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Abstract

In situations where the traditional instruments of trade policy are not available, protection for import-competing industries can be given only indirectly. One of the candidates of giving indirect subsidies is environmental regulation. The competitiveness of a domestic industry can be improved by low emission taxes, by low environmental taxes on the consumption of the industry's output, or by low quality standards that have to be met by the goods that are produced by this industry. The paper looks at these instruments in a partial-equilibrium setting. There are a domestic and a foreign industry that produce goods that are regarded as imperfect substitutes by the consumers. Firms are price takers. The government has five policy instruments at its disposal: the emission tax rate, taxes on the consumption of domestic and foreign goods, and environmental-quality standards for domestic and foreign goods. In a first step, the small-country case is addressed. Two lobby groups that are interested in influencing environmental policies are considered: the owners of an industry-specific factor and environmentalists. The process of regulatory capture is modelled via a political-support-function approach. Two cases are distinguished. First, the lobbies capture only single policy instruments. Second, they capture environmental policy as a whole. It is seen that some counter-intuitive results turn up, and this is explained by the fact that lobbies and policy makers are interested in providing protection in the most efficient way. Then we look at the large-country case where environmental policies affect the terms of trade. It is seen that regulatory capture may lead to welfare gains since lobbies sometimes happen to internalise part of the external effects arising in the international policy game.

1 The Problem

Most of the theoretical literature on environmental regulation in open economies has looked at optimal policies. See *Markusen* (1975), *Merrifield* (1988), *Rauscher* (1991a), *Krutilla* (1992). What are the emission tax rates or environmental standards that would be chosen by a benevolent government in order to maximise social welfare? Unfortunately governments are not benevolent in reality. Therefore, the optimal policies derived in this literature may serve as a reference point of what can be achieved, but they do not explain what is. In the real world, policies and policy instruments chosen by governments and administrations are rarely those which are regarded as being optimal by the economic theorist. In environmental policy, the command-and-control approach is still much more common than emission taxes or tradable permits although the merits of these instruments have been praised by economists for decades. In trade policy, protectionism is omnipresent and there is even a tendency to move from relatively efficient instruments (tariffs) to inefficient ones (voluntary export restraints).

There are in principle two ways of explaining the deviations of actual policy decisions from the ones recommended by economic theorists.

- Firstly, the voting process itself may lead to inefficient policies. Economic welfare analysis is usually based on the concept of the representative individual whose utility is to be maximised. If voting behaviour is introduced, however, differences between individuals begin to matter. In a direct democracy, the policies are deterermined by the preferences or perceptions of the median voter. And the interests of the median voter may differ from the interests of the average voter, who may be view as the representative individual of the economy. Since income and wealth distributions are usually skewed to the left, i.e. the majority of the voters (and the median voter as well) is relatively poor, this theory would predict a tendency of redistribution from the rich to the poor. As long as the proposal is a lump-sum redistribution scheme, this does not cause inefficiencies. If, however, the policy instruments to be decided upon affect the allocation of resources in the economy (like tariffs and environmental taxes), the resulting policy tends to be distortive.
- Secondly, in most countries the voter does not decide directly on issues that are relevant for her or him. Most decisions are delegated to the government or to the public administration. Since the control of the politician by the electorate is imperfect, politicians enjoy discretion in their decisions and they will use this discretion to maximise their own well-being. For instance, they may be able to increase their political support by giving presents to her clientele. Since this is usually not done by lump-sum transfers, non-efficient policies are likely to be adopted. Moreover, in the competition for these presents, resources tend to be wasted for redistributional purposes.

The median-voter model is useful in explaining economic and environmental policies in direct democracies like Switzerland, where voters themselves can decide on issues they consider to be relevant. But even in situations where voters do not decide directly, the results of the median-voter model are useful as a benchmark. If the well-being of the policy maker in a representative democracy depended only on the preferences of the voters, she would act as an agent of the median voter and choose the appropriate policies. See also *Mueller* (1989, ch. 10). The median-voter model will not be discussed here. For an application to the theory of tariff formation see *Mayer* (1984). He has shown that trade policy tends to be biased if the factor-ownership distributions differ between factors. The median voter over-represents the interests of the more equally distributed factor. If it is realistic to assume that the distribution of environmental harm across the population is more equal than the distribution of capital ownership, there is not much reason to argue that the resulting environmental policy should be biased by protectionist interests.

The emphasis in this paper, however, will be placed on the decisions that are made in representative democracies. In particular we are interested in the problem of regulatory capture, i.e. in situations where policies that are meant to enhance economic welfare are modified to serve the idiosyncratic interests of powerful subgroups of society.[1] Examples are environmental product standards that discriminate against foreigners and the enforcement of domestic environmental process standards outside the territory of a country. The policy instruments considered in the model are environmental taxes, standards, and tariffs, and the idiosyncratic groups are sector-specific factors of production and environmentalists.

2 Representative Democracy and the Capture of Environmental Regulation in an Open Economy

Regulatory capture is a problem typical for representative democracies. The term describes a phenomenon where regulatees are able to exert some influence on the regulating

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1 The term "regulatory capture" is due to *Stigler* (1971) and his paper contains some good examples of which shapes regulatory capture can take.

institutions and to bias policy decisions in their own favour. Often, this leads to discrimination against competitors and to the adoption of inefficient policies. We will briefly survey the insights concerning the mechanism of regulatory capture that have been gained by public-choice theorists.

