of our approach relies on the explicit modeling of an environmentally preferable substitute to the traded polluting good, which is valued by at least a fraction of consumers.8

The remainder of the paper is structured as follows. Section 2 presents the model. Section 3 describes the equilibrium conditions in the world market. Section 4 is devoted to the consequences of trade liberalization with large countries and compares an unselective tariff cut for the conventional variety and its green substitute (subsection 4.1) with selective tariff cuts for the environmentally preferable product (4.2). Section 5 considers the environmental and terms-of-trade consequences of an environmental tax in the exporting country, and section 6 concludes.

5“The outcome of inter-jurisdictional competition, when regulatory entities compete each other down to undesirably low levels of environmental regulation because some or all countries engage in eco-dumping” (Kraus, 2000)

6See Rauscher (1999) for a clear survey of economic mechanisms at stake on the interface between environmental and trade policies, including regulatory capture.

7Note that this possibility is not discussed under present EGS negotiations, even though this could be a way to discriminate among polluting and Environmentally preferable products.

8Moreover, we focus on the cut in ad valorem tariffs, while Krutilla chose specific tariffs. Specific tariffs simplify the expression of tariff revenue, but complicate the expressions of the derivatives of other surpluses.
2 The Model

Consider two countries (Bloc of countries): a large Northern country, ‘Home’ (e.g. the European Union), and a large Southern country, ‘Foreign’ (e.g. the Mercosur), and assume away the rest of world. Given the initial prices of inputs, Home is a net importer and Foreign a net exporter. We denote variables pertaining to Foreign by an asterisk (*). The main features of our analysis are (1) a partial equilibrium model with two substitutable goods: a conventional variety whose production causes local pollution, and an environmentally preferable variety that is valued by consumers in the Northern country; (2) perfect competition among producers, but international trade between large countries allowing for terms-of-trade effects; (3) classical policy instruments: tariffs (homogeneous vs. differentiated upon PPMs) and environmental taxes.

Consumers are able to distinguish between green and conventional goods without ambiguity (perfect labeling). In Home (the Northern country), they display preferences for the green product. Traditional assumptions are made about the utility function: increasing in each of its arguments, quasilinear and concave, with parameters such that products are imperfect substitutes and G preferred to C for the same price.

Let \( D_G(p_G, p_C) \) and \( D_C(p_G, p_C) \) represent the demand for green and conventional goods in the Northern country. In the Southern country, we assume that there is no demand for the Environmentally Preferable Product: the green product is an export commodity. Let \( D^*(p_C^*) \) represent the Southern demand of conventional goods.

In each country, green and conventional goods are produced in two distinct competitive sectors (hereafter G and C). Technologies do not differ from one country to another. Let \( f(x) = f(x_p, x_{\neg p}) \) be a production function of \( x \), a vector of inputs priced \( r \), where \( x_p \) is the subset of polluting inputs and \( x_{\neg p} \) is the subset of other “clean” factors (labor, non-polluting capital). \( f \) displays decreasing returns to scale. To make things simple we limit \( x_p \) to one single polluting input \( x_p \), priced \( r_p \). The conventional production process is characterized by a local negative production externality \( E(x_p) \), linked to the use of the dirty input. The environmental damage is an increasing function of the polluting input \( (E'(x_p) > 0) \). The green technology differs only by the additional constraint that the use of the polluting input \( x_p \) is exogenously set to zero. Both sectors (in both countries) are competitive and producers are price-takers.\(^{11}\)

\(^9\)This simplifying assumption will be discussed in the conclusion.

\(^{10}\)Similar results can be derived by assuming a simple threshold in the use of the polluting input (Gozlan and Ramos, 2006) for the green technology, but for expositional convenience we set \( x_p \) to zero. When looking for a specification of the production function -e.g. for simulations- the need to set the use of the \( x_p \) to zero may require a non-conventional form allowing the use of non-essential inputs (Just et al., 1982; Soloaga, 1999).

\(^{11}\)The possibility that producers switch from conventional to green production processes is not addressed here,
Denoting $y_C$ and $y_G$ the output of, respectively, conventional and green products, the profit maximization program of a representative producer in each sector is given by

$$\max_{y_C} \quad \pi_C = p_C \cdot y_C - r \cdot x$$
$$s.t. \quad y_C = f(x)$$

$$\max_{y_G} \quad \pi_G = p_G \cdot y_G - r - p \cdot x - p \cdot x_p = 0$$
$$s.t. \quad y_G = f(x - p; x_p = 0)$$

where $p_C$ and $p_G$ represent equilibrium prices of conventional and green outputs and $r$ is the vector of input prices.

Due to the additional constraint that $x_p = 0$ in the Green cost minimization program, its marginal cost is higher than in the conventional sector and thus, its supply function $S_G(p_G)$ is more inelastic than the conventional one, $S_C(p_C)$.

Let $T_E$ denote an environmental tax on the polluting input (initially set to zero). The dirty input demand schedule is determined by the equality of its private cost (including the environmental tax whenever implemented) and the value of its marginal product, that is, its marginal physical productivity valued at the world price. Therefore, producers will demand the polluting input in the domestic importing / foreign (∗) exporting countries until the marginal revenue for an additional unit of this input ($p_C \cdot \frac{\partial f(.)}{\partial x_p}$) equals its marginal cost, $(r + T_E)$.

Our initial assumption of $T_E = 0$ in the importing country is supported by the strategic underinternalization of the environmental damage when trade policy is constrained by negotiations. When the government cannot increase tariffs in order to improve its terms of trade, lowering environmental taxes is optimal.

3 Trade

Both countries (bloc of countries) are engaged into trade negotiations aimed at reducing tariffs. Following the empirical evidence, developed countries tend to have a high level of protection in agricultural products (tariff picks), while many developing countries protect relatively more industrialized products. According to this specification of their tariff structures, a trade liberalization will improve access conditions in developing markets for industrialized sectors in developed countries and vice-versa for agricultural sectors in developing countries. Considering a “green” tariff cut, developed countries will distort their patterns of trade, exporting ‘clean’

which could be the result of existing barriers to conversion in the short run (e.g. delay before a producer is entitled to use the “organic” label.)
technologies to developing countries and importing relatively more ‘sustainable’ agricultural products from developing countries.

Although in this paper we focus on the consequences of a trade liberalization scenario in agricultural (conventional and organic) products only, we keep in mind that developed countries will also benefit from reciprocal export gains in the sector of industrialized products.

Selective tariff cuts for environmentally preferable products would result in a lower tariff $\tau_G$ for the green product compared to the conventional substitute (remaining with an unchanged tariff $\tau_C=\tau$). However, it is also possible to reduce tariffs in a non selective manner. Further, we assume that the exporting country does not retaliate against the importing country.

