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# Trade and environment: policy linkages

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ABSTRACT. This paper develops a simple model to investigate linkages between trade and environmental policy. In the case of purely local pollution, trade liberalization without constraints on environmental policy induces a non-cooperative game between countries in pollution policy. Without any agreement on environmental policy, trade negotiations are unlikely to lead to a point on the Pareto frontier. When pollution is global, countries may be expected to disagree on linkages between trade agreements and environmental agreements. Countries importing pollution-intensive goods have an incentive to try to link trade agreements with environmental agreements, while countries exporting pollution-intensive goods have an incentive to try to obtain a binding commitment to free trade prior to negotiations over global pollution.

## 1. Introduction

In recent years, environmental concerns have spilled over into the trade negotiation process. Some authors, such as Daly and Goodland (1994), have argued that free trade is bad for the environment because it will allow polluting industries to move to parts of the world with weak environmental policy. Moreover, there are concerns that increased pressures of globalization may lead to a 'race to the bottom' in environmental policy, as governments fail to enforce or implement proper environmental standards because of fears that they will place local firms at a competitive disadvantage. Other authors, such as Grossman and Krueger (1993) argue that fears of a race to the bottom are unsupported by empirical evidence and that trade may be good for the environment because it will raise real incomes, allowing countries to afford better environmental policy.

One of the key issues arising from this controversy is whether or not agreements on trade and environmental policy should be linked. In the past, the two issues have tended to be dealt with separately. Trade agreements, such as the General Agreement on Tariffs on Trade (GATT), dealt with trade issues; while environmental policy was dealt with either domestically (in the case of local pollution) or in separate multilateral environmental agreements (in the case of transboundary or global pollution). Many economists (such as Bhagwati and Srinivasan, 1996) have argued that this was both efficient and prudent. Efficiency follows from

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the policy targeting literature, which demonstrates that trade problems are best dealt with using trade policy instruments, and environmental problems with environmental policy instruments. And prudence follows from concerns that linkage may slow down trade negotiations or create new avenues through which special interest groups can block imports to protect their profits at the expense of consumers.

Recently, however, there have been several high profile controversies surrounding trade negotiations which have raised the spectre of future linkages. The linkage between trade and environment was an important issue in the debate over NAFTA, it was a major factor in the opposition to the proposed Multilateral Agreement on Investment, and it has led to the creation of a working group in the World Trade Organization (WTO). Moreover there was significant linkage in other policy areas in the WTO agreement that emerged from the Uruguay Round of trade negotiations—for example, agreements on intellectual property were included as part of the package of agreements on trade.[1] And as well, there has been a very strong movement towards increased linkage in Europe as the distinction between purely domestic and international policy there has eroded.

This paper investigates the rationale for linking trade and environmental policy. There are many ways in which two types of policies can be linked, but my main concern in this paper is whether trade liberalization also requires some agreement between countries on environmental policy, either to protect the environment, or to protect economic interests. A secondary issue that is only touched on here is whether bad environmental regulation should be treated as a production subsidy and subject to the same type of trade remedy measures available for other forms of subsidies under WTO rules.

The object of this paper is to illustrate how standard economic theory yields a couple of fairly straightforward arguments for linkage. Not all of the analysis in the paper is novel, but rather the purpose of the paper is to present the linkage issue in a simple unified model that clarifies the key issues at work.

I begin by developing a simple model in which trade liberalization has environmental consequences. This model is a simplified version of North–South models developed by Copeland and Taylor (1994, 1997) and Richelle (1996). The model illustrates how income-induced policy differences can generate trade and how trade can alter the incidence and level of pollution around the world,[2] but its main purpose is to provide a simple vehicle to investigate the policy linkage issue.

[1] Charnovitz (1998) provides a very good overview of the pros and cons of linkage in international agreements, with environmental policy used as an example in several cases. He also points out that the idea of linkage is not new and gives examples of linkages in past treaties.

[2] There are of course other types of environmental problems that may be affected by trade (such as habitat loss, renewable resource depletion, etc.), but in an effort to keep the model very simple and clear, this paper focuses on environmental damage caused by production-generated pollution.

After setting up the model, I turn to policy issues. If governments implement efficient first-best policy and if they do not act strategically with one another, then the case for separating trade and environmental policy has considerable merit. However, once we drop either the assumption of efficient policy or of non-strategic behaviour, the case for separation is considerably weakened.

With inefficient policy, the case for linkage is well-known, and so I do not spend much time on it here. If governments are unable to internalize externalities, then trade policy can be used as a second-best instrument to protect the environment.[3]

The main focus of this paper is on the implications of strategic interaction between governments for linkage. Even if governments are able to internalize externalities, strategic behaviour may inevitably lead to linkage. I consider two motives for strategic behaviour. In the first case, pollution is purely local, and governments interact strategically in an effort to influence their terms of trade. In the second case, pollution is transboundary and governments interact strategically with respect to both trade and environmental quality.

Drawing on the trade negotiation literature (and especially Mayer, 1981; Dixit, 1987; and Copeland, 1990), I first consider the effects of an agreement to eliminate tariffs on trade without any linkage to an environmental agreement. Because the constraints on tariffs do not eliminate the incentive for governments to protect industry, the trade agreement induces a non-cooperative game in environmental policy.[4] Thus in this simple model, it is not possible for the two countries to obtain an efficient outcome unless they commit to binding agreements on environmental policy as well as trade policy.

If there is a transboundary pollution, then environmental policy in one country directly affects other countries, and hence there is an incentive for international negotiations on emissions of transboundary pollutants. Here I focus on the timing of negotiation and show how a commitment to free trade can give the exporter of pollution-intensive goods a strategic advantage in subsequent bargaining over global pollution. Hence importers of pollution-intensive goods have an incentive to try to link trade and

[3] There are numerous papers dealing with second-best problems in trade and the environment. Some examples are Markusen (1975), who shows how trade policy can achieve environmental objectives in models with transboundary pollution, Copeland (1994), who analyzes trade policy reform in the presence of inefficient environmental policy, and Brander and Taylor (1998), who consider the effects of trade policy in a renewable resource model with inefficient conservation policy.

[4] This part of the paper is an application to environmental policy of the approach in Copeland (1990). In that earlier paper, I considered trade negotiations with two instruments: tariffs and subsidies. Governments anticipate that a ban on tariffs will induce a non-cooperative game in subsidies, and this affects the outcome of a trade agreement. In the present paper, the two instruments are trade and environmental policy. Other relevant applications of this approach include Walz and Wellisch (1997) who consider environmental dumping in a partial equilibrium model with imperfectly competitive firms and Ederington (1998) who considers enforcement of trade and environmental agreements.

environmental negotiations, while exporters have an incentive to try to secure access to foreign markets prior to negotiating pollution.[5]

The focus of this paper is deliberately kept quite narrow in order to clearly emphasize a few simple points. More comprehensive discussions of policy issues surrounding the linkage between trade and the environment may be found in Esty (1994), Bhagwati and Srinivasan (1996), and Charnovitz (1998). I concentrate on trade in this paper, but similar issues arise in investment flows, and on this point, Wilson (1996) has a very nice survey. Finally, I avoid questions of enforcement of trade and environmental agreements. Ederington (1998) has a recent paper that looks at self-enforcing trade agreements when governments have incentives to use environmental policy as a substitute for trade policy. And there is a large literature on the stability of global environmental agreements—Barrett (1994a) is a recent contribution.

## 2. The model

There are two countries, Home and Foreign; and two goods ($X$ and $Y$). Foreign variables are denoted with an asterisk (*). Pollution ($Z$) is generated as a by-product of $X$ production; good $Y$ does not pollute.

I intentionally keep the model very simple. There is one representative consumer in each country who owns two primary factors, capital ($K$) and labour ($L$). Neither factor is mobile internationally. Technology is identical across countries. $Y$ is produced using only labour, with one unit of labour yielding one unit of output. Hence

$$Y = L \tag{1}$$

Good $X$ is produced with constant returns to scale using capital and environmental services ($Z$). I assume that one unit of environmental services corresponds to one unit of pollution emissions. Thus, $Z$ can be thought of as pollution. The production function is increasing and concave in the inputs

$$X = F(K,Z) = \min(\delta K, K^{1-\alpha}Z^{\alpha}) \tag{2}$$

where $\delta > 0$. The upper bound, $\delta K$, reflects an assumption that regardless of the level of pollution, there is an upper limit to the amount of $X$ that can be produced per unit of capital. Another way to think of this is that if there is no abatement, then $X = \delta K$, and pollution is $Z = \delta^{1/\alpha}K$. With a fixed input of $K$, the firm can reduce pollution below this level by allocating some of the $K$ to abatement, but this reduces output. This yields the trade-off between emissions and output implicit in (2). Throughout the paper, I focus on interior solutions where pollution taxes or quotas mean that there is always some abatement.