The precondition for regulations to be captured by idiosyncratic interests is that voters are not perfectly informed. If they were, any politician not acting on behalf of the voters would be punished by not being re-elected. *Downs* (1957, chs. 11-13) has argued that a rational voter will indeed be uninformed to some extent because the costs of being well-informed are high. This rational ignorance results in an imperfect control of the policy-making process by the electorate and it gives the politician some discretion in her or his decisions. The discretion is utilised by particular interest groups who are then able to affect political decisions in a way the electorate would not tolerate if it were informed. The basic questions to be answered by a theory of regulatory capture are threefold:

1 Who is interested in influencing the political decision-making process?

2 Who is able to influence the political decision-making process?

3 How is the influence over the political decision-making process exerted?

The first question has a simple answer. Everyone should have an interest in influencing the political process in her or his favour. However, the willingness to spend resources on exerting this influence is unevenly distributed. In many cases, the group of beneficiaries of a policy intervention is rather small whereas the group of losers is large.[2] In a direct democracy with majority voting, such a policy would not be adopted. In a representative democracy this may be different. The willingness to spend resources on lobbying activities depends on a number of parameters that ure unevenly distributed among different sub-groups of society. The most important one is group size. If the gains from a policy intervention are highly concentrated, i.e. they are appropriated by a small group, then the gains accruing to an individual member of this group are large. If the welfare losses are widely dispersed, the share of the costs to be borne by an individual member of the losing group is small. Thus, an individual belonging to the first group has a large incentive to place effort and resources on activities directed towards an influence on politics whereas the incentive is small in the case of a member of group two. Typically, group one consists of the producers that are active in a particular industry; group two usually consists of consumers or tax payers. The consumers of environmental quality constitute a special case. About twenty years ago, they would have fallen into category two. However, this has changed with the raising influence of non-governmental environmental organisations and green lobbying is becoming increasingly important.[3]

For the construction of a model in which interest groups matter, a decision has to be made whether to use a partial or a general-equilibrium framework. In the partial equilibrium framework, one neglects the possibility that the general-equilibrium repercussions of policy measures may offset their direct and straightforward effects.[4] It may, however, not be far-fetched to assume that lobbyists are usually unaware of the general-equilibrium effects of their

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2 An example is trade protection of an industry by tariffs or subsidies. The gains accrue to workers and capital owners in this particular industry whereas the costs have to be borne by the economy as a whole.

3 It may be true that the power of green lobbies has been over-emphasised in the past. *Peirce* (1991, p. 282), for instance shows that out of more than 500 pressure groups that are formally represented at the European Communities only seven represent consumers' or environmentalists' interests.

4 See *Rauscher* (1994a) for a model where interest groups lobbying for "competitiveness" benefit from stringent environmental policies because the general-equilibrium effects of such a policy are positive and dominate the direct increase in production costs. The general-equilibrium framework has been used by *Young/Magee* (1986) and *Magee/Brock/Young* (1989) for the investigation of trade barriers.

activities. Moreover and more importantly, the model framework is decisive for the identification of what constitutes an interest group. Partial-equilibrium and specific-factors models find that interest groups are sector-specific whereas the Heckscher-Ohlin model predicts that sectoral effects of policy changes are irrelevant because, in the long run, factors are perfectly mobile across sectors. Thus, they are completely indifferent where to be employed. The Stolper-Samuelson theorem predicts that factors of production should constitute economy-wide interest groups. Empirical evidence presented by *Magee* (1980) suggests strongly that industry-specific rather than factor-specific lobbying coalitions are formed when trade policy is at disposal. This indicates that interest group formation is based mainly on short-term objectives and that the potential to move to another sector if one's own industry is hit by a policy measure is not considered to be a realistic alternative. Therefore, we will choose a model framework where factors are tied to a particular sector of production.

If a group of persons is interested in achieving a policy change, this is a necessary but no a sufficient condition for the change actually taking place. Each interest group faces an internal free-rider problem. By fighting for her own interest, a group member also fights for the other group members. Thus, she provides a public good and like all public goods this public good will be under-provided: the marginal benefit to the individual is smaller than the marginal benefit to the group. Interest groups have to overcome this free-rider problem to be influential. The conditions for this are that the group be small, that the group be homogeneous and have a common interest. See *Olson* (1965). A relatively small and homogeneous group like a dozen steel producers in a single country may be more effective in solving their free-rider problem than the large and heterogeneous group of downstream producers, consumers and tax payers that may be negatively affected if the government decides to support the steel industry by means of tariffs, subsidies or administered prices.

The relationship between the policy maker and a lobbyist may be thought of as one of mutual exchange of gifts or of supply and demand. The lobbyist demands economic support from the policy maker and can help the policy maker to increase her political support. The policy maker is desirous of political support and can supply economic support to the lobbyist. There is a potential for gains from trade. The exchange of gifts may take the following shape. In a situation where voters are imperfectly informed about what is going on in politics, the politician can increase her political support, e.g. the probability of being re-elected, by spending money on advertising. This money is offered by specific interest groups that are ready to contribute to the politician's election campaign if the politician recognises the needs and wants of these interest groups in a sufficient manner.

The exchange of gifts can be modelled in various ways. See *Ursprung* (1991). The most realistic framework is the multi-lobby multi-party model. In this model, also referred to as the interest-group-cum-electoral-competition model, two games take place at the same time. Interest groups play against each other by giving campaign contributions to different candidates. The candidates themselves play against each other by choosing their policies such that their probabilities of being elected are maximised. These two games are linked because the probabilities of being elected depend on the campaign contributions the lobbies are willing to make. For applications of this model framework to trade policy see *Young/Magee* (1986) and *Hillman/Ursprung* (1992,1994).[5] A simpler way of modelling interest group influence on public policies is to assume that political platforms are given. In this case, the whole problem reduces to a probabilistic voting model which can be thought of as a special case of a rent-

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5 A special variation of this type of models has been considered by *Laffont/Tirole* (1991) who distinguish the government as a legislator and the public administration as the government's agent. Both may be subject to lobbying activities by interest groups and *Laffont/Tirole* derive policy equilibria with regulatory capture.

seeking game. See *Tullock* (1980) for the original contribution and *Brooks/Heijdra* (1989), *Mitchell/Munger* (1991) and *Nitzan* (1994) for surveys. This modelling framework has been applied to environmental policy by *Bartsch/Rauscher/Thomas* (1993). An even simpler category of models emerges if the so-called political-support function approach is considered. It is assumed that the policy maker is influenced by various interest groups and the policy maker's objective function is a weighted average of the welfare functions of the individual lobbies. This approach is due to *Peltzman* (1976) who used it to model regulatory capture. The political-support function model may be thought of as a reduced form of a more complicated model involving games between interest groups and policy makers who wish to maximise the probability of being elected. See *Coughlin/Mueller/Murrell* (1990) and *Grossman/Helpman* (1994).