By convention, equilibrium prices are expressed as domestic prices $p = (p_G, p_C)$, so the price received by foreign producers is $p_i/(1+\tau_i)$ where $i = G, C$ and $\tau_i$ is the tariff rate applied by Home on imports of $i$. Let $X_i(p_i)$ denote the export supply of product $i = G, C$ defined as the difference between foreign supply and foreign demand at each price level, and $M_i(p)$ the import demand defined as the difference between the domestic demand and the domestic supply at each price level. The equilibrium in the world market is characterized by the two following conditions:

$$X_G\left(\frac{p_G}{1+\tau_G}\right) = M_G(p) \quad (3)$$

$$X_C\left(\frac{p_C}{1+\tau_C}\right) = M_C(p) \quad (4)$$

Note that the import demand functions depend on the vector of prices $p$, where the substitution effect between varieties comes from the demand side in Home, while the export supply functions only depend on their own prices, due to our simplifying assumptions on demand in the Southern country.

The Southern country has an absolute advantage vis-à-vis the Northern country in the production of all varieties, and comparative advantage in the “green” product: this is because the green technology requires a substitution of capital (polluting inputs) to labour and wages are lower in the Southern country.

To analyze the implications of trade and environmental policies, we totally differentiate the equilibrium conditions (3) and (4) with respect to the relevant policy variable.

4 Trade liberalization: selective vs. unselective tariff cuts

We first consider the consequences on domestic and foreign equilibrium prices of a uniform reduction in the (undifferentiated) tariff rate $\tau$, and then derive the environmental and welfare implications of such a ‘full’ liberalization scenario. This shall serve as a benchmark in order
to discuss the opportunity for large countries to negotiate tariff cuts upon the environmental characteristics of the production process.

4.1 Unselective tariff cuts

Let $\varepsilon_i > 0 \ (i = C, G)$ represent the price elasticity of the export supply function of product $i$, $\eta_{ii} < 0$ represent the own-price elasticity of import demand functions $M_i(\cdot)$, and $\eta_{ij}$, with $i \neq j$, the cross-price elasticity of import demands ($\eta_{ij} > 0$ since $i$ and $j$ are substitutes).

Lemma 1 Let $p^*_G$ (resp. $p^*_C$) and $p^*_G$ (resp. $p^*_C$) represent the equilibrium prices in the importing (resp. exporting) country.

- A cut in $\tau$ results in a decrease in domestic equilibrium prices under the following condition:

$$\frac{dp^*_G}{d\tau} = \frac{p_G(\tau)}{(1 + \tau)} \left[ \frac{\varepsilon_G(\varepsilon_C - \eta_{CC}) + \varepsilon_C\eta_{GC}}{\Delta} \right] > 0$$

(5)

$$\frac{dp^*_C}{d\tau} = \frac{p_C(\tau)}{(1 + \tau)} \left[ \frac{\varepsilon_C(\varepsilon_G - \eta_{GG}) + \varepsilon_G\eta_{CG}}{\Delta} \right] > 0$$

(6)

- A cut in $\tau$ results in an increase in foreign equilibrium prices under the following condition:

$$\frac{dp^*_G}{d\tau} = \frac{p_G(\tau)}{(1 + \tau)^2} \left[ \frac{\varepsilon_G(\eta_{GC} + \eta_{GG}) + \eta_{CG}\eta_{GC}}{\Delta} \right] < 0$$

(7)

$$\frac{dp^*_C}{d\tau} = \frac{p_C(\tau)}{(1 + \tau)^2} \left[ \frac{\varepsilon_C(\eta_{CC} + \eta_{CG}) + \eta_{CG}\eta_{GC}}{\Delta} \right] < 0$$

(8)

The sign of the own- and cross-price elasticities, and the fact that direct effects are greater than cross-price effects ($|\eta_{ii}| > |\eta_{ij}|$) ensure the validity of the signs derived above, where $\Delta = (\varepsilon_C - \eta_{CC})(\varepsilon_G - \eta_{GG}) - \eta_{CG}\eta_{GC} > 0$.

Fig.1 illustrates the impact of a unselective tariff cut in both markets (green and conventional equilibria expressed in terms of domestic prices).

[INSERT FIGURE 1 and 2]

The interpretation is straightforward: a cut in $\tau$ results (i) in a shift (increase) in both export supply curves, lowering equilibrium prices $p_C$ and $p_G$. (ii) The decrease in $p_i$ has a downward shifting effect on the import demand curve $M_j(p_G, p_C)$, which further decreases domestic prices. Conversely, the increase in foreign prices $p_i^* = \frac{p_i}{1 + \tau}$ is the expected terms-of-trade improvement resulting from a lower tariff in the large importing country. The shift in the import demand
functions when equilibrium is derived in terms of world prices (Foreign markets for \(C\) and \(G\)) is depicted in fig. 2.

In other words, variations in prices resulting from changes in the undifferentiated tariff have the same sign than in the single-product market treated in the literature, but the magnitude of price variations is greater due to the substitution effects from the demand functions.

Let’s turn to the welfare implications of unselective tariff cuts. Let \(W = V(p_G, p_C) + PS_C + PS_G - E(p_C) + TR\) represent the domestic welfare function, where \(V(p_G, p_C)\) is the indirect utility function of consumers, \(PS_i = \int_0^{p_i} S_i(p_i) dp_i\) represents the surplus of producers of good \(i (i = G, C)\), \(E(p_C)\) is the externality and \(TR = \frac{\tau}{1 + \tau}[p_C M_C(p_G, p_C) + p_G M_G(p_G, p_C)]\) is the tariff revenue from the undifferentiated ad valorem tariff,\(\tau\). Similarly, foreign welfare is \(W^* = CS^*(p_C^*) + PS_C^* + PS_G^* - E^*(p_C^*)\) where the expression of consumer surplus is simply \(CS^* = \int_{p_C^*}^{\infty} D_C^*(p_C^*) dp_C^*\), because the green product is not consumed in the South. Let us start by totally differentiating each term in \(W\) and \(W^*\) with respect to \(\tau\).