Note that because $X$ and $Y$ do not use a common input, this model is essentially a generalization of an endowment economy, where one of the endowments (environmental quality) is endogenous and declines in quality with usage.

[5] This analysis is developed here in a much simplified version of the Copeland and Taylor (1995) model that has been designed to focus on the role of strategic commitment. The linkage issue is only briefly mentioned in that earlier paper, and here it is developed with more clarity and detail.

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I let good $Y$ be the numeraire; hence $p_y \equiv 1$. The price of $X$ is denoted by $p$. Since both countries will always produce good $Y$, wages are tied down by the zero profit conditions in $Y$. Hence we have

$$w = 1$$

If firms are given a pollution quota, production in sector $Y$ can be represented with a profit function

$$\pi(p,K,Z) = pF(K,Z)$$

The marginal abatement cost is then easily obtained as $\pi_z = pF_z$. This measures the increase in profits as firms are allowed to pollute more (or equivalently, the reduction in profits if they are forced to pollute less).

If instead firms pay a tax $\tau$ for the right to pollute, then net profits are

$$\tilde{\pi}(p,K,\tau) = \underset{\{z\}}{\text{Max}}\{pF(K,Z) - \tau Z\}$$

in which case the pollution generated can be obtained from Hotelling's lemma as $Z = -\tilde{\pi}_\tau$. If firms act efficiently, they choose pollution so that their marginal abatement cost is set equal to the pollution tax (that is $\tau = pF_z$).

Preferences over goods are homothetic and identical across countries. Pollution is a pure public bad, and in this section I assume that the harmful effects of a unit of pollution are confined to the country that generated the pollution. The representative consumer's utility function is

$$U = \ln(x^\beta y^{1-\beta}) - \mu Z^\gamma/\gamma$$

and the corresponding indirect utility function is

$$W = \ln(I/p^\beta) - \mu Z^\gamma/\gamma \tag{3}$$

where $\gamma \geq 1$ and $\mu > 0$.

To find the autarky relative price of $X$, I equate the relative demand and supply. For a given level of pollution, relative supply $(X/Y)$ is

$$RS = \frac{F(K,Z)}{L} \tag{4}$$

and the relative demand $(X/Y)$ is

$$RD = \frac{\beta}{(1-\beta)p} \tag{5}$$

Solving for the relative price of $X$, we obtain

$$p = \frac{\beta L}{(1-\beta)F(K,Z)} \tag{6}$$

Note that increases in pollution increase the relative supply of $X$ and hence reduce $p$. That is, $dp/dz < 0$.

Finally, income in autarky is

$$I = Y + pX = L + pF(K,Z)) = L/(1-\beta) \tag{7}$$

where I have used (6) to eliminate $p$.

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Initially, suppose there is no trade. Then the government chooses pollution to maximize the representative consumer's utility (3). This yields

$$\tau = \mu Z^{\gamma-1} I \equiv MD(I,Z) \tag{8}$$

where $\tau$ is either a pollution tax or equilibrium permit price, *MD* denotes marginal damage, and *p* is given by (6). That is, the government internalizes the externality by choosing pollution so that the pollution tax or permit price is equal to marginal damage. Because this is a general equilibrium model, marginal damage depends on equilibrium income *I*.

Firms choose pollution by setting their marginal benefit of polluting, $\pi_z$, equal to the price $\tau$ of emitting one unit of pollution

$$\tau = pF_z(K,Z) \equiv \pi_z. \tag{9}$$

Combining (8) and (9), we obtain

$$\pi_z(p,K,Z) = MD(I,Z) \tag{10}$$

or, using (2) to obtain $F_z$, we have

$$\alpha p(K/Z)^{1-\alpha} = \mu Z^{\gamma-1} I \tag{11}$$

where *MD* denotes marginal damage, and where *p* is given by (6). Condition (10) is illustrated in figure 1 and simply says that the marginal benefit of polluting (given by the marginal profit generated by an extra

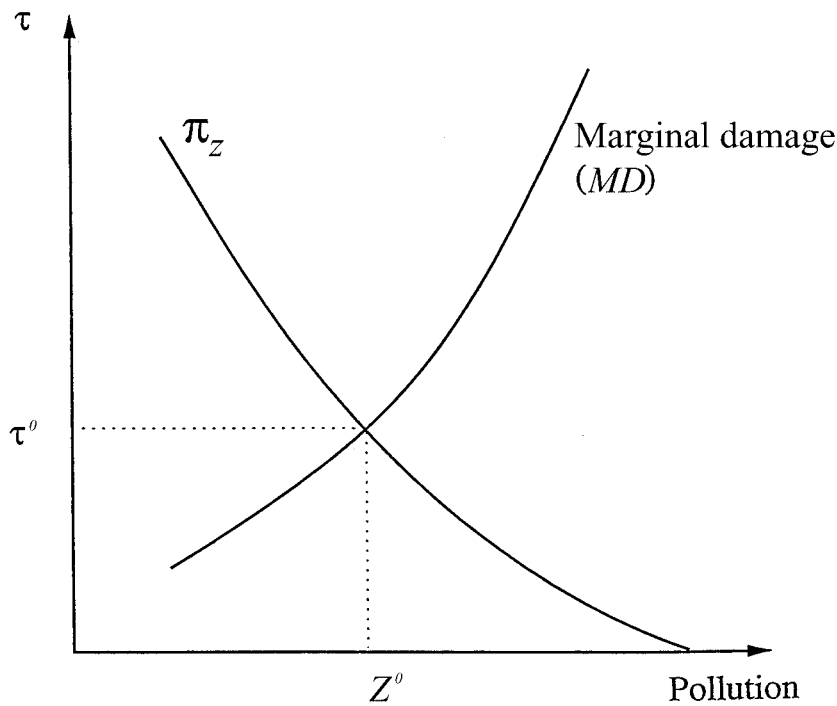


Figure 1. *Efficient pollution level*

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unit of pollution) should be set equal to the marginal damage. Marginal damage increases as income rises because environmental quality is a normal good. The marginal benefit of polluting falls as pollution rises both because of diminishing returns on the production side, and because increases in pollution are accompanied by more output, which depresses prices.

The shadow price of pollution is determined by $\tau = MD(I,Z)$ in the diagram. If the government uses pollution taxes or permits, then this is the price firms pay for the right to release a unit of emissions.

In figure 2, I illustrate the effects of economic growth in autarky on pollution and on environmental regulation. Suppose that the agent's endowment vector is scaled up by the factor $\lambda > 1$. That is, the new endowment vector is $(\lambda K, \lambda L)$. Using (6) and (7), we can rewrite (11) as

$$\frac{\alpha\beta\lambda L}{(1-\beta)Z} = \frac{\mu Z^{\gamma-1}\lambda L}{(1-\beta)} \tag{12}$$

The left-hand side is the marginal benefit of polluting, which increases with $\lambda$—the marginal product of environmental services rises as the productive capacity of the economy rises. This tends to increase pollution. However, the marginal damage curve must also shift up because of the increase in income. This is reflected in the term on the right-hand side.

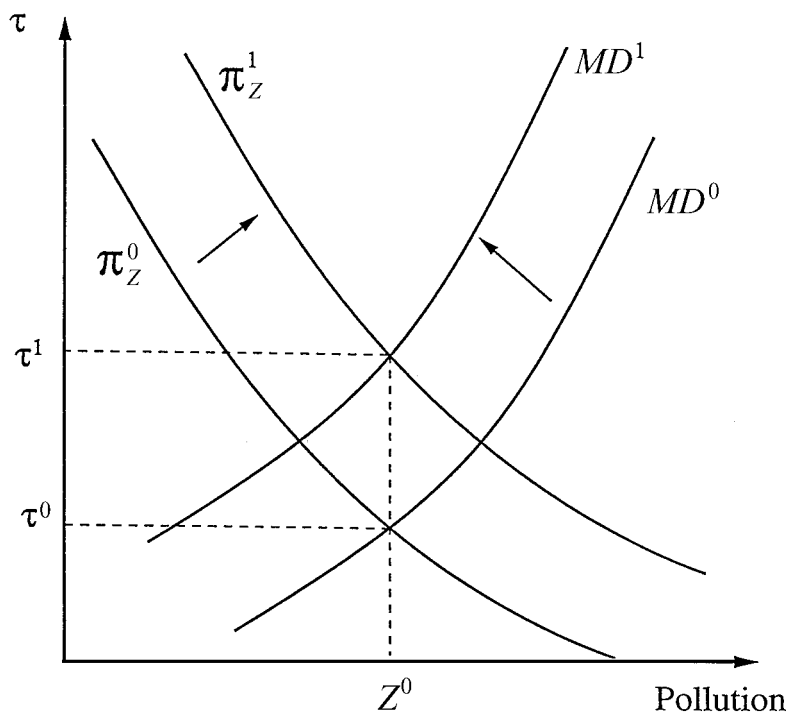


Figure 2. *Neutral growth increases the efficient pollution tax*

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Note that each curve shifts up by exactly the same factor λ, and hence growth has no effect on the optimal level pollution in our simple model. Solving (12) yields

$$Z = (\alpha\beta/\mu)^{1/\gamma} \tag{13}$$

which is independent of the endowment vector.