Finally, the government and the members of state bureaucracy have some independent goals and may be able to follow them due to the lack of control by the voter. These goals include maximisation of the tax revenue, shirking and unproductive status-signalling activities. See *Niskanen* (1973), for instance. Of course, these objectives are not idiosyncratic to the public sector and its employees. Employees of private firms have similar interests but they are often better controlled and the incentives to perform well are usually stronger. Although the leviathan state is an interesting subject of economic analysis, it will not be addressed here. The activities of a Leviathan government in a trading economy are not much different from those in a closed economy and, therefore, their consideration would not contribute much to the analysis of regulatory capture of environmental policies in a trading economy.[6]

For the following analysis, I have chosen a partial-equilibrium framework. A single import-competing industry is considered. The foreign industry produces a similar good which the home country imports. These goods are close substitutes and, therefore, the possibilities to pass increases in the production costs through to the consumers are limited. In order to keep the model tractable, I assume that the firms act as price takers. If there were non-price taking behaviour, the optimal emission tax rate should contain components that correct for the market imperfection. In order to avoid this, we will start from a competitive setting.[7] The lobbies are an industry-specific factor of production and an environmentalist interest group. The environmental-policy instruments that are subject to regulatory capture in this model are taxes on emissions from production and consumption and a minimum environmental product quality standard.[8]

3 A Partial-Equilibrium Model Regulatory Capture

Consider a market where two goods are traded. One good is produced in the home country and the other one is imported from abroad. These goods are substitutes. Firms maxim-

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6 Moreover, many of the results would be ambiguous anyway. If, for instance, one includes the target of administering a large budget in the policy maker's objective function, the effect on the optimal tax rate may be positive or negative, depending on whether tax revenue is an increasing or declining function of the tax rate. In the case of a hill-shaped Laffer curve, the effect on the optimal tax rate depends on whether the tax rate which generates the maximum tax revenue is located to the left or to the right of the welfare-maximising tax rate.

7 *Hillman/Ursprung* (1992,1994) have looked at models with non-competitive producers. They lobby for increases in profits and the paper shows that the lobbying equilibria depend, inter alia, on the market structure, i.e. on the number of firms.

8 The issue of choice of instruments will be neglected. For instance, there are good reasons as to why industries as well as environmentalists may prefer quantitative instruments of environmental policy to taxes or tradable-permits schemes, in particular under non-competitive market conditions. See *Hoekman/Leidy* (1992) and *Leidy/Hoekman* (1994). However, these arguments are not altered by the existence of trade and the desire for protection from foreign competition and, therefore, this issue will not be taken up here.

ise their profits and take prices as given. The government can use its environmental policy to give protection to domestic industries that compete in international markets. It can do this in three ways. Firstly, taxes that internalise consumption externalities can be modified such that they discriminate against foreign products. This is nothing else but a tariff policy. Secondly, the government may relax emission taxes or environmental standards and pollution abatement requirements for particular production processes or industries. This reduces production costs and, therefore, has the character of a hidden subsidy. Thirdly, environmental product standards may be used to discriminate against foreign suppliers of goods. It is assumed here that the pollution intensity of consumption is not exogenous but is determined by the producer who decides on the design of the final product. Since environmentally friendly goods are more expensive in their production than less environmentally friendly goods, the government may wish to restrict the choices of the producer by imposing an environmental product standard.[9] Product standards are subtler means of protection than tariffs and they have been a continuous source of international trade disputes. Often it is only a matter of interpretation whether a specific product standard is primarily a measure of environmental protection or consumer safety or a means of discrimination against imports.[10] From the view point of the policy maker, these standards have the great advantage of providing protection in a rather discreet way. Environmental protection and environmental protectionism are difficult to disentangle.

I start by presenting the structure of the model. The two countries are name the home and the foreign countries; all lower-case variables refer to the home country and the corresponding upper-cse variables refer to the foreign country. Let us assume that there are constant returns to scale. The unit-cost function $\hat{c}(.,.,.)$ has as its arguments the environmental tax rate, t^e, the remuneration of the specific factor of production, r, and the environmental product standard, ω, which is measured by the negative pollution intensity of consumption, b: $\omega=-b$. Thus the smaller b, the larger ω and the stricter the environmental regulation. The properties of the unit-cost function are

$$\hat{c}_t > 0,\ \hat{c}_r > 0,\ \hat{c}_{tt} < 0,\ \hat{c}_{rr} < 0,\ \hat{c}_{rt} > 0,\ \hat{c}_{rr}\hat{c}_{tt} - \hat{c}_{rt}^2 \geq 0,$$
$$\hat{c}_\omega > 0,\ \hat{c}_{\omega\omega} > 0,\ \hat{c}_{r\omega} > 0,\ \hat{c}_{t\omega} > 0.$$

The foreign industry's unit-cost function, $\hat{C}(R,T^e,\Omega)$ has the same properties and $\Omega = -B$ is the domestic quality standard for foreign products.

The demand side is characterised by demand functions for domestic and foreign products, $d(p,P)$ and $D(p,P)$, respectively, where p and P are the prices of domestic and foreign goods. The demand functions satisfy

$$d_p < 0,\ d_P > 0,\ D_p > 0,\ D_P < 0,\ d_p D_P - d_P D_p > 0,$$

i.e. none of the goods is a Giffen good, the goods are substitutes and the final inequality is a stability condition which is satisfied if the own-price effects dominate the cross-price effects.