Using Roy’s Identity and the quasilinearity of the domestic utility function, gives the following variation in domestic consumers’ surplus:

\[
\frac{dV(p_G, p_C)}{d\tau} = -D_G(p_G, p_C).\frac{dp_G}{d\tau} - D_C(p_G, p_C).\frac{dp_C}{d\tau}
\]

(9)

while for foreign consumers we have:

\[
\frac{dCS^*(p_C^*)}{d\tau} = -D^*(p_C^*).\frac{dp_C^*}{d\tau}
\]

(10)

The variation of domestic and foreign producer surplus in each market \(i = C, G\) is:

\[
\frac{dPS_i}{d\tau} = S_i(p_i).\frac{dp_i}{d\tau}
\]

(11)

\[
\frac{dPS_i^*}{d\tau} = S_i^*(p_i^*).\frac{dp_i^*}{d\tau}
\]

(12)

The variation in domestic and foreign environmental costs can be decomposed as follows:

\[
\frac{dE(p_C)}{d\tau} = \frac{\partial E}{\partial S_C} \frac{\partial S_C}{\partial p_C} \frac{dp_C}{d\tau} \quad \text{and} \quad \frac{dE^*(p_C^*)}{d\tau} = \frac{\partial E^*}{\partial S_C^*} \frac{\partial S_C^*}{\partial p_C^*} \frac{dp_C^*}{d\tau}
\]

(13)

(14)

where \(\frac{\partial E}{\partial S_C} = \frac{\partial E}{\partial x_p} \frac{\partial x_p}{\partial p_C} > 0\) is the marginal environmental damage. Finally, the tariff revenue in Home varies as follows:

\[
\frac{dT R}{d\tau} = p_C M_C + p_G M_G + \frac{dp_C}{d\tau} \left[ a_C M_C + \frac{\tau}{1 + \tau} p_G \frac{\partial M_G}{\partial p_C} \right] + \frac{dp_G}{d\tau} \left[ a_G M_G + \frac{\tau}{1 + \tau} p_C \frac{\partial M_C}{\partial p_G} \right]
\]

(15)

where \(a_C = \frac{\tau}{(1 + \tau)}(1 + \eta_{CC})\) and \(a_G = \frac{\tau}{(1 + \tau)}(1 + \eta_{GG})\).

From the sign of the price variations given in Lemma 1, it is easy to derive the following proposition:
Proposition 1 Unselective tariff cuts for both conventional and green products result in:

- a decrease in domestic pollution and an increase in foreign pollution;
- a decrease in Home producers’/ an increase in Foreign producers’ profits;
- an increase in domestic consumption of C and G and consumers surplus / a loss in foreign consumers’ surplus;
- a loss in domestic tariff revenue.\(^{12}\)

Since a cut in \(\tau\) results in a lower domestic price for the conventional product, the domestic polluting production decreases while imports and consumption of \(C\) increase. Domestic producers of \(C\) and \(G\) suffer from lower domestic prices, tariff revenues decrease, while consumers benefit.

The net effect on domestic welfare depends upon the initial level of protection. Rearranging the sum of the variations in surpluses derived above, it is possible to express the variation in welfare as follows:

\[
\frac{dW}{d\tau} = \frac{dT R}{d\tau} - M_G(p_G,p_C)\frac{dp_G}{d\tau} - M_C(p_G,p_C)\frac{dp_C}{d\tau} - \frac{\partial E}{\partial p_C}\frac{dp_C}{d\tau} \tag{16}
\]

where the first term is the change in tariff revenue, the second and the third terms reflect effects of the tariff variation on imports of both commodities, and the last term reflects its environmental consequences.

Substituting the change in tariff revenue given in eq. (15) and rearranging the expression of \(dW\) yields:

\[
\frac{dW}{d\tau} = \frac{p_C M_C + p_G M_G}{(1 + \tau)^2} + \frac{dp_C}{d\tau} \left[ M_C(a_C - 1) - \frac{\partial E}{\partial p_C} + \frac{\tau}{1 + \tau} p_G \frac{dM_G}{dp_C} \right] + \frac{dp_G}{d\tau} \left[ M_G(a_G - 1) + \frac{\tau}{1 + \tau} p_C \frac{dM_C}{dp_G} \right] \tag{17}
\]

The first term in this expression is positive, as well as the derivatives of prices with respect to \(\tau\). The sign of the welfare variations varies with \(\tau\) and the threshold value such that (17) is zero (optimal tariff) depends on the values of the terms between the brackets. It is easy to see that \((a_C - 1) < 0\) and \((a_G - 1) < 0\), \(-\frac{\partial E}{\partial p_C} < 0\) while the cross-price derivatives of the import

\(^{12}\)Provided that the initial tariff rate was not greater than the optimal tariff, which would be surprising for rational governments participating in multilateral trade negotiations.
demand functions are positive. In the absence of externalities and without cross-price effects, this expression would reduce to

\[
\frac{dW}{d\tau} = \frac{p_C M_C + p_G M_G}{(1 + \tau)^2} + \frac{dp_C}{d\tau} \left[ M_C(a_C - 1) \right] + \frac{dp_G}{d\tau} \left[ M_G(a_G - 1) \right]
\]

(18)

This shows that (i) the negative externality of the production process lowers the optimal tariff since there is a benefit to substitute polluting domestic production for imports while (ii) the existence of cross-price effects tend to increase the optimal tariff.\(^\text{13}\)

In the Southern country (foreign), exporters of both varieties benefit from higher prices and supply increases, resulting in a higher pollution. Consumers suffer from the increase in \(p^*_C\) and still won’t consume the ‘green’ variety since its price increases further. The net welfare effect of a full liberalization in Foreign simplifies to the following expression:

\[
\frac{dW^*}{d\tau} = \frac{dp^*_G}{d\tau} X_G(p_G) + \frac{dp^*_C}{d\tau} \left[ X_C(p_C) - \frac{\partial E^*}{\partial p^*_C} \right]
\]

(19)

From Lemma 1, the derivatives of foreign prices with respect to \(\tau\) are negative, while from our assumptions about the conventional technology, external costs increase with conventional prices. Equation (19) shows that the benefits from trade liberalization in Foreign are reduced due to the increase in the (uninternalized) local pollution.

The global impact of a full liberalization on the welfare of Home and Foreign depends on the relative magnitude of the effects described above (Equations 17 and 19), and shall be discussed later.