The result that growth has no effect on pollution is of course sensitive to the assumptions of our model. In particular, I have implicitly assumed that the elasticity of marginal damage with respect to income is 1. If this elasticity were greater than 1, then pollution would fall with growth, and if it were less than 1, then pollution would rise with growth.

While growth does not affect pollution, it unambiguously pushes up the price of a pollution permit τ. Hence we expect environmental regulation to be more stringent in rich countries than in poor countries. This can lead to a motive for trade.

## 3. Trade

Trade adds a potential complication for the regulator, since pollution policy can be used to manipulate the terms of trade. I will deal with this in the next section. For now, I want to focus on the pattern of trade, and hence will simply assume that governments use pollution policy only to internalize externalities. Hence (10) continues to apply.

To determine the pattern of trade it is useful to derive relative supply and demand curves for goods, with the supply of pollution endogenized. This is done in figure 3. The relative demand curve is given by (5) as before, and is the same in both countries regardless of incomes because preferences are identical and homothetic.

Relative supply is given by (4), but we must remember to take into account the endogenous changes in pollution as prices change. To obtain this relation, rewrite (10) as

$$F_z(K,Z) = \mu z^{\gamma-1}[L/p + F(K,Z)]$$

Totally differentiating, we obtain

$$dZ/dp > 0 \tag{14}$$

That is, pollution rises as $p$ (the price of the polluting good) rises, and hence the relative supply curve (13) slopes upward, as illustrated in figure 3 by the curve $RS^0$.

Now, to determine the pattern of trade, let us compare the relative supply curves of two countries that have different endowment vectors. Using (11) to solve for $Z$, and substituting into the production function (2), we obtain for any given $p$

$$\frac{X/Y}{X^*/Y^*} = \left(\frac{K^b/L}{K^{*b}/L^*}\right)\left(\frac{I^*}{I}\right)^{\alpha/(\gamma-\alpha)} \tag{15}$$

where $b \equiv \gamma(1-\alpha)/(\gamma-\alpha) > 0$, $X/Y$ is Home relative supply and $X^*/Y^*$ is Foreign relative supply.

Let us consider two countries which differ only in the scale of the con-

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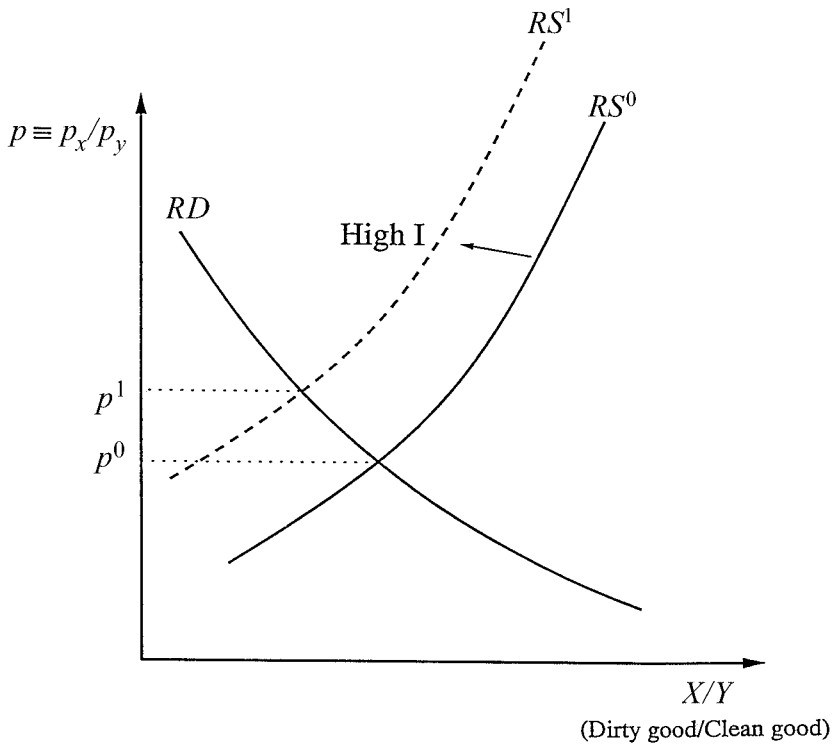


Figure 3. *Pattern of trade: conflicting roles of income and factor abundance*

sumer's wealth. That is, suppose Home's endowment vector is a scaled up version of Foreign's, so that $(K,L) = \lambda(K^*,L^*)$, where $\lambda > 1$. Then from (15) we have

$$\frac{X/Y}{X^*/Y^*} = \frac{I^*}{I} \tag{16}$$

One can show that with $\lambda > 1$, we have $I > I^*$. Hence the relative supply of $X$ is smaller in the high-income country (Home) than in the low-income country (Foreign), as illustrated by the curve $RS^1$ in figure 3. Because of Home's higher productive capacity, the environment is a relatively scarce factor there, and hence pollution permit prices are higher than in Foreign. Consequently, Home has a comparative advantage in the clean good, and Foreign in the dirty good.

If we open up these countries to trade, then the relative price of $X$ will rise in Foreign, and from (14) pollution will rise in Foreign. On the other hand, the relative price of $X$ will fall at Home, and hence pollution will fall at Home. Trade thus leads to a change in the global incidence of pollution, shifting some polluting activity from the rich country to the poor country. As in Copeland and Taylor (1994), it is noteworthy that growth and trade have very different effects on pollution. In this model neutral growth in

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autarky has no effect on pollution, but trade raises pollution in poor countries and lowers it in rich countries. Neutral growth changes the scale of economic activity, which elicits an offsetting policy response. Trade may also change the scale of economic activity, but as well, it can also have a significant effect on the composition of economic activity—in this case, the share of the polluting industry in Foreign's GDP rises.[6]

## 4. Trade policy

In this section, I investigate the interaction between trade policy and environmental policy. I assume that governments have two policy instruments available: import tariffs and pollution taxes. Both pollution taxes and trade taxes will affect a country's excess supply and demand curves and hence can affect its terms of trade.

Each government sets out to use its two instruments to maximize the utility of its representative consumer. Let $t$ be Home's *ad valorem* import tariff and let $\tau$ be its pollution tax; and let $M$ denote imports and $E$ denote exports. The corresponding Foreign variables are denoted with an asterisk (*). I assume that any tax revenue is rebated in lump sum to the consumer.

To avoid repetition, I will mainly focus on the Home country's problem. Suppose that Home imports the pollution-intensive good and exports the clean good. With these policy instruments in place, the consumer's budget constraint is

$$I = L + \tilde{\pi}(p(1 + t),K,\tau) + tpM + \tau Z \tag{17}$$

The government chooses tariffs and pollution policy to maximize the consumer's utility (3) subject to the budget constraint (17) and subject to the given levels of Foreign's policy instruments. The first-order conditions for the choice of $t$ and $\tau$ are

$$-M\frac{dp}{dt} + tp\frac{dM}{dt} + (\tau - MD)\frac{dZ}{dt} = 0 \tag{18}$$

$$-M\frac{dp}{d\tau} + tp\frac{dM}{d\tau} + (\tau - MD)\frac{dZ}{d\tau} = 0 \tag{19}$$

where recall that $MD$ denotes marginal damage and is defined by (10). Noting that home imports must equal foreign exports ($E^*$), we have

$$dM = E^*_p dp \tag{20}$$

and by substituting this into (18) and (19), we can find the optimal policy pair

[6] If countries differ in both capital abundance and in income, then the pattern of trade is determined by conflicting forces. If a rich country is also capital abundant, then its strict pollution policy tends to make the autarky price of the dirty good high, but its capital abundance tends to make the price low. The pattern of trade depends on the strength of the two opposing effects. If relative capital abundance is sufficiently greater than relative income differences, then it is possible for the rich country to export the dirty good. These issues are pursued in more detail in theory in Copeland and Taylor (1997) and Richelle (1996); and empirically in Antweiler, Copeland, and Taylor (1998).

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$$\tau = MD \tag{21}$$

$$t = \frac{1}{\epsilon^*} \tag{22}$$

where $\epsilon^* \equiv pE^*_p / E^* > 0$ is the elasticity of the foreign export supply function.