The equilibrium in this market is determined by six equations. Free entry and exit together with profit maximisation imply that the producer prices equal the marginal costs of

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9 Alternatively, the government could use a variable scheme for the taxation of consumption goods, where the tax rate depends on environmental friendliness. Although environmental-quality standards are non-price instruments, they are equivalent to such a tax scheme. If there were uncertainty or problems of rationing in the model or if we considered the possibility of environmental innovation, pecuniary instruments would do better that the command-and-control approach. See *Pearce/Turner* (1990, ch.7) or *Siebert* (1994, ch. 8)

10 See *Hoekman/Leidy* (1992), for instance. European examples are the Danish-bottle case and the purity laws for German beer and Italian pasta, that have all been subject to the jurisdiction of the European Court of Justice.

production, which here equal the unit costs. The final goods prices are determined by adding the consumption tax rates, t^C and T^C. The factor market equilibrium requires that the industry-specific factor is fully employed. Factor demand follows from Shephard's lemma and factor supply (k in the home country and K abroad) is exogenously given and fixed. Finally there are the goods-markets equilibria: supply equals demand, i.e. $q=d(p,P)$ and $Q=D(p,P)$. Two of these equations can be eliminated by combining the conditions for the goods market equilibrium and the factor market equilibrium. Thus, we have

(1) $$p=\hat{c}(r,t^e,\omega)+t^c,$$

(1') $$P=\hat{C}(R,T^e,\Omega)+T^c,$$

(2) $$d(p,P)\hat{c}_r(r,t^e,\omega)=k,$$

(2') $$D(p,P)\hat{C}_R(R,T^e,\Omega)=K.$$

Most of the following analysis will be restricted to the small-country case, i.e. it is assumed that the foreign country's resource constraint, equation (2') is not binding. This implies that the price of the foreign good depends on the foreign environmental policy and on the domestic quality requirement for foreign goods in a very simple fashion:

(3a) $$\frac{dP}{dT^c}=1,$$

(3b) $$\frac{dP}{dT^e}=\hat{C}_T,$$

(3c) $$\frac{dP}{d\Omega}=\hat{C}_\Omega.$$

Total differentiation of equations (1) and (2) gives

(4) $$\begin{pmatrix} 1 & -\hat{c}_r \\ d_p\hat{c}_r & q\hat{c}_{rr} \end{pmatrix}\begin{pmatrix} dp \\ dr \end{pmatrix}=\begin{pmatrix} 1 & \hat{c}_t & \hat{c}_\omega & 0 \\ 0 & -q\hat{c}_{rt} & -q\hat{c}_{r\omega} & -d_P\hat{c}_r \end{pmatrix}\begin{pmatrix} dt^c \\ dt^e \\ d\omega \\ dP \end{pmatrix}.$$

The comparative statics follow from Cramer's rule and the detailed results are reported in the appendix. The qualitative results are summarised in table 1 and in proposition 1.

Proposition I

Tight environmental taxes or standards in the home country raise the price of domestic goods, reduce the output of the domestic industry and raise imports. Tight quality standards on imported goods raise the prices, reduce the demand for imported goods and raises the demand for domestic goods. The effect on the income of the domestic industry's specific factor is ambiguous. Foreign emissions from production are raised. Domestic emissions from production are reduced in the case of an emission tax. The effect of a product standard on domestic emissions is ambiguous.

Table 1: Comparative Statics of the Partial-Equilibrium Model

	Effects of a change in					
on	t^c	T^c	t^e	T^e	ω	Ω
p	+	+	+	+	+	+
P	0	+	0	+	0	+
q	-	+	-	+	-	+
Q	+	-	+	-	+	-
r	-	+	?	+	?	+
e	-	+	-	+	?	+
E	+	-	+	-	+	?

These results can be explained as follows:

- Prices. Tight environmental standards and emission taxes raise the costs of the firms who are subject to these standards and taxes. Part of this is passed through to the consumers in the shape of higher prices. This results in an increased demand for the other good, which is a substitute, and therefore its price rises as well. Environmental consumption taxes raise the price of the affected good and of its substitute. Some of the domestic policy variables do not have an impact on the price of foreign good due to the small-country assumption.
- Output. Tight environmental standards and taxes lead to output reductions in the industry affected by these standards and taxes. The producers of the substitute commodity will raise their output since their price has been risen.
- Rate of return to capital. High taxes and quality standards raise the remuneration of the specific factor of the industry producing the substitute commodity. The increase in the price of the output of this industry induces output expansion and an increase in the demand for the specific factor. Since the supply of this factor is inelastic, its price goes up. The effect on the income of the specific factor of the industry affected directly by the tighter standards or higher taxes is ambiguous in some cases. High consumption taxes unambiguously reduce the remuneration of the specific factor. However, the effects of policy instruments that affect the production costs, i.e. emission taxes and quality standards, are indeterminate. There are two effects, a substitution effect and a demand effect. On the one hand, an increase in emission taxes induces a substitution process: capital for environmental resources. With increased demand for capital and fixed supply, this factor tends to become dearer. On the other hand, the increase in production costs is passed through to the consumer and the consumer reacts by reducing demand. If demand is elastic, the decline in output may be so large that the specific factor becomes more abundant. Its price tends to decline. It can be seen from equations (A1c) and (A1e) in the appendix that effects on the price and on the factor income depend on the own-price effect of domestic demand, d_p. If the absolute value of d_p is large, i.e. if demand is elastic, then the specific factor is harmed by tighter environmental regulation. Otherwise, the substitution effect dominates and the specific factor gains. To make this effect more plausible, consider capital in this model consisting of two components, production capital and abatement capital. The owners of production capital lose if emission taxes are increased, the owners of abatement capital gain. The effect on the aggregate capital stock is ambiguous.
- Emissions. Higher emission taxes induce emission reductions in the industry directly affected. This is plausible. The emissions of the industry in the other country are increased.