4.2 Selective tariff cuts for EPPs

We now turn the impact of a selective tariff cut for the green product, holding the tariff on the conventional product \(\tau_C = \tau\) unchanged at its initial level. Totally differentiating the equilibrium conditions with respect to \(\tau_G\) leads to the following lemma in the neighborhood of the equilibrium:

**Lemma 2** • A variation in \(\tau_G\) affects the domestic prices \(p_G\) and \(p_C\) as follows:

\[
\frac{dp^*_G(\tau_G)}{d\tau_G} = \frac{p_G(\tau_G)}{(1 + \tau_G)} \left[ \frac{\varepsilon_G(\varepsilon_C - \eta CC)}{\Delta} \right] > 0
\]

(20)

\(^{13}\)Although countries participating in multilateral negotiations do not set import tariffs such that their domestic welfare is maximized, the level of the optimal tariff is interesting for comparisons.
\[
\frac{dp^*_C(\tau_G)}{d\tau_G} = \frac{p_G(\tau_G)}{(1 + \tau_G)^2} \left[ \frac{\eta_G(\varepsilon_C - \eta_CC) + \eta.CG\eta_GC}{\Delta} \right] < 0
\]  

(22)

\[
\frac{dp_C^*(\tau_G)}{d\tau_G} = \frac{p_C}{(1 + \tau_C)(1 + \tau_G)} \left[ \frac{\varepsilon_G CG}{\Delta} \right] > 0
\]  

(23)

In other words, a selective tariff cut for the Environmentally Preferable Product -holding constant the tariff on the polluting good- decreases the domestic prices for both varieties. The decrease in \(p_C\) comes from a substitution in the domestic consumption pattern.

World prices react differently to a cut in \(\tau_G\): while the foreign price for the EPPs increases, the foreign price of the conventional variety \(p^*_C = \frac{p_C}{1 + \tau_C}\) decreases, due to the reduction in the domestic price while holding \(\tau_C\) constant.

Let’s turn to the welfare implications of selective tariff cuts, and differentiate the surpluses with respect to \(\tau_G\).

The variation in domestic consumer surplus becomes:

\[
\frac{dV(p_G, p_C)}{d\tau_G} = -D_G(p_G, p_C). \frac{dp_G}{d\tau_G} - D_C(p_G, p_C). \frac{dp_C}{d\tau_G}
\]  

(24)

while for foreign consumers we have:

\[
\frac{dCS^*(p^*_C)}{d\tau_G} = -D^*(p_C). \frac{dp^*_C}{d\tau_G}
\]  

(25)

The variation of domestic and foreign producer surplus in each market writes:

\[
\frac{dPS_i}{d\tau_G} = S_i(p_i). \frac{dp_i}{d\tau_G}
\]  

(26)

\[
\frac{dPS^*_i}{d\tau_G} = S_i^*(p^*_i). \frac{dp^*_i}{d\tau_G}
\]  

(27)

Similarly, variations in domestic and foreign environmental costs are:

\[
\frac{dE(p_C)}{d\tau_G} = \frac{\partial E}{\partial p_C}. \frac{dp_C}{d\tau_G}
\]  

(28)

\[
\frac{dE^*(p^*_C)}{d\tau_G} = \frac{\partial E^*}{\partial p_C^*}. \frac{dp^*_C}{d\tau_G}
\]  

(29)

Finally, the tariff revenue in Home varies as follows:

\[
\frac{dTR}{d\tau_G} = \frac{p_G M_G}{(1 + \tau_G)^2} + \frac{dp_C}{d\tau_G} \left[ \alpha_G M_C + \frac{\tau_G}{1 + \tau_C} p_G M_G \frac{dM_G}{dp_C} \right] + \\
\frac{dp_G}{d\tau_G} \left[ \alpha_G M_G + \frac{\tau_C}{1 + \tau_C} p_C M_C \frac{dM_C}{dp_G} \right]
\]  

(30)
where \( \alpha_C = \frac{\tau_C}{1 + \tau_C} (1 + \eta_{CC}) \) and \( \alpha_G = \frac{\tau_G}{1 + \tau_G} (1 + \eta_{GG}) \). From the sign of the price variations given in Lemma 2, it is easy to derive the following proposition:

**Proposition 2** Selective tariff cuts for green products result in:

- a decrease in pollution in Home and in Foreign;
- an increase in consumer surpluses in Home and in Foreign;
- a decrease in conventional producers’ profits in Home and Foreign;
- a decrease in profits of green domestic producers / increase in profits of green foreign producers.

[INSERT FIGURES 3 and 4]

In other words, a selective tariff cut for EPPs makes it possible to reduce the environmental damage in both countries, because the conventional production in both countries decreases through substitution effects from the demand side in Home (see fig.3). It lowers domestic profits in both sectors and conventional profits in Foreign. Profits, production and exports only increase in the green foreign sector. Consumers in both countries, according to their pattern of consumption,\(^{14}\) benefit from the reduction in prices.

The net welfare impact on Home is found by summing up the previous surplus derivatives and reduces to \( \frac{dW}{d\tau_G} = \frac{dTR}{d\tau_G} - \frac{dp_G}{d\tau_G} M_G(p_G, p_C) - \frac{dp_C}{d\tau_G} [M_C(p_G, p_C) + \partial E / \partial p_C] \). Substituting the expression of \( \frac{dTR}{d\tau_G} \) given in (30) and rearranging:

\[
\frac{dW}{d\tau_G} = \frac{p_G M_G}{(1 + \tau_G)^2} + \frac{dp_C}{d\tau_G} [M_C(\alpha_C - 1) - \frac{\partial E}{\partial p_C} + \frac{\tau_C}{1 + \tau_C} p_C \frac{dM_C}{dp_C}] + \frac{dp_G}{d\tau_G} [M_G(\alpha_G - 1) + \frac{\tau_G}{1 + \tau_G} p_G \frac{dM_G}{dp_G}] \tag{31}
\]

leading to similar conclusions than previously, but with a different magnitude of price variations.

In the Southern country, the net welfare variation under selective tariff cuts writes:

\[
\frac{dW^*}{d\tau_G} = \frac{dp_G^*}{d\tau_G} X_G(p_G) + \frac{dp_C^*}{d\tau_G} X_C(p_C). - \frac{\partial E^*}{\partial p_C^*} \tag{32}
\]

\(^{14}\)This is due to our assumption that there is no demand for green products in the southern country.
From Proposition 2, exporters of the green variety benefit from higher prices and supply increases, consumers and the environment benefit from the decrease in $p^*_C$, while conventional producers lose. In other words, Foreign enjoys traditional gains from trade in the green market, while the net effects on the conventional market depend on the relative magnitude of producers’ losses, consumers’ gains and environmental benefits.

4.3 Discussion

Propositions 1 and 2 show that cutting tariffs upon the environmental characteristics of the PPMs has important implications in terms of the distribution of welfare gains and losses, as compared to unselective tariff cuts.

This results from differences in the sign and the magnitude of price variations under each liberalization scenario (Lemma 1 and 2), which can be resumed as follows:

1. $p^*_C$ decreases under a “green” liberalization scenario, but increases under a “full” liberalization scenario (resulting in a different distribution of benefits);

2. Under both scenarios, $p^*_G$ increases while domestic prices decrease;

3. The effect of unselective tariff cuts is unambiguously stronger on both domestic and foreign prices, as direct- and cross-price effects add up (amplifying the magnitude of gains and losses for those variable varying in the same directions under both scenarios).