The solution is a standard result: the government should internalize externalities with environmental policy, and should use tariffs to target the terms of trade (see for example, Dixit, 1985). An important implication of (21) is that there is no implicit subsidy for the use of environmental services. Although the government has an incentive to protect the polluting industry, it is more efficient to protect it with trade policy than with weak environmental policy.

Figure 4 illustrates Home's choice of the level of protection. If pollution externalities are fully internalized, then equation (18) reduces to

$$-M\frac{dp}{dt} = -tp\frac{dM}{dt}$$

The left-hand side can be interpreted as the marginal benefit of protection (illustrated as *MB* in figure 4), which comes from an improvement in the terms of trade. The right-hand side is the marginal cost of protection ($MC_t$ in figure 4), which results from a fall in the volume of trade. Given the foreign tariff, Home's optimal tariff is given by $t_0$ in figure 4.

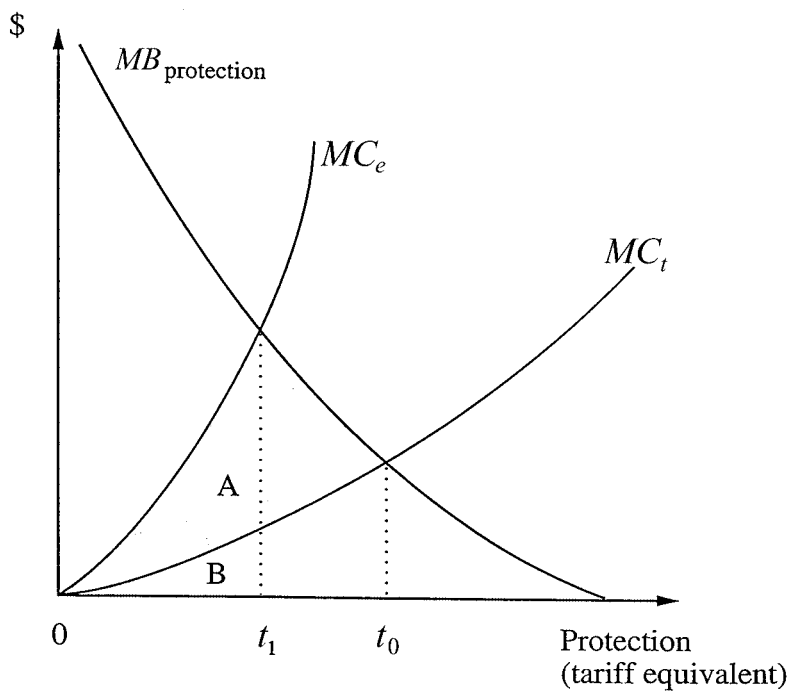


Figure 4. *Marginal benefits and costs of protection with two different instruments*

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Alternatively the government could forsake the use of tariffs and instead protect the polluting industry by weakening environmental policy. Define $\sigma \equiv MD - \tau$. This is the gap between marginal damage and the pollution tax, and hence measures the implicit subsidy to polluting industries for their access to environmental services. We can define the 'tariff equivalent' environmental subsidy as that level of $\sigma$ which reduces imports by the same amount as a tariff $t$. Then the marginal benefit of weakening environmental policy by an amount equivalent to a tariff increase is the same as with the tariff; but the marginal cost is higher because an implicit environmental subsidy is an inefficient instrument to target the terms of trade. This is illustrated in figure 4 as $MC_e$, which denotes the marginal cost of protection when environmental policy is used. Because trade policy is more efficient, the government does not grant environmental subsidies if it is unconstrained in its use of tariffs.

The results for the foreign country (the exporter of pollution-intensive goods) are also familiar and so are suppressed here. The foreign government's optimal policy is to fully internalize externalities and either protect its import-competing industry ($Y$) or equivalently to tax exports of the polluting good. Pollution policy could also potentially be used to improve the terms of trade. Since Foreign exports the polluting good, then in the absence of trade protection, there would be an incentive to set the pollution tax too high (that is set $\sigma^* < 0$) to reduce the supply of the dirty good and force up its price. But this is a second-best alternative to tariffs and would not be used here.

Because both countries will always fully internalize the pollution externality, the interaction between the two countries reduces to a standard non-cooperative tariff game.[7] In equilibrium, both countries set positive levels of trade protection, and end up inside the global Pareto frontier. To confirm this, note that as Mayer (1981) points out, global efficiency requires that goods prices be equalized across countries. Letting $p$ denote the world price of $X$, $t$ be Home's tariff on $X$, and $t^*$ be Foreign's export tax, then the domestic price of $X$ at Home is

$$p^d = p(1 + t)$$

and the domestic price of $X$ in the Foreign country is

$$p^{d^*} = p/(1 + t^*)$$

Along the Pareto frontier we required $p^d = p^{d^*}$, which implies

$$(1 + t)(1 + t^*) = 1$$

Note that free trade ($t = t^* = 0$) must lie on the Pareto frontier. Other points are also on the frontier, but note that if Home's tariff is positive ($t > 0$), then Foreign's export tax must be negative ($t^* < 0$). That is, one country's trade subsidy must exactly offset the other's trade tax. As Mayer notes, this is equivalent to free trade plus a transfer between countries. In the non-cooperative trade tax equilibrium, however, note from (22) that each country will levy positive trade taxes, and hence they end up inside the Pareto frontier.

[7] See Mayer (1981) and Dixit (1987) for good expositions of the tariff game.

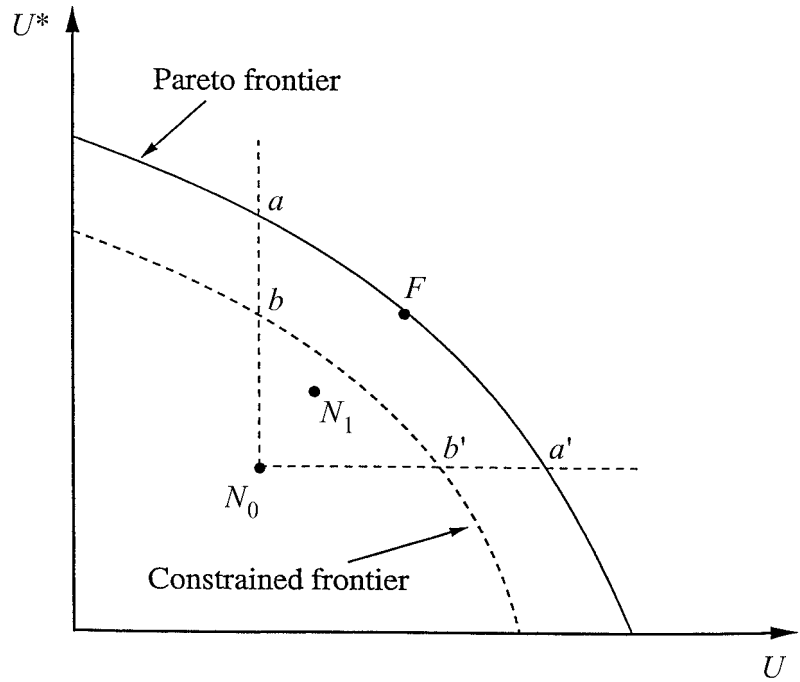


Figure 5. *Trade negotiations*

This is illustrated in figure 5. Along the Pareto frontier, pollution externalities are fully internalized and relative prices are the same in both countries. Point $F$ denotes free trade, and point $N_0$ denotes the non-cooperative trade war equilibrium. Both countries are better off along the segment $aa'$ than in the trade war, and hence $aa'$ represents the set of first-best outcomes that are individually rational if we take the trade war as the threat point. In the case illustrated here, I have assumed that free trade is on the segment of individually rational points; however this need not hold in general. If Home has a sufficiently larger economy than Foreign, then it may do better in the trade war than in free trade and hence point $F$ would lie on the frontier to the northwest of point $a$. Such a point could be supported by free trade plus a transfer from Foreign to Home.[8]

Because the trade war leaves the countries inside the Pareto frontier, there is an incentive for them to enter into trade negotiations to try to get on to the frontier. The outcome of these negotiations depends on the relative bargaining strengths of the countries; however, for our purposes, it is sufficient to note that in the first best they would agree to some point on

[8] Kennan and Riezman (1988) showed, for example, that big countries might 'win' a trade war and therefore require a transfer or some other concession to compensate them for a movement to free trade.

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the frontier. Since free trade is an obvious focal point, let us take that as the target outcome.[9]

Suppose then that countries agree to ban tariffs. Will this get them on to the Pareto frontier? Referring to figure 4, the marginal benefit of protection is unaffected by the tariff ban—governments still have an incentive to try to protect the polluting industry. But the marginal cost of protection has been altered by the trade agreement. If tariffs were the only available instrument of protection, and, if the trade agreement were binding, then the marginal cost of protection would be a vertical line at the point $t = 0$. Free trade would be obtained and the countries would be on the Pareto frontier.