This is due to the increase in output and to the increase in the price of the specific factor. The latter effect induces a substitution of environmental resources for the specific factor. The same argument can be used to explain the effect of a tighter product standard on the emissions of the industry producing the substitute. However, the effect of a tighter product standard on the emissions from the directly affected industry is ambiguous. The output is reduced but the emission intensity of production may be increased.

Many of these results are plausible. It is, however, remarkable that even in this simple partial-equilibrium framework some counter-intuitive results are possible. Environmentalists may find ambient quality being negatively affected by tight product standards.[11] Moreover, industry lobbies may be surprised to gain from tight environmental standards even if there are foreign competitors that are not subject to these standards. In this context, it is interesting to note among the domestic policy instruments that address the supply side of the economy (emission taxes and product standards) the only instrument which has an unambiguous effect on the remuneration of the specific factor of the domestic industry is the quality standard on foreign goods. The stricter this standard, the higher the income of the specific factor.

4 Optimal Environmental Policies

In a first step, we will look at a scenario where lobbies do not influence the political decision making process. The difference between this model and many other models of international trade and the environment (i) that we now look at a partial equilibrium, (ii) that domestic and foreign goods are not perfect but only imperfect substitutes and (iii) that product standards are considered as means of environmental policy. In order to concentrate on the effects of interest group influence in the following analysis, it is assumed that transfrontier pollution is negligible and that trade, i.e. international transport, does not cause additional environmental harm. Thus environmental pollution in the home and foreign countries is

(5) $z = ae + bq + BQ,$

(5') $Z = AE.$

a, A, b and B are the pollution impacts of domestic and foreign emissions and of domestic consumption of domestic and foreign goods, respectively. The utility derived from environmental quality is $u(-z)$ and $U(-Z)$, respectively, and the utility functions have the usual properties..

The benevolent government maximises the sum of consumer surplus, profits, the income of the specific factor, the tax revenue and the utility derived from environmental quality.

(6) $w = -\varepsilon(p,P;\upsilon) + (p - t^c)q - \hat{c}(r,t^e,-b)q + rk + t^c q + T^c Q + t^e e + u(-ae - bq - BQ),$[12]

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11 This is not an artifact of the model but this phenomenon is relevant for real-world problems. Improvements of environmental quality in one dimension may cause environmental disruption in another one and it is not clear that the net effect is always positive. It has been argued, for instance, that policies which encourage the recycling of used materials can be counter-productive from an environmental point of view. It is not a priori clear that recycling processes are less environmentally disruptive than the storage or combustion of waste plus the production of final goods involving new raw materials rather than recycled ones. See *Klepper/Michaelis* (1995) for a case study which deals with recycling schemes for metal scrap containing cadmium.

12 Here we do not use the conventional notion of consumer surplus but the negative value of the expenditure necessary to attain a certain level of consumer satisfaction, υ. The vector product of the derivative of this

(6') $$W = PQ - \hat{C}(R, T^e, -B)Q + RK + T^e E + U(-AE).$$ [13]

The policy instruments of the home government are t^c, T^c, t^e, b and B, and the foreign government decides on the foreign emission tax rate, T^e. Differentiation of w and W and the use of Shephard's lemma and the first-order conditions of profit maximisation to eliminate some of the terms yields the following necessary conditions for optimal environmental policies.

(7a) $$(t^e - au')\frac{de}{dt^c} + (t^c - bu')\frac{dq}{dt^c} + (T^c - Bu')\frac{dQ}{dt^c} = 0,$$

(7b) $$(t^e - au')\frac{de}{dT^c} + (t^c - bu')\frac{dq}{dT^c} + (T^c - Bu')\frac{dQ}{dT^c} = 0,$$

(7c) $$(t^e - au')\frac{de}{dt^e} + (t^c - bu')\frac{dq}{dt^e} + (T^c - Bu')\frac{dQ}{dt^e} = 0,$$

(7d) $$(t^e - au')\frac{de}{db} + (t^c - bu')\frac{dq}{db} + (T^c - Bu')\frac{dQ}{db} + \hat{c}_\omega q - u' q = 0,$$

(7e) $$(t^e - au')\frac{de}{dB} + (t^c - bu')\frac{dq}{dB} + (T^c - Bu')\frac{dQ}{dB} + \hat{C}_\Omega Q - u' Q = 0,$$

(7a') $$T^e = AU' - Q\frac{dP}{dT^e}\Big/\frac{dE}{dT^e}.$$

It is assumed that the second-order conditions are satisfied. Equations (7a) to (7e) can be rewritten in matrix notation:

$$\begin{pmatrix} \frac{dq}{dt^c} & \frac{dQ}{dt^c} & \frac{de}{dt^c} & 0 & 0 \\ \frac{dq}{dT^c} & \frac{dQ}{dT^c} & \frac{de}{dT^c} & 0 & 0 \\ \frac{dq}{dt^e} & \frac{dQ}{dt^e} & \frac{de}{dt^e} & 0 & 0 \\ \frac{dq}{db} & \frac{dQ}{db} & \frac{de}{db} & q & 0 \\ \frac{dq}{dB} & \frac{dQ}{dB} & \frac{de}{dB} & 0 & Q \end{pmatrix} \begin{pmatrix} t^c - bu' \\ T^c - Bu' \\ t^e - au' \\ \hat{c}_\omega - u' \\ \hat{c}_\Omega - u' \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}.$$

Since the matrix on the left-hand side has full rank,[14] the optimal policies turn out to be

(8a) $$t^e = au',$$

---

function with respect to the prices and the changes in the prices gives the equivalent variation, which is an exact measure of the change in consumer well-being. See *Varian* (1992, p. 162).