The last point can be easily seen by comparing, for example, the variations in the green domestic price. The decrease in $p_G$ under a full liberalization scenario consists of two terms (eq. 5), one accounting for the own-prices effects, the second accounting for the cross-price effect $\varepsilon_C \eta_{GC}$, that is, the further decrease in the green price resulting from the decrease in the price of its polluting substitute. Under a “green” liberalization scenario (eq. 20), this second effect vanishes.

The distribution of benefits from selective tariff cuts for the EPP is interesting, since it allows for an improvement in consumer surpluses and in the environment in both Home and Foreign. However, the gains to domestic consumers and the environment in Home would be greater under a full liberalization scenario, and whether these greater gains would more than offset foreign losses is ambiguous, depending on the own and cross-price elasticities of the demand functions and on the price elasticity of the demand for the polluting input in each country (comparative statics are provided in the appendix).

Conversely, a full trade liberalization leads to a greater terms-of-trade deterioration (improvement) for Home (Foreign).
Let’s turn to the comparison of the variation in domestic welfare under selective (eq. 31) and unselective tariff cuts (eq.17). Starting from the same initial equilibrium (with $\tau_C = \tau_G = \tau$) and assuming that this initial tariff is not greater than the optimal tariff, we get:

$$\frac{dW}{d\tau} - \frac{dW}{d\tau_G} \bigg|_{\tau_G = \tau} = \frac{p_C M_C}{(1 + \tau)^2} 
+ \left[ \frac{dp_C}{d\tau} - \frac{dp_C}{d\tau_G} \right] \left[ M_C (a_C - 1) - \frac{\partial E}{\partial p_C} + \frac{\tau}{1 + \tau p_C} \frac{dM_G}{dp_C} \right] 
+ \left[ \frac{dp_G}{d\tau} - \frac{dp_G}{d\tau_G} \right] \left[ M_G (a_G - 1) + \frac{\tau}{1 + \tau p_G} \frac{dM_C}{dp_G} \right]$$

(33)

where the differences between price variations are positive. In other words, if the initial tariff was below the optimal tariff, the magnitude of the domestic welfare losses is likely to be greater under a full liberalization scenario, depending on whether the greater loss from the deterioration in terms of trade can be offset by the greater environmental benefits.

For the Southern country, the comparison of the net welfare variations under both liberalization scenarios is also ambiguous - unselective tariff cuts allowing higher traditional gains from trade, while green tariff cuts provide a different distribution of gains from trade and the environment.

5 Environmental Policy in the exporting country

In the previous section, we have assumed away the possibility that countries could address externalities and terms of trade issues by implementing an environmental policy. This was supported by the empirical evidence in many Northern countries that governments are reluctant to increase producers’ production costs, and that environmental taxes are still unfrequent in Southern countries. Moreover, the theoretical arguments from the trade-and-environment literature suggest that large importing countries have an incentive to underinternalize environmental damages in order to improve their terms of trade. However, as large exporting countries have an incentive to overinternalize damages for strategic reasons, it is interesting to analyze the impacts of an environmental policy in the Southern country, in order to discuss the rationale for Foreign to rely on multilateral negotiations on environmental goods to improve its welfare, when environmental policy is an available tool.

Let $\varepsilon_{CTE} < 0$ represent the elasticity of the foreign export supply function for conventional products with respect to the level of tax on the polluting input.

**Lemma 3** A tax on the polluting input implemented if Foreign $T^*_E$ results in an increase in domestic equilibrium prices. In the neighborhood of the equilibrium, caeteris paribus we
get:

\[
\frac{dp^e_C(T^*_E)}{dT^*_E} = -\frac{pc}{T^*_E} \left[ \frac{\varepsilon CT^*_E (\varepsilon G - \eta GG)}{\Delta} \right] > 0
\] (34)

\[
\frac{dp^e_G(T^*_E)}{dT^*_E} = -\frac{pg}{T^*_E} \left[ \frac{\varepsilon CT^*_E (\varepsilon G - \eta GG)}{\Delta} \right] > 0
\] (35)

- A tax on the polluting input implemented in Foreign increases the foreign equilibrium prices as follows:

\[
\frac{dp^*_C(T^*_E)}{dT^*_E} = -\frac{pc}{(1 + \tau T^*_E)T^*_E} \left[ \frac{\varepsilon CT^*_E (\varepsilon G - \eta GG)}{\Delta} \right] > 0
\] (36)

\[
\frac{dp^*_G(T^*_E)}{dT^*_E} = -\frac{pg}{(1 + \tau T^*_E)T^*_E} \left[ \frac{\varepsilon CT^*_E \eta GC}{\Delta} \right] > 0
\] (37)

The impact of a foreign tax on the polluting input on Home (for a given level of the import tariff \(\tau\)) is depicted on figure 5. The environmental tax shifts the export supply of the conventional good downwards, resulting in an increase in its domestic price \(p^*_C\), which in turn results in an upward shift of the demand function for the green substitute, resulting in an increase in \(p^*_G\) as well. Fig. 6 displays the mechanism on the foreign conventional market.

[INSERT FIGURES 5 and 6]

As the tariff remains unchanged, the foreign price \(p^*_G\) increases due to the increase in \(p^*_G\).

The welfare implications are, again, highlighted by differentiating domestic and foreign surpluses with respect to \(T^*_E\).

The variations in consumers surpluses, domestic producer surpluses and foreign ‘green’ producer surpluses remain formally similar to variations resulting from tariff changes, since the only impact on these agents is through variations in (domestic or world) prices:

\[
\frac{dV(p_G, p_C)}{dT^*_E} = -D_G(p_G, p_C) \cdot \frac{dp_G}{dT^*_E} - D_C(p_G, p_C) \cdot \frac{dp_C}{dT^*_E}
\] (38)

and in Foreign:

\[
\frac{dCS^*(p^*_C)}{dT^*_E} = -D^*(p_C) \cdot \frac{dp^*_C}{dT^*_E}
\] (39)

For domestic producers of both varieties and “green” producers in Foreign:

\[
\frac{dPS_i}{dT^*_E} = S_i(p_i) \frac{dp_i}{dT^*_E}
\] (40)

\[
\frac{dPS^*_G}{dT^*_E} = S^*_G(p^*_G) \frac{dp^*_G}{dT^*_E}
\] (41)