But reaching the Pareto frontier is not so simple. Governments also choose environmental policy. And, while environmental policy is not the ideal instrument to use to protect an industry, it can act as a second-best instrument of protection. Recall from figure 4 that the marginal cost of protection when environmental policy is used as an instrument of protection is illustrated by the curve $MC_e$. This curve lies above $MC_t$ because subsidizing firms with lax environmental policy is more distortionary than using tariffs. But, because the social marginal cost of implementing an environmental subsidy approaches zero for a small subsidy, then if this is the only other available instrument, Home has an incentive to respond to tariff elimination by switching to an implicit environmental subsidy.

To confirm this, note that if we set $t = 0$ in equation (19), we obtain

$$\tau = MD + M\frac{dp/d\tau}{dZ/d\tau} < MD$$

That is, in response to the free trade agreement, Home government provides an implicit subsidy to the industry by setting the pollution tax below marginal damage.

In figure 4, the level of protection falls to $t_1$ from $t_0$. Notice that the trade agreement has had the desired effect of reducing the level of protection, despite the cheating induced by the weakening of environmental policy. This is because the trade agreement has a *deterrent effect* on protection. By banning the most convenient instruments of protection, the trade agreement raises the marginal cost of protection and induces a lower overall level of protection—Home's protection reaction function shifts in. Foreign is similarly affected and hence its reaction function shifts in as well, reducing the overall level of protection in the world. This effect is beneficial.

But as well as deterring protective activity (by raising the marginal cost of protection), the trade agreement also raises the average cost of protection. Weaker environmental policy not only stimulates production, but also increases pollution, and this harms consumers. This effect is illus-

[9] The argument that follows requires only that tariffs be subject to some binding constraint, and hence continues to apply if they pick some other point on the frontier. However, as noted above, other points on the frontier can be supported by free trade plus a transfer. If we assume the transfer is paid up front, then we are left with a zero tariff outcome regardless of where we are on the frontier.

trated in figure 4. The total cost of raising protection from 0 to $t_1$ is area $A + B$ after the trade agreement. If instead, governments were allowed to use tariffs, that same level of protection could be provided at cost equal to area $B$. Whether or not the trade agreement is beneficial depends on whether or not the benefits of the deterrence effect (lower foreign protection) are great enough to offset the increased average cost of protection.

The discussion above has focused on the incentives facing the importer of polluting goods. The exporter of polluting goods also has an incentive to look for an alternative to a tariff. In this case, as mentioned previously, Foreign has an incentive to reduce the world supply of the polluting good, and hence elimination of tariffs will cause it to tighten up environmental policy

$$\tau^* = MD^* - E^* \frac{dp/d\tau^*}{dZ^*/d\tau^*} > MD^*$$

One important implication of this is that the potential to substitute environmental policy for trade policy need not be harmful to the environment. In this model, importers of pollution-intensive goods have an incentive to loosen up environmental policy to subsidize local production, while exporters have an incentive to tighten up policy to tax production.[10]

If the deterrence effect is quite strong, the trade agreement does indeed raise welfare in both countries. Then the effect of the trade agreement is to move countries from point $N_0$ to $N_1$ in utility space (figure 5). But point $N_1$ must still lie below the Pareto frontier because pollution externalities are no longer fully internalized. In this simple model with just two policy instruments, trade negotiations that do not cover environmental policy will be ineffective in getting countries on to the Pareto frontier. This suggests that governments may have incentives to constrain both trade and environmental policy when negotiating trade agreements.

If countries negotiate and can enforce an agreement on both trade barriers and either pollution taxes or emissions (and if there are no other policy instruments available), then they will be able to implement points along the Pareto frontier. That is, while an agreement on tariffs alone can move countries from the non-cooperative point $N_0$ to point $N_1$, linked agreement on tariffs and environmental policy can move the countries to an even better point, such as $F$. Full trade liberalization requires that countries coordinate their domestic environmental policy as well as their trade policy. If they do not coordinate their environmental policy, then it may be used as a substitute for trade policy, which can potentially undermine the trade agreement.

Notice that linkage does not required that environmental policy be harmonized across countries.[11] Rather, it must be coordinated. For example, if

[10] On this point see Baumol and Oates (1988), Markusen (1975), and others. In the context of imperfect competition, see Barrett (1994b) who shows that whether an environmental tax or subsidy will be provided to exporters of the polluting good depends on market structure.

[11] See Bhagwati and Srinivasan (1996) for a recent lucid discussion of the case against harmonization of environmental policy.

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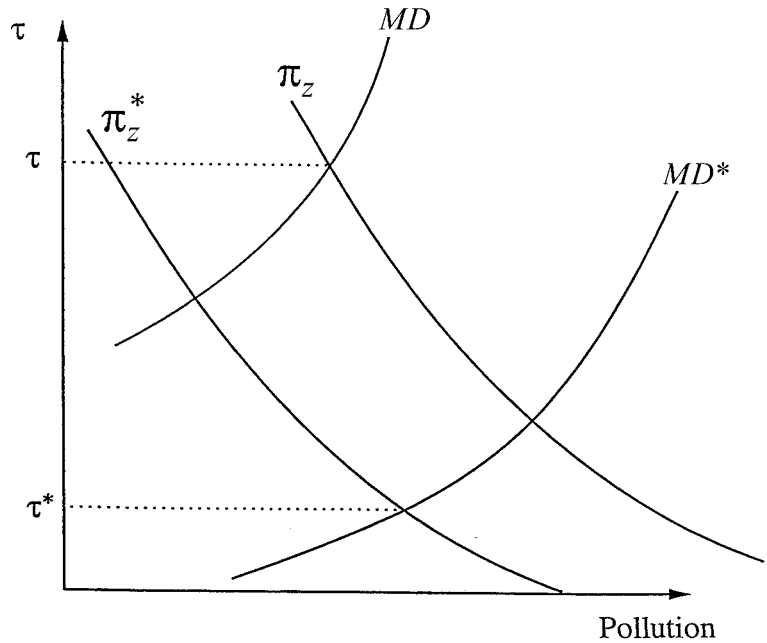


Figure 6. *Different environmental policy across countries in free trade*

Home is rich and Foreign is poor, and if capital/labour ratios are similar across countries, then we expect Home to export the clean good and Foreign the dirty good, and so efficient pollution taxes might look something like that illustrated in figure 6. Home's pollution tax is high and Foreign's is low, and that is Pareto efficient because it reflects the different valuations of goods and environmental quality at the two different levels of income. Trade in this model is likely to reduce the gap between the pollution taxes across countries, since it relieves pressure on Home's environment and adds pressure to Foreign's. But there is no reason to expect trade to fully eliminate the gap, and efficiency does not require so. All that is required is that countries refrain from using environmental policy as a substitute for trade policy.

*Non-negotiable environmental policy*

What if it is not feasible to constrain environmental policy in a trade agreement? Then a commitment to free trade is unlikely to be second-best optimal even in an agreement that leads to binding commitments on tariffs. Countries can do better than point $N_1$ in figure 5 by looking ahead to the induced non-cooperative game in environmental policy when negotiating the trade agreement. That is, if countries anticipate that trade liberalization will influence the outcome of the environmental policy game, they have an incentive to take this into account when negotiating trade agreements. Free trade is a feasible outcome of this negotiation, but is unlikely to be optimal. There is a constrained frontier illustrated as the dashed line *bb′*, each point

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of which is induced by a different combination of home and foreign tariffs (each of which in turn induces an environmental policy game). This is the second-best frontier which gives the best feasible outcomes given that environmental policy is uncoordinated. By choosing tariffs strategically, the two countries can influence the outcome of the environmental policy game and implement an agreed-upon point on this frontier.[12]

In this case, while the trade agreement is not explicitly linked to environmental policy, it cannot really succeed with awareness of the implicit environmental linkages.

*Multiple instruments of trade protection*

The model outlined implies that free trade agreements that do not simultaneously constrain environmental policy will be doomed to failure because the option of using environmental subsidies to protect domestic industries will leave a loophole in trade agreements that will be harmful both for the environment and for efficiency of trade between countries. Linkage as outlined above would require that countries be subject to a sanction if they deviate from first-best environmental policy.[13]

Current trade agreements have faced this issue to varying degrees. WTO rules do not provide for such linkage. For example, countervail laws are legal under WTO rules, and these laws provide for retaliation against foreign export subsidies. However, retaliation against implicit environmental subsidies is not permitted under these rules. NAFTA has gone a little further than the WTO by linking a side agreement on environmental policy to the trade agreement. This provides for some limited sanctions if countries fail to enforce their environmental policies. However, each country is free to determine its own environmental policy. The European Union has gone much further than most trade agreements by requiring explicit harmonization of some environmental policies.