13 One could consider an export tax or subsidy which the foreign country could use to improve its terms of trade but this will be discussed only in an informal way.

14 This follows from the fact that, according to equations (7.A2a,b,c,d,g,h) and (7.A3a,bd)

$$\frac{dq}{dt^c}\Big/\frac{dq}{dt^e} = \frac{dQ}{dt^c}\Big/\frac{dQ}{dt^e} \neq \frac{de}{dt^c}\Big/\frac{de}{dt^e} \text{ and } \frac{dq}{dt^c}\Big/\frac{dq}{dP} = \frac{de}{dt^c}\Big/\frac{de}{dP} \neq \frac{dQ}{dt^c}\Big/\frac{dQ}{dP}$$

(8b) $t^c = bu'$,

(8c) $T^c = Bu'$,

(8d) $\hat{c}_\omega = u'$,

(8e) $\hat{C}_\Omega = u'$,

In the home country, the optimal tax rates equal the marginal environmental damages and the optimal product standard is chosen such that the marginal cost of increasing product quality equals the marginal improvement in environmental quality. It should be noted that even commodities that are very similar from the viewpoint of the consumer can be subject to significantly different quality standards. These differences can be justified from the cost side. Goods whose quality improvement is cheap should be subject to stricter standards than products whose improvement is costly. If the second category of goods were subject to the same regulation as the first one, the loss of consumer surplus due to the high price would exceed the gain in environmental quality. The foreign tax rate (equation (7a') equals the marginal environmental damage plus a positive term due to the terms-of-trade improving effect of tight environmental standards.

4 Lobbies that Influence Single Policy Instruments

Within the framework of the political-support function approach, one can assume that powerful interest groups can capture either environmental policy as a whole or only certain aspects and instruments of environmental policy, e.g. merely the regulation of production or of final-goods design. We start the analysis of regulatory capture by looking at the second case. The more general and more complicated scenario will be discussed later on. Moreover, we will restrict most of the analysis to the case of a single country, the home country. The interactions of lobbying activities in different countries will also be discussed later.

It is assumed that all environmental-policy instruments except the one captured by the interest group remain at their optimal levels and that their optimal levels are not affected by the change in the captured variable. This is only possible if the utility of environmental quality is a linear function of pollution. It is assumed that this is the case for the remainder of this section.[15]

There are two lobbies here, the industry-specific factor and the environmentalists. The specific factor is interested in increasing its income, rk. The environmentalists are concerned about environmental quality. Like *Hillman/ Ursprung* (1992, 1994), I distinguish "greens" and "supergreens". The normal green lobby cares about the domestic environmental quality only; supergreens in contrast take a more global view and are concerned about the environment in the foreign country as well. Thus, the political-support function turns out to be

(9) $\tilde{w} = w + \lambda^k rk + \lambda^g(-z) + \lambda^s(-Z)$

where w is the social-welfare function defined in equation (6), and λ^k and λ^g are the weights of the interest group stakes in the policy maker's objective function. λ^s/λ^g is the importance the green lobby places on foreign environmental quality compared to domestic environmental

15 Note that this assumption implies that the technology and the preferences over the consumption goods are convex enough to assure that the second-order conditions of optimisation hold.

quality. It is reasonable to assume that $0 \leq \lambda^s \leq \lambda^g$. The extreme cases represent the interests of the simple greens and the supergreens, respectively. According to *Grossman/Helpman* (1994), the parameters also reflect the technology the policy maker uses to transform lobbyist contributions into votes or political support:[16]

- λ^k is the relative increase in the political support in case a sum of money previously used in the private sector is given to the policy maker in the shape of a campaign contribution. For example if λ^k=0.5, then an increase in campaign contributions by one dollar raises political support by 1.5 times as much as a one-dollar increase in the disposable income of the private sector.
- λ^g/λ^k is the marginal and average utility the environmentalists derive from domestic environmental quality.
- λ^s/λ^k is the marginal and average utility the environmentalists derive from foreign environmental quality.

Under the assumption that only one policy instrument is captured by the lobbies, the support maximising policies can be derived easily:

$$\text{(10a)} \quad t^e = au' + \left(-\lambda^k k \frac{dr}{dt^e} + \lambda^g \left(a \frac{de}{dt^e} + b \frac{dq}{dt^e} + B \frac{dQ}{dt^e} \right) + \lambda^s A \frac{dE}{dt^e} \right) \Big/ \frac{de}{dt^e},$$

$$\text{(10b)} \quad t^c = bu' + \left(-\lambda^k k \frac{dr}{dt^c} + \lambda^g \left(a \frac{de}{dt^c} + b \frac{dq}{dt^c} + B \frac{dQ}{dt^c} \right) + \lambda^s A \frac{dE}{dt^c} \right) \Big/ \frac{dq}{dt^c}.$$

$$\text{(10c)} \quad T^c = Bu' + \left(-\lambda^k k \frac{dr}{dT^c} + \lambda^g \left(a \frac{de}{dT^c} + b \frac{dq}{dT^c} + B \frac{dQ}{dT^c} \right) + \lambda^s A \frac{dE}{dT^c} \right) \Big/ \frac{dQ}{dT^c},$$

$$\text{(10d)} \quad \hat{c}_\omega = qu' + \lambda^k k \frac{dr}{d\omega} - \lambda^g \left(a \frac{de}{d\omega} + b \frac{dq}{d\omega} + B \frac{dQ}{d\omega} + q \right) - \lambda^s A \frac{dE}{d\omega},$$

$$\text{(10e)} \quad \hat{c}_\Omega = Qu' + \lambda^k k \frac{dr}{d\Omega} - \lambda^g \left(a \frac{de}{d\Omega} + b \frac{dq}{d\Omega} + B \frac{dQ}{d\Omega} + Q \right) - \lambda^s A \frac{dE}{d\Omega}.$$

Notice that equations (10a) to (10e) represent five different scenarios in which only one policy instrument is captured by the interest groups. For each of these scenarios, there exist four additional optimality conditions like equations (8a) to (8e) which determine the policy variables that are not captured by the interest groups.