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However the change in conventional producers surplus in Foreign results both from the
increase in the price of the polluting input, and from the subsequent change in the price of the
conventional output:

$$\frac{dPS^*_C}{dT^*_E} = S^*_C(p^*_C), \frac{dp^*_C}{dT^*_E} + \frac{\varepsilon C}{T^*_E} \int_0^{p^*_E} S^*_C(p^*_C) dp_C$$

(42)

Similarly, while variations in domestic environmental costs result only from changes in prices,
in Foreign it also depends upon the tax-elasticity of the supply function:

$$\frac{dE^*(p_C)}{dT^*_E} = \frac{\partial E}{\partial p_C} \frac{dp_C}{dT^*_E}$$

(43)

$$\frac{dE^*(p^*_C)}{dT^*_E} = \frac{\partial E^*}{\partial p^*_C} \left[ \frac{dp^*_C}{dT^*_E} + S^*_C(p^*_C) \frac{\varepsilon C}{T^*_E} \right]$$

(44)

The tariff revenue in Home is influenced by the changes in prices resulting from the tax in
Foreign:

$$\frac{dTR}{dT^*_E} = \frac{dp_C}{dT^*_E} \left[ a_C M_C + \frac{\tau}{1 + \tau} p_G \frac{dM_G}{dp_C} \right] + \frac{dp_G}{dT^*_E} \left[ a_G M_G + \frac{\tau}{1 + \tau} p_C \frac{dM_C}{dp_G} \right]$$

(45)

where $a_C$ and $a_G$ have been defined in section 4.1. Eventually, the Environmental tax revenues
ETR collected in Foreign vary as follows with respect to the level of the tax:

$$\frac{dETR}{dT^*_E} = x^*_p(p^*_C) + T^*_E \left[ \frac{dx^*_p}{dT^*_E} + \frac{dx^*_p}{dp^*_C} \frac{dp^*_C}{dT^*_E} \right]$$

(46)

where $x^*_p(p^*_C)$ represents the derived demand for the polluting input in Foreign. From lemma 3,
we are able to derive the following proposition:

**Proposition 3** An foreign environmental tax on the polluting input results in:

- a decrease in pollution in Foreign but an increase in pollution in Home;
- a decrease in consumer surpluses in Home and in Foreign;
- a increase in green producers’ profits in Home and Foreign;
- a increase in conventional producer’s profits in Home / an ambiguous effect on foreign
  conventional producers.

In other words, a positive environmental tax on the polluting input in the foreign country
improves the environmental conditions in Foreign because of a shift in the conventional supply
function, while the green supply increases (via the substitution effect on the domestic demand side). However, the environmental damage increases in the domestic country due to higher domestic prices. As a consequence of the increase in domestic and foreign prices, consumers surpluses decrease in both countries. Conventional consumption in Home and Foreign decreases, while the demand of green increases in Home because of the change in relative prices. This change in the relative prices leads to an increase in green trade while the conventional trade decreases. However, we have to highlight that the positive variation in green trade flows does not compensate the decrease in the conventional one.

5.1 Discussion

It is interesting to compare, from the Southern (exporting) country’s viewpoint, the welfare implications of a domestic environmental policy with the consequences of trade liberalization scenarios. Indeed an environmental tax reduces its pollution while improving its terms of trade (because the shrinking of its conventional supply and exports results in an increase in both conventional and green world prices), reinforcing its “green exporting capacities”. These objectives are precisely the point put forward in the debates on the opportunity to extend current EGS negotiations to EPPs of interest for developing countries (organic products).

Table 6 summarizes the magnitude and the direction of surplus variations under the three policy scenarios described in propositions.

[INSERT TABLE 6]

The comparison of the magnitude of price variations under trade- and environmental policy changes is not immediate as it depends on the respective levels of tariffs and taxes. Therefore whenever needed, we discuss price effects assuming an \textit{ad valorem} tax-equivalent of $T^*_E$ equal to $\tau$.

1. The improvement in green exporting capacities of Foreign is greater under selective tariff cuts for the EPP than under an environmental policy, because the latter does only result from cross-price effects; however a full liberalization would perform even better.

2. The pollution in Foreign decreases under both selective tariff cuts and an environmental policy; the comparison of the net effect depends on the tax-elasticity of the demand for the polluting input. A full liberalization would result in a dramatic increase in environmental damages in Foreign.

3. Foreign consumers are hurt by the increase in $p^*_C$ resulting either from a tax on the polluting input or from a full liberalization; this loss is likely to be greater under a full liberalization.
because direct and cross-price effects add up. This loss does not occur under a green liberalization scenario.

These results suggest that it could be rational for developing countries to insist on the inclusion of agricultural EPPs in the list of environmental goods eligible for selective tariff cuts under the present WTO negotiations, even when environmental policy is an available instrument.

Among the three policy scenarios considered in this paper, the “green” liberalization is the only one resulting in an improvement in environmental conditions and consumer surpluses in both countries. It also avoids a too harsh deterioration of the terms of trade for the importing country. However its net overall welfare implications are ambiguous: focusing on EU-Mercosur trade in organic and conventional products, it would be interesting to calibrate the model for a specific commodity in order to determine which effect would prevail.

6 CONCLUSION

In this paper we had two distinct objectives: (i) to model explicitly the consequences of trade and environmental policy in partial equilibrium when, in addition to the externality-generating good, there is an environmentally preferable substitute and (ii) to shed some light on the current WTO negotiations on environmental goods liberalization, focusing on the group of Environmentally Preferable Products for which developing countries could have a comparative advantage.

Many simplifying assumptions have been made necessary, among which the fact that there is no demand for green products in the Southern country. While this may be consistent with empirical observations, and allows to link the green and conventional markets in a simple manner -through the demand functions of the sole importing country, we ought to clarify under which conditions trade policy might modify the relative prices faced by foreign consumers in a way that would challenge this assumption.

The definition of an “environmentally preferable product” that we used -an exogenous constraint on the use of the polluting input- also deserves a deeper analysis. Indeed, this definition is an environmental standard and it could work as a non-tariff barrier for trade. Even if developing countries could benefit from selective tariff cuts for environmentally preferable products, our analysis overlooked an important issue about the mutual recognition of “environmentally preferable” production processes: in a large part, this is a traditional certification issue, which raises concerns about the ability of Northern countries to use green labels in a protectionist manner.
References


**Figures and Tables**
Table 1: Impacts of Trade and Environmental Policy changes

<table>
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Figure 1: Home effects of unselective tariff cuts
Figure 2: Foreign effects of unselective tariff cuts

Figure 3: Home effects of ‘green’ tariff cuts

Figure 4: Foreign effects of ‘green’ tariff cuts
Figure 5: Home effects of a Foreign environmental tax

Figure 6: Unselective tariff cut: foreign prices
Appendix

Comparative statics

In order to express the variations in supply and demand functions in terms of elasticities, we totally differentiate them with respect to the relevant policy variable, and rearrange after substituting the values of price derivatives calculated in Lemma 1, 2, and 3.