One potential explanation for these differences can be obtained from a slight generalization of the above model. So far, the model has been rigged so that tariffs and environmental policy are the *only* policy instruments available to governments.[14] In practice, however, governments have many potential policy instruments that can substitute for trade barriers.[15] Allowing access to other instruments can lead to important changes in the results and suggests that the need for trade and environmental policy

[12] This is an application of the analysis in Copeland (1990) to environmental policy.

[13] Enforcement has been explored in some detail in Ederington (1997). He considers self-enforcing trade agreements; that is, trade agreements which are enforced by trigger strategies. He finds that in such a framework, an efficient agreement requires that countries agree both on tariff levels and to set domestic environmental policy efficiently. Each country then retaliate against either a deviation in tariffs, or against any attempt to weaken environmental policy.

[14] Much of the recent literature on using environmental policy to protect firms makes a similar assumption (for example, Barrett, 1994; Krutilla, 1991; Walz and Wellisch, 1997).

[15] This point has been made very nicely in the context of the 'race to the bottom' strategic investment literature in a survey by Jay Wilson (1996).

linkage will be an issue only for trade agreements that are very comprehensive in scope.

Consider figure 4 again. A standard result from trade theory is that a tariff is equivalent to a domestic consumption tax combined with a domestic production subsidy. If we ignore administrative and disbursement costs, then if the government signs a treaty that bans tariffs, it can simply switch to the equivalent tax/subsidy package. If it can do this, then the trade agreement has no effect on the marginal cost of protection in figure 4 (and so protection stays at $t_0$), and the economy would not move away from the point $N_0$ in figure 5. That is, a trade agreement that does not also cover production subsidies contains a giant loophole. More important for our purposes is that there would be no incentive to use environmental policy as a substitute for trade policy because there are superior policy instruments available for cheating on the trade agreement.

Even if there is no perfect substitute for a tariff available, there may be other imperfect substitutes that can serve as loopholes in the trade agreement. That is, referring to figure 4, there is a plethora of other policy instruments (such as border inspections, loan guarantees, R&D subsidies) that can provide trade protection, but which have marginal-cost-of-protection curves higher than $MC_t$, but still below $MC_e$. In this case, governments would have little or no incentive to use environmental policy to cheat on the trade agreement, and linkage would provide no benefits (except possibly in giving the government an additional commitment device that they can use to stand up to lobbyists). This suggests that if a trade agreement is very narrow and covers only simple trade barriers, such as tariffs and quotas, then there may be little point in trying to constrain environmental policy because it is unlikely to be used as a trade barrier.

On the other hand, trade negotiators are well aware of the loophole problem in trade agreements and much of the recent trade policy agenda has been aimed at closing such loopholes by expanding the scope of trade agreements to constrain subsidies and other instruments. This suggests that the more comprehensive is the trade agreement, the fewer are the loopholes, and the more likely it is that governments may be tempted to use environmental policy as a trade policy. That is, if trade negotiators gradually eliminate or constrain the use of policy instruments that have marginal-cost-of-protection curves below $MC_e$, then eventually governments may find it worthwhile to manipulate environmental policy for protectionist purposes. Consequently, the case for linking environmental policy to trade policy will be more compelling when trade agreements are very comprehensive (such as in the European Union) than in less comprehensive agreements such as NAFTA or past rounds of the GATT/WTO agreements. As the WTO becomes more comprehensive, the case for linkage there may become stronger. The greater degree of harmonization of environmental policy that has in fact occurred in Europe as compared with North America supports the predictions of this model.

*Empirical relevance*

One of the key components of the argument for linkage here is that changes in domestic environmental policy can change the competitiveness

of domestic firms relative to their trading partners. If environmental policy has no effect on the pattern of trade or on firm location, then it will be an ineffective substitute for trade policy. And, if environmental policy is not a good substitute for trade policy, then rational governments should not attempt to manipulate environmental policy to protect local firms, because it will not work.

The effects of differences in environmental policy on the pattern of trade and firm location has been the subject of a growing empirical literature, recently surveyed by Levinson (1996). As Levinson notes, the almost unanimous conclusion of this literature is that environmental regulations have had very little measurable effect on trade patterns or firm location. There are a number of possible explanations for this, some of which Levinson reviews. A common explanation is that environmental compliance costs have been relatively small. If this is the case, then other differences between countries would overwhelm the effects of environmental policy differences. Recall that the pattern of trade in the model in section 3 of this paper was determined by the interaction between differences in relative factor abundance and differences in environmental policy. If differences in the cost of complying with environmental policy are small, then their effects may not be measurable empirically. If this explanation is accurate, then as environmental regulations become more stringent in the future in some countries, it is possible that they may have more effects on competitiveness than they have had in the past.

Another possibility is that the effects of environmental policy on the pattern of trade are subtle and hard to measure. Two recent interesting studies provide examples of this. Becker and Henderson (1997) investigate the effects of air quality regulation in the United States on the location of new plant births in polluting industries. Previous studies have used state-level data and found no effect. Becker and Henderson use county-level data. If counties are not in compliance with the Clean Air Act ('non-attainment' counties), then they must adopt specific stringent environmental regulations that affect new plants. Becker and Henderson find that non-attainment status reduces plant births in polluting industries by 40–50 per cent. They conclude that the stringent environmental policies in these counties lead to a shift in the location of polluting plants to cleaner areas of the country. What is especially striking about this work is that it illustrates that the effect of environmental policy on firm location may not be detected when aggregate (state-level) data are used, but may nevertheless still be important.

Another recent study illustrating the need for very careful analysis of the data is Levinson (1999). He uses data on shipments of hazardous waste in the United States. Different states have imposed different levels of taxes on these shipments. Standard theory would predict that increases in taxes on hazardous waste by a state should deter shipments of waste to that state. But a very simple OLS (ordinary least squares) regression suggests the reverse: all else equal, an increase in the tax appears to be accompanied by increased imports of toxic waste. Levinson, however, argues that the simple OLS regression is misspecified because it does not take into account simultaneity problems. He corrects for this several different ways

(including the use of a fixed effects model), and in each case finds that the corrected model yields results consistent with the theory: high environmental taxes do indeed impede toxic waste flows to a state. Again, this study illustrates the need for very careful analysis of the data to pick up the subtle effects of environmental policy.

Finally, as Levinson (1996) notes, there is a huge gap between the popular perception of the effects of environmental policy on competitiveness and most of the empirical evidence that has found very little effect. Moreover, government policy has clearly been affected by concerns about competitiveness—carbon taxes implemented in European countries have typically been accompanied by exemptions for industries which are perceived as being vulnerable to foreign competition. And in Canada, one of the main political arguments against a carbon tax is that it would hurt Canadian competitiveness with respect to the US. If the empirical work has to date been unsuccessful in convincing politicians that environmental policy has no effect on competitiveness, then they may be tempted to cave into political pressures to use environmental policy as a substitute for trade policy, regardless of what the true facts are. In this case, linkage can help to prevent politicians from doing foolish things. But then linkage would only be an imperfect substitute for a better knowledge. More empirical work in this area is needed.

## 5. Global pollution

Let us now consider global pollution. This adds an additional channel of linkage, since countries are now directly affected by foreign pollution. I generalize the model in section 3 to obtain a simplified version of the Copeland and Taylor (1995) model.

Suppose that Home is rich and Foreign is poor. The utility function $W$ for each country now depends on both local and foreign pollution, and, for simplicity, I assume that the effects of emissions on global environmental quality do not depend on the location in which the emissions are generated

$$W = \ln\left(\frac{I}{p^{\beta}}\right) - \frac{\mu(Z + Z^*)^{\gamma}}{\gamma} \tag{23}$$

Initially, suppose there is no trade. Countries are nevertheless interdependent because of pollution spillovers. Following the same line of analysis that led to equation (10), we can find the condition for Home's optimal choice of pollution (given Foreign pollution)

$$\pi_z = \mu(Z + Z^*)^{\gamma-1} I \equiv MD(I, Z + Z^*) \tag{24}$$

This differs from (10) only in that foreign (as well as home) pollution enters the marginal damage function.

Figure 7 illustrates both Home's and Foreign's choice of pollution, given the level of the other's pollution. Note that, as in the case of local pollution, the shadow price of the right to pollute will be higher at Home than in Foreign, but pollution levels may be higher or lower, depending on relative factor endowments.