The results summarised in table 1 can be used to determine the biases in environmental policies that re caused by regulatory capture:

- Emission taxes. The view of the specific factor is ambiguous. On the one hand, emission taxes are bad because they raise costs and prices and reduce the demand for the domestic good. On the other hand, substitution processes are induced and there may be an increased demand for factors that are substitutes for environmental resources. It seems as if in the present discussion of environmental policy much more emphasis is placed on the first argument. If this is true, the specific factor is anti-green. The view of the greens is ambiguous as well. Of course, domestic emissions will be reduced and the demand for dom-

---

16 *Grossman/Helpman* (1994) use a slightly different notation. The following propositions follow from their equations (5) and (11) and from footnote 5 if the notation is adapted properly.

estic goods will decline. This is good for the environment. But here will be substitution processes on the demand side. The demand for foreign goods will be increased and since consumption is environmentally harmful, the environmentalists may have an interest in avoiding too-high tax rates.[17] If the greens care about foreign environmental quality as well, the emission tax rate is reduced even further.

- Taxes on the consumption of the domestic good. The specific factor opposes these taxes since they reduce its income. The view of the environmentalists is ambiguous again. Domestic emissions and consumption of the home good are reduced but production of and consumption of the foreign good are increased.
- Taxes on the consumption of the foreign good. The specific factor gains from these taxes. The green position is ambiguous. Foreign emissions and consumption are reduced by a large tax rate, but domestic emissions and consumption are raised.
- Quality standards for domestic goods. The position of the specific factor is ambiguous for the same reason as in the case of emission taxes. The position of the greens is indeterminate as well. High environmental quality standards reduce the pollution per unit of the goods consumed as well as the number of the units of good itself, but the demand for foreign goods is raised and foreign emissions in the production process are increased. The effect of emissions from domestic production is ambiguous. It is possible, though unlikely, that they are increased by tight quality standards.
- Quality standards for foreign goods. The specific factor will always benefit from this non-tariff barrier to trade. The green position depends on the model parameters again. Tight product standards reduce the pollution impact parameters and reduce demand for the regulated good. However, the domestic substitute will be produced and consumed in greater quantities and this causes additional environmental disruption. The effect on foreign emissions is ambiguous, but under normal circumstances, they tend to decline.

The positions of the two interest groups towards the various policy instruments are less obvious than one would guess after a first thought. In particular, the green position always depends on the parameters of the model since policies that reduce domestic emissions and consumption of the domestic good tend to raise foreign emissions and the consumption of the foreign good. If, however, the own-price elasticities of the goods are substantially larger than the cross-price elasticities, then the indirect effects of a policy, which affect the production and consumption of the substitute good, are dominated by the direct effects and the green position is unambiguous:

Proposition 2

If the power of the specific factor in the lobbying process is large, then the quality requirements foreign goods have to meet are too high, the tax on consumption of foreign goods is too high and the tax on consumption of domestic goods is too low. If the direct effects of environmental regulation dominate its indirect effects, strong green lobbies tend to bias the environmental policy towards high emission taxes, high consumption taxes, and high environmental product standards.

As a corollary, we obtain

---

17 Equations (7.A2c) and (7.A2d) reveal that besides the pollution intensity parameters b and B, the values of the own-price elasticity of demand for the domestic good and the cross-price elasticity of the foreign good decide on the sign of the net effect of the changes in consumption on environmental quality.

Proposition 3

If the direct effects of environmental regulation dominate its indirect effects, then industrial and green lobbies have a common interest in strict standards for the quality of foreign goods and high taxes on the consumption of foreign goods. They are opposed to each other in the case of taxation of consumption of domestic goods. They may be opposed to each other in the cases of emission taxation and domestic product quality standards but it is also possible that both of them lobby for high domestic emission taxes and strict quality standards for domestic goods.

This result has the following implications:

- High taxes on foreign consumption goods may be in the interest of domestic producers and environmentalists, but tax differences (which are nothing else but tariffs) are very obvious instruments of protection and, therefore, resistance by foreign producers and the foreign government has to be expected.
- High environmental quality standards for foreign goods serve the interests of domestic industry lobbies and tend to be supported by environmentalists. Moreover, and this is important for real-world issues, they are often not easy to be detected as protectionist devices.
- The last part of the proposition is a bit surprising. Industry specific factors profit from tight regulation if the price elasticity of demand is small. Then the substitution effect dominates the demand effect and strict environmental policies raise the factor income. This result is a consequence of the introduction of aggregate capital as a homogeneous factor of production. The share of this capital which is used for pollution abatement will profit from tight environmental standards but it is questionable whether in reality this effect is strong enough to offset the negative impact of tight taxes and standards on the remuneration of normal production capital. [18]

Thus, the implication of this model for practical purposes is that of the instruments discussed here the discriminative use of environmental product standards is the only one which (i) is likely to be supported by a coalition of lobbies in the home country and (ii) whose protectionist content can be obfuscated rather easily. Thus, such standards are first choice if environmental and trade protection are to be combined.