Since these comparative statics require the introduction of new price elasticities for supply and demand functions, by convention we add a superscript denoting the function being derived (e.g. $\varepsilon^X_C$ and $\varepsilon^S^*_C$ resp. for the conventional export supply and the foreign supply of $C$).

Unselective tariff cuts

- The transmission of changes in export prices to foreign supply functions depends on their own price elasticity of supply:

  \[
  \frac{dS^*_C}{d\tau} = S^*_C(\cdot) \varepsilon^*_C \left[ \frac{\varepsilon^X_G (\eta^M_{CC} + \varepsilon^M_{CG}) + \eta^M_{GC} \varepsilon^M_{CG}}{\Delta} \right] < 0 \tag{47}
  \]

  \[
  \frac{dS^*_G}{d\tau} = S^*_G(\cdot) \varepsilon^*_G \left[ \frac{\varepsilon^X_C (\eta^M_{GC} + \varepsilon^M_{CG}) + \eta^M_{GC} \varepsilon^M_{CG}}{\Delta} \right] < 0 \tag{48}
  \]

- The same is reciprocally true in the case of domestic supply functions:

  \[
  \frac{dS_C}{d\tau} = S_C(\cdot) \varepsilon^*_C \left[ \frac{\varepsilon^X_C (\varepsilon^X_G - \eta^M_{CG}) + \varepsilon^X_G \eta^M_{CG}}{\Delta} \right] > 0 \tag{49}
  \]

  \[
  \frac{dS_G}{d\tau} = S_G(\cdot) \varepsilon^*_G \left[ \frac{\varepsilon^X_G (\varepsilon^X_C - \eta^M_{CC}) + \varepsilon^X_C \eta^M_{CG}}{\Delta} \right] > 0 \tag{50}
  \]

- The impact of changes in export prices on foreign levels of consumption depends on the price elasticity of demand:

  \[
  \frac{dD^*_C}{d\tau} = D^*_C(\cdot) \eta^D_C \left[ \frac{\varepsilon^X_C (\eta^M_{CC} + \varepsilon^M_{CG}) + \eta^M_{GC} \varepsilon^M_{CG}}{\Delta} \right] > 0 \tag{51}
  \]

- On the demand side in Home, own-price effects and cross-price effects add up:

  \[
  \frac{dD_C}{d\tau} = D_C(\cdot) \eta^D_C \left[ \frac{\varepsilon^X_C (\varepsilon^X_G - \eta^M_{CG}) + \varepsilon^X_G \eta^M_{CG}}{\Delta} \right] < 0 \tag{52}
  \]
\[ \frac{dD_G}{d\tau} = \frac{D_G}{1 + \tau} \eta_{GG}\frac{\varepsilon_G\varepsilon_X - \eta_{CC}}{\Delta} + \varepsilon_X\eta_{MC} + \eta_{GC}\frac{\varepsilon_G\varepsilon_X - \eta_{GG}}{\Delta} + \varepsilon_X\eta_{MC} < 0 \tag{53} \]

- The effect on domestic demands and domestic supplies reflects the impact on the import demand function. An unselective cut in tariff results in an increase in both import demand functions:

\[
\frac{dM_G(p_G,p_C)}{d\tau} = \frac{M_G}{1 + \tau} \varepsilon_G\frac{\eta_{CC}(\varepsilon_G - \eta_{GG}) + \eta_{GC}(\varepsilon_G + \eta_{GC})}{\Delta} < 0 \tag{54} \\
\frac{dM_C(p_G,p_C)}{d\tau} = \frac{M_G}{1 + \tau} \varepsilon_G\frac{\eta_{CC}(\varepsilon_G - \eta_{GG}) + \eta_{GC}(\varepsilon_G + \eta_{GC})}{\Delta} < 0 \tag{55} 
\]

- Variations in export supplies are found using comparative static for the foreign supply and demand functions.

When the undifferentiated tariff reduces the export supply increases due to the positive effect on export prices, as we can see in the following comparative statics:

\[
\frac{dX_C(p_{GC}(1+\tau))}{d\tau} = \frac{X_C}{1 + \tau} \varepsilon_G\frac{\eta_{GC}(\varepsilon_G + \eta_{GC}) + \eta_{GC}(\varepsilon_G + \eta_{GC})}{\Delta} < 0 \tag{56} \\
\frac{dX_G(p_{GC}(1+\tau))}{d\tau} = \frac{X_G}{1 + \tau} \varepsilon_G\frac{\eta_{GC}(\varepsilon_G + \eta_{GC}) + \eta_{GC}(\varepsilon_G + \eta_{GC})}{\Delta} < 0 \tag{57} 
\]

Under an undifferentiated tariff reduction both import prices reduces and export prices increases. The effect on prices are transmitted to the demand and supply functions depending on their (own- and cross-) price elasticities.

**Selective tariff cuts for EEPs**

- When the importer country differentiates tariff according to the PPMs, a preferential tariff reduction for EPPs leads to an increase (decrease) in Green (Conventional) trade.

- On the supply side

Under a selective tariff cut on EPPs the conventional supply reduces while the green supply increases.
\[ \frac{dS^*_c}{d\tau_G} = \frac{S^*_c(\cdot)}{1 + \tau_G} \epsilon^{\cdot \cdot}_C \left[ \frac{\epsilon_{\cdot \cdot}^{X \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot}}{\Delta} \right] > 0 \] (58)

\[ \frac{dS^*_G}{d\tau_G} = \frac{S^*_G(\cdot)}{1 + \tau_G} \epsilon^{\cdot \cdot}_G \left[ \frac{\eta_{\cdot \cdot \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot}}{\Delta} \right] < 0 \] (59)

In contrast, both conventional and green production increases in the domestic country as a consequence of the increase in their domestic prices.

\[ \frac{dS^*_c}{d\tau_G} = \frac{S^*_c(\cdot)}{1 + \tau_G} \epsilon^{\cdot \cdot}_C \left[ \frac{\epsilon_{\cdot \cdot}^{X \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot}}{\Delta} \right] > 0 \] (60)

\[ \frac{dS^*_G}{d\tau_G} = \frac{S^*_G(\cdot)}{1 + \tau_G} \epsilon^{\cdot \cdot}_G \left[ \frac{\epsilon_{\cdot \cdot}^{X \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot}}{\Delta} \right] > 0 \] (61)

• On the demand side

Foreign demand of conventional product increases under a selective tariff cut on green commodities. This effect is possible though the cross-price effect in the international market.