Note also that each country's pollution level depends on its rival's pol-

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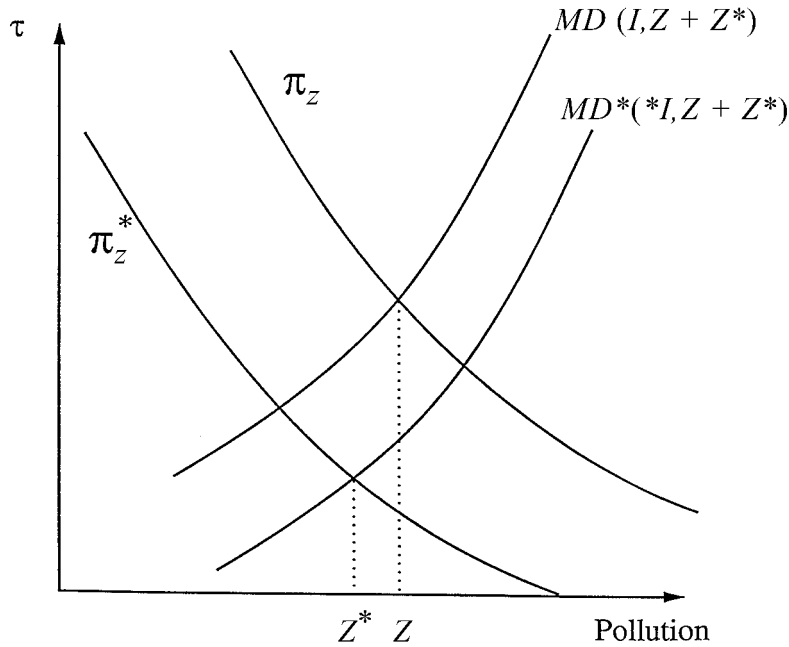


Figure 7. *Global pollution emissions in Home and Foreign*

lution, and so figure 7 allows us to derive reaction functions. An increase in foreign pollution shifts up the marginal damage curve for the home country, leading to a reduction in home pollution. Hence Home and Foreign pollution are strategic substitutes and reaction curves slope down, as illustrated in figure 8.

The Nash equilibrium in pollution levels is at point *A* in figure 8. Pollution indifference curves for each country have been drawn through this point, and, as one would expect, the non-cooperative equilibrium is inefficient, since each country ignores the effects of its pollution on the other country. Both countries could gain via a coordinated reduction in global pollution.

Prior to trade then, Home and Foreign face two sources of inefficiency—high trade barriers and too much pollution. Ultimately, we might expect negotiation over both of these issues. Figure 9 illustrates the Pareto frontier for Home and Foreign. Points along their frontier require that goods prices be equalized across countries, and that global pollution be chosen efficiently. Note that the latter condition requires that each country take into account the effects of its own pollution on the other country, and so efficient policy choices must satisfy

$$\tau = \pi_z = \mu(I + I^*)(Z + Z^*)^{\gamma-1},$$

$$\tau^* = \pi^*_{z^*} = \mu(I + I^*)(Z + Z^*)^{\gamma-1}$$

Hence a necessary condition for efficient global allocation of pollution

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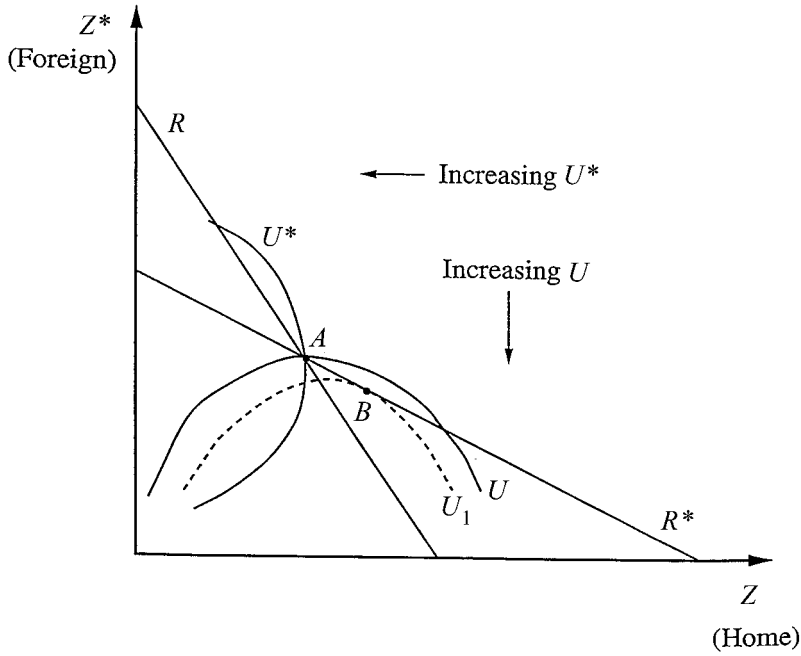


Figure 8. *Non-cooperative choice of pollution levels in autarky*

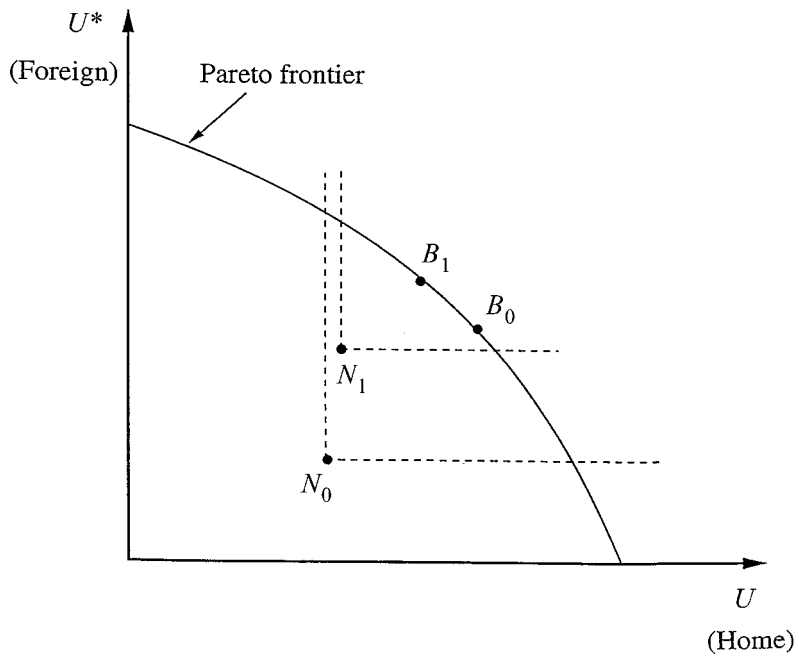


Figure 9. *Effect of trade liberalization on pollution negotiations*

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emissions is that pollution permit prices be equalized across countries. This is different from the case of local pollution where differences in permit prices across countries were efficient because they reflected differences in the shadow value of environmental services across countries.

This has important implications for the types of negotiations required to obtain efficiency. When pollution is purely local, large differences across countries in the willingness to pay for environmental quality can easily be accommodated by simply allowing countries to set pollution policies than reflect local concerns. Harmonization of environmental policy is neither required nor desirable. The only real concern for negotiators in that case is to set up a mechanism to ensure that governments do not use environmental policy as a disguised trade barrier. With global pollutants that are pure public bads, however, the efficient solution requires that marginal abatement costs be equated across countries. Clearly, if countries differ significantly in their marginal damage functions, such equalization will not be in the interests of all countries unless it is accompanied by some form of compensation. And therefore, as is usually the case, a typical point on the Pareto frontier can only be supported if there are lump sum transfers across countries.

Because there are two issues for countries to negotiate, it is natural to consider whether or not trade and environmental agreements should be linked. In one respect, linkage is unavoidable because changes in trade barriers will shift pollution reaction functions and affect global pollution. Conversely, restrictions on global pollution will affect the volume and possibly the pattern of trade. Nevertheless, negotiators may find it more convenient to address the two issues separately. Trade liberalization may seem relatively straightforward, especially if there is a clear focal point, such as free trade; while environmental negotiations may be much more cumbersome, especially if there is serious disagreement about the severity of the environmental problem or about how to distribute the burden of abatement across countries. On the other hand, if there is a looming environmental crisis (such as with the depletion of the ozone layer), then countries may prefer to deal with the environmental problem and defer trade negotiations for the future.

In reality, it is clear that international negotiations on trade and environmental policy have often proceeded independently. Several rounds of GATT trade liberalizations occurred prior to agreements over environmental problems, such as global warming, and in Europe the elimination of tariffs was implemented prior to agreements on transboundary pollution issues, such as acid rain. The Montreal Protocol on ozone gasses was negotiated independently of, and prior to, the completion of the Uruguay Round of trade negotiations.

If negotiations over the two issues do take place sequentially, then it can matter whether a trade agreement or an environmental agreement is obtained first, because the first agreement can influence the outcome of the next agreement. That is binding commitments made in one period will affect strategic interactions in future periods.[16] For example, a commitment

[16] To focus on the linking issue, I abstract from enforcement problems and assume that agreements will be treated as binding.

in the current period to restrictions on carbon emissions will affect the strategic interaction between countries over trade issues in future periods. It is therefore useful to consider what types of commitments each country would like to make if it could.