5 Regulatory Capture of More than One Policy Instrument

Let us now turn to the more general case where the lobbies influence environmental policy as a whole. Again the policy maker's objective is to maximise her political support, defined by the political-support function, equation (9). In matrix notation, the first-order conditions are

[18] It should be noted that this is not a phenomenon specific to open economies; it is also relevant for industries that are not affected by international trade.

$$
(11)\quad
\begin{pmatrix}
\frac{dq}{dt^c} & \frac{dQ}{dt^c} & \frac{de}{dt^c} & 0 & 0 \\
\frac{dq}{dT^c} & \frac{dQ}{dT^c} & \frac{de}{dT^c} & 0 & 0 \\
\frac{dq}{dt^e} & \frac{dQ}{dt^e} & \frac{de}{dt^e} & 0 & 0 \\
\frac{dq}{db} & \frac{dQ}{db} & \frac{de}{db} & q & 0 \\
\frac{dq}{dB} & \frac{dQ}{dB} & \frac{de}{dB} & 0 & Q
\end{pmatrix}
\begin{pmatrix}
t^c - bu' - b\lambda^g \\
T^c - Bu' - B\lambda^g \\
t^e - au' - a\lambda^g \\
\hat{c}_\omega - u' - \lambda^g \\
\hat{C}_\Omega - u' - \lambda^g
\end{pmatrix}
=
\begin{pmatrix}
\lambda^s A\frac{dE}{dt^c} - \lambda^k k\frac{dr}{dt^c} \\
\lambda^s A\frac{dE}{dT^c} - \lambda^k k\frac{dr}{dT^c} \\
\lambda^s A\frac{dE}{dt^e} - \lambda^k k\frac{dr}{dt^e} \\
\lambda^s A\frac{dE}{db} - \lambda^k k\frac{dr}{db} \\
\lambda^s A\frac{dE}{dB} - \lambda^k k\frac{dr}{dB}
\end{pmatrix}.
$$

The second-order conditions are assumed to be satisfied. Due to equations (A1b,d,f,h), (A2a,c,e,g) and (A4a) to (A4e) in the appendix, this can be rewritten

$$
(12)\quad
\begin{pmatrix}
\frac{dq}{dt^c} & \frac{dQ}{dt^c} & \frac{de}{dt^c} & 0 & 0 \\
\frac{dq}{dT^c} & \frac{dQ}{dT^c} & \frac{de}{dT^c} & 0 & 0 \\
\frac{dq}{dt^e} & \frac{dQ}{dt^e} & \frac{de}{dt^e} & 0 & 0 \\
\frac{dq}{db} & \frac{dQ}{db} & \frac{de}{db} & q & 0 \\
\frac{dq}{dB} & \frac{dQ}{dB} & \frac{de}{dB} & 0 & Q
\end{pmatrix}
\begin{pmatrix}
t^c - bu' - b\lambda^g - \frac{\hat{c}_r}{q\hat{c}_{rr}}k\lambda^k \\
T^c - Bu' - B\lambda^g - A\hat{C}_T\lambda^s \\
t^e - au' - a\lambda^g \\
\hat{c}_\omega - u' - \lambda^g \\
\hat{C}_\Omega - u' - \lambda^g
\end{pmatrix}
=
\begin{pmatrix}
0 \\
0 \\
\lambda^k k\frac{\hat{c}_{rt}}{\hat{c}_{rr}} \\
-\lambda^k k\frac{\hat{c}_{r\omega}}{\hat{c}_{rr}} \\
-\lambda^s A\hat{C}_{T\Omega}Q
\end{pmatrix}.
$$

Using results from the appendix, one can conclude that:

$$
(13a)\quad t^c = bu' + b\lambda^g + \frac{\hat{c}_r\hat{c}_{tt} - \hat{c}_t\hat{c}_{rt}}{q\left(\hat{c}_{rr}\hat{c}_{tt} - \hat{c}_{rt}^{\,2}\right)}k\lambda^k,
$$

$$
(13b)\quad T^c = Bu' + B\lambda^g + A\hat{C}_T\lambda^s,
$$

$$
(13c)\quad t^e = au' + a\lambda^g + \frac{k\hat{c}_{rt}}{q\left(\hat{c}_{rr}\hat{c}_{tt} - \hat{c}_{rt}^{\,2}\right)}\lambda^k,
$$

$$
(13d)\quad \hat{c}_\omega = u' + \lambda^g + \frac{k\left(\hat{c}_{rt}\hat{c}_{t\omega} - \hat{c}_{r\omega}\hat{c}_{tt}\right)}{q\left(\hat{c}_{rr}\hat{c}_{tt} - \hat{c}_{rt}^{\,2}\right)}\lambda^k,
$$

$$
(13e)\quad \hat{C}_\Omega = u' + \lambda^g - A\hat{C}_{T\Omega}\lambda^s.
$$

If u' is constant, the impact of the lobbying activities can be derived directly from these equations:

- The taxation of domestic consumption goods is affected positively by environmental lobbies and negatively by the lobby of the specific factor. This result is intuitive. Concerns about foreign environmental quality do not influence the taxation of domestic goods.

- Taxes on foreign consumption goods are increased if domestic concern about environmental quality at home and abroad rises. The interests of the industry-specific factor have no impact on the tax rate. At a first glance, this is surprising since domestic industries would get protection by high tax rates on foreign goods. This is nothing else but a tariff. However, it is well-known that the same degree of protection can be achieved more efficiently by means of direct subsidies, i.e. by lowering the consumption tax rate of the good the industry produces itself. Since the policy maker maximises her political support, she will always choose the most efficient means of supporting the lobbies.
- Emission taxes are positively influenced by domestic environmental lobbies and by the specific factor of production. They are not affected by concerns for foreign environmental quality. That the influence of green lobbies on the policy making process raises emission taxes is not surprising. The positive effect of industry lobbying, however, is counter-intuitive and deserves an explanation. As has been shown earlier, a high emission tax rate has two effects on the remuneration of capital. There is a negative effect due to the decline in demand and a positive effect due to substitution. The efficient policy to deal with the demand effect is a subsidy on consumption. A lower emission tax rate achieves the same objective in a more costly way and is, therefore, not chosen by a rational policy maker. However, the efficient way to induce substitution processes that benefit the specific factor is a high emission tax. This result becomes more intuitive if the specific factor is interpreted