\[ \frac{dD^*_c}{d\tau_G} = \frac{D^*_c(\cdot)}{1 + \tau_G} \eta_{\cdot \cdot \cdot \cdot} \left[ \frac{\epsilon_{\cdot \cdot}^{X \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot}}{\Delta} \right] < 0 \] (62)

Domestic demand on the conventional product decrease as a consequence of a selective tariff cut on green products, through a simple substitution effect.

\[ \frac{dD^*_C}{d\tau_G} = \frac{D^*_C(\cdot)}{1 + \tau_G} \eta_{\cdot \cdot \cdot \cdot} \left[ \frac{\epsilon_{\cdot \cdot}^{X \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot}}{\Delta} \right] > 0 \] (63)

\[ \frac{dD^*_G}{d\tau_G} = \frac{D^*_G(\cdot)}{1 + \tau_G} \eta_{\cdot \cdot \cdot \cdot} \left[ \frac{\epsilon_{\cdot \cdot}^{X \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot}}{\Delta} \right] < 0 \] (64)

• The impact on trade is:

\[ \frac{dM^*_G(p_G, p_C)}{d\tau_G} = \frac{M^*_G(\cdot)}{p_G(\tau_G)} \epsilon^{\cdot \cdot}_G \left[ \frac{\eta_{GG} \eta_{\cdot \cdot \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot}}{\Delta} \right] < 0 \] (65)

\[ \frac{dM^*_C(p_G, p_C)}{d\tau_G} = \frac{M^*_C(\cdot)}{(1 + \tau_G)} \epsilon^{\cdot \cdot}_G \left[ \frac{\eta_{CG} \eta_{\cdot \cdot \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot} \eta_{\cdot \cdot \cdot \cdot}}{\Delta} \right] > 0 \] (66)
\[
\frac{dX_G\left(\frac{p_G(\tau_G)}{1+\tau_G}\right)}{d\tau_G} = \frac{X_G(\cdot)}{(1 + \tau_G)} \varepsilon_G \left[\frac{\eta_{GC} \eta_{CG} + (\varepsilon_C - \eta_{GC}) \eta_{GG}}{\Delta}\right] < 0 \quad (67)
\]

\[
\frac{dX_C\left(\frac{p_C(\tau_G)}{1+\tau_G}\right)}{d\tau_G} = \frac{X_C(\cdot)}{(1 + \tau_G)} \varepsilon_C \left[\frac{\varepsilon_G \eta_{CG}}{\Delta}\right] > 0 \quad (68)
\]

The impact of a “green” tariff reduction on its own-price is greater than the impact of this tariff cut on the conventional price, that is why in the neighborhood of the equilibrium a preferential tariff cut for EPPs increases (decreases) the “green” (conventional) trade.

**Foreign Environmental Tax**

Totally differentiating demand and supply functions and rearranging terms in order to express the results in terms of elasticities, we find that the following expressions for comparative statics when the foreign country punishes the conventional production with an environmental tax.

- impact on the international market (imports and exports)

According to the the Lemmas the increase in the import prices makes conventional import demand reduces and “green” import demand slightly increases, because the environmental tax affect more the conventional import price than the “green” price. There are two effects: the first one is that the variation on the conventional price is greater than for the “green” price and the second one is that the own price effect is always greater than the cross-price effect. On the conventional demand both effects reinforce the decrease on the import demand but on the “green” demand both effect go in opposite directions

\[
\frac{dM_C(p_G, p_C)}{d\tau_E} = -\frac{M_C}{\tau_E} X \varepsilon_{CT_E} \left[\left(\eta_{CC} (\varepsilon_G - \eta_{GG}) + \eta_{CG} \eta_{GC}\right)\right] < 0 \quad (69)
\]

\[
\frac{dM_G(p_G, p_C)}{d\tau_E} = -\frac{M_G}{\tau_E} X \varepsilon_{CT_E} \left[\eta_{GC} \varepsilon_G \frac{X}{\Delta}\right] > 0 \quad (70)
\]

The impact of the environmental tax on the exporter price differs. This policy in the foreign country increases conventional export price and thus conventional exports; however ...

\[
\frac{dX_C}{d\tau_E} = -\frac{X_C}{\tau_E} \varepsilon_{CT_E} \left[\eta_{CC} (\varepsilon_G - \eta_{GG}) - \eta_{CG} \eta_{GC}\right] < 0 \quad (71)
\]

\[
\frac{dX_G}{d\tau_E} = -\frac{X_G}{\tau_E} \varepsilon_{CT_E} \left[\eta_{GC} \varepsilon_G\right] > 0 \quad (72)
\]
• the impact of the foreign environmental tax on the domestic country

As the price increases the supply in the domestic country also does for both products; however the conventional production increases more than the “green” one. Demand for conventional product reduces but for “green” products increases due to the change in the relative price which favor the “green” demand.

\[
\frac{dS_C}{dT_E} = -S_C \frac{\varepsilon_X}{T_E} \frac{\varepsilon^S_C(\varepsilon^N_C - \eta^M_{NG})}{\Delta} > 0
\]  

(73)

\[
\frac{dS_G}{dT_E} = -S_G \frac{\varepsilon_X}{T_E} \frac{\varepsilon^S_G \eta^M_{NG}}{\Delta} > 0
\]

(74)

\[
\frac{dD_C}{dT_E} = -D_C \frac{\varepsilon_X}{T_E} \frac{\eta^D_C(\varepsilon^N_C - \eta^M_{GC}) + \eta^D_G \eta^M_{GC}}{\Delta} < 0
\]

(75)

\[
\frac{dD_G}{dT_E} = -D_G \frac{\varepsilon_X}{T_E} \frac{\eta^D_G(\varepsilon^N_G - \eta^M_{GC}) + \eta^D_G \eta^M_{GC}}{\Delta} > 0
\]

(76)

• impact on the foreign market

\[
\frac{dS^*_C}{dT_E} = S^*_C \frac{\varepsilon^S_C}{T_E} \frac{\varepsilon^N_C - \eta^M_{GC} - \varepsilon^N_G - \eta^M_{GG} + \eta^S_G \eta^M_{GC}}{\Delta} < 0
\]

(77)

\[
\frac{dS^*_G}{dT_E} = S^*_G \frac{\varepsilon^S_G}{T_E} \frac{\varepsilon^N_G}{\Delta} > 0
\]

(78)

\[
\frac{dD^*_C}{dT_E} = -D^*_C \frac{\eta^D_C}{T_E} \frac{\varepsilon^N_C - \eta^M_{GC}}{\Delta} < 0
\]

(79)