To illustrate the incentives for countries to make commitments on pollution emissions, it is useful to briefly consider a hypothetical two-stage (Stackelberg) game, where Home is first allowed to credibly commit to a pollution level, and then Foreign responds in the second stage. This is illustrated in figure 8. Given Foreign's reaction function, $R^*$, Home's preferred point is at $B$; that is, Home has an incentive to commit to a higher level of pollution than it emits during the simultaneous move game. This is because with higher global pollution, Foreign will choose to back off and reduce its pollution level. Similarly, if Foreign could move first, it also could gain by committing to a higher pollution level. I conclude then, that each country would gain if it were somehow able to credibly commit to polluting more than in the simultaneous move game.

Let us now turn to the effects of trade liberalization. For simplicity, I take autarky as the starting point, although similar results are obtained if we start with a trade war equilibrium. Consider the simple game where Home and Foreign are identical and have the same capital/labour ratio), except that Home's endowment of capital and effective labour is higher than Foreign's. In this case, because of Home's higher pollution taxes, it will have a comparative advantage in the clean good and Foreign will have a comparative advantage in the dirty good. As in section 3, trade liberalization will reduce the marginal benefit of polluting at Home (the fall in the relative price of the dirty good reduces $\pi_z$), and hence Home pollution falls. Referring to figure 10, Home's pollution reaction curve shifts in from $R_A$ to $R_T$. Foreign, on the other hand, has a comparative advantage in the dirty good and the relative price of the dirty good rises there with the opening of trade. Hence the marginal benefit of polluting rises in Foreign. Foreign's pollution reaction function shifts out in figure 10 from $R_A^*$ to $R_T^*$. The net effect of trade liberalization is therefore to alter the distribution of emission sources: pollution emissions fall at Home and rise in Foreign. World pollution may rise or fall in general.

To consider the welfare effects of trade liberalization, recall the discussion of the commitment incentives above. Each country would gain if it could make a credible commitment to pollute more. However, in the simultaneous move pollution game, such commitments are not credible. A trade agreement, on the other hand, can be interpreted as a credible commitment to freer trade. A side effect of this is that it indirectly commits countries to different pollution strategies. Note that Foreign's reaction function shifts out with free trade. Hence, free trade indirectly allows Foreign to credibly commit to pollute more. Foreign not only experiences standard gains from trade, but it also gets a strategic advantage in the pollution game: because its reaction curve shifts out, Home reduces its pollution in response to Foreign's new aggressiveness in the pollution game.

What about Home? Because it has a comparative disadvantage in the dirty good, Home's pollution reaction function shifts in as a result of trade

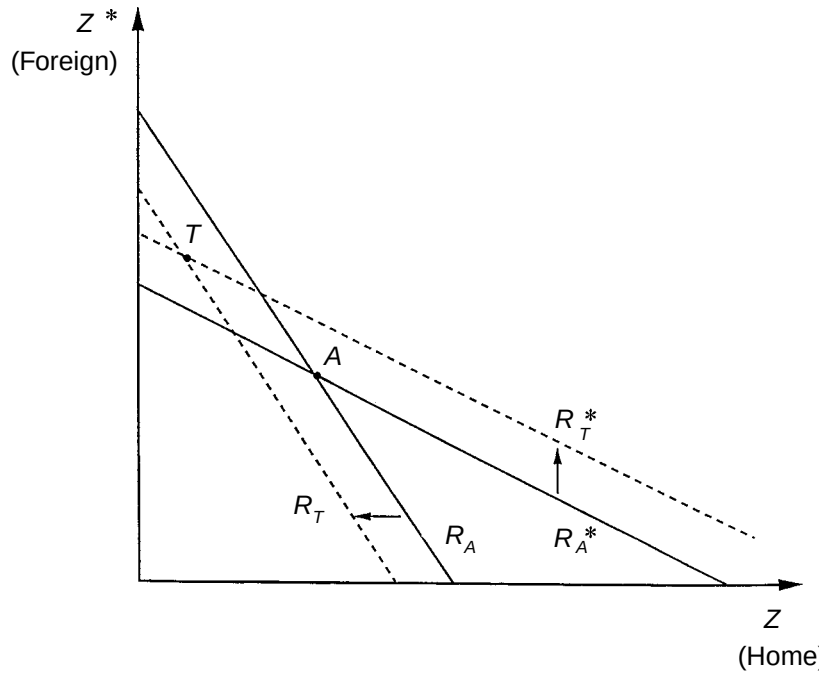


Figure 10. *Effect of trade liberalization on non-cooperative choice on pollution levels*

liberalization. Hence free trade effectively allows Home to credibly commit to pollute less. This is the opposite to what Home would want to do if it could make direct commitments on pollution. Hence freer trade puts Home at a strategic disadvantage in the pollution game. Consequently, Home's gains from trade are mitigated by its losses in the pollution game: the increase in Foreign pollution works against the standard gains from trade. In fact, it is possible for Home to lose from trade (see Copeland and Taylor, 1995).

We now turn to the linkage issue. Figure 9 illustrate the Pareto frontier for the two countries. Points along the Pareto frontier require bargaining over both pollution and trade. This is a little different than the bargaining process in the previous section where pollution was a subject for bargaining because it could be used as a loophole in a trade agreement. Here the problem is that pollution directly affects the foreign country.

First suppose there is no trade and a non-cooperative equilibrium in pollution. This yields point $N_0$. If this was taken as the threat point in a Nash bargaining game, then the outcome would be a point like $B_0$. Both countries would gain from bargaining over trade and pollution.

Suppose now that we consider a two-stage game. In the first stage countries commit to free trade, and in the second stage, they negotiate a pollution agreement. If the trade agreement is binding, then the threat point for the pollution game is the Nash equilibrium in pollution, which is

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at point $N_1$. The threat point has moved in Foreign's favour because of the strategic effects of the trade agreement noted above. Consequently, the outcome of the second stage pollution bargaining game is at point $B_1$. Hence regardless of whether or not Home gains from trade (i.e. whether or not $N_1$ is a Pareto improvement over $N_0$), Home ultimately loses if there is a pre-commitment to free trade prior to the pollution bargaining game. Hence, given a choice between linking trade and environmental agreements and an independent two stage process in which trade liberalization precedes pollution bargaining, Home prefers linkage and Foreign prefers not to link.

If Home has foresight, then it is unlikely to agree to free trade. Rather, to avoid a deterioration in its bargaining position, it may well hold back trade concessions until after a pollution bargain has been struck. Home would, for example, agree to an opening of trade, but only if it retains tariffs large enough relative to Foreign's, so as to ensure that its bargaining position in the subsequent pollution game is not compromised. When bargaining subsequently occurs over pollution, Home would then simultaneously be willing to discuss further trade liberalization.

This result does not require that trade be based only on differences in pollution policy as in this example. Rather, the more general point is that the importer of goods whose production contribute to global pollution would always have an incentive to try to negotiate trade and pollution levels simultaneously, while the exporter has an incentive to try to get a prior commitment to free trade.

## 6. Conclusion

The case for the separation of trade and environmental policy has been heavily influenced by the policy targeting literature. According to that view, trade instruments deal with trade problems and environmental policy deals with environmental problems. However, the real world falls short of this ideal. When there is policy failure at the government level, or when policy-effective governments are engaged in strategic behaviour with one another, linkage between trade and environmental policy is unavoidable.

If governments are unable to implement first-best environmental policy, the case for free trade for even a small economy is considerably weakened. Trade liberalization may stimulate polluting industries and reduce welfare. In this case, second-best trade policy reform cannot ignore the presence of uninternalized externalities.

Even if governments are able to implement efficient environmental policy, it may not be in their interests to do so after a trade agreement is signed. All trade liberalization agreements are incomplete contracts that eliminate and restrict some but not all instruments of protection. When tariffs are eliminated, governments face the same incentives to protect as they did prior to the trade agreement, and hence they look for alternative instruments of protection. While environmental policy is not a first-best trade policy, it may become an attractive substitute for trade protection if more favourable instruments are constrained by the treaty. In this case, the signing of a trade agreement may create a non-cooperative game in pollution policy. Theory suggests that this is likely to become more of a

problem as countries become increasingly integrated and trade agreements expand their scope. One remedy for this is to incorporate restrictions on environmental policy into trade agreements.

Finally, even if governments do not use environmental policy as a substitute for trade policy, trade liberalization can affect the bargaining power of countries in negotiations over global pollution. A commitment to free trade allows an exporter of pollution intensive goods to credibly commit to pollute more. This gives such a country a strategic advantage in future bargaining over global pollution. Consequently, importers of pollution-intensive goods have an incentive to try to link trade negotiations to global environmental agreements. Failing that, they may be unwilling to liberalize trade unless they are able to retain some trade barriers so as not to compromise their bargaining position in future environmental negotiations.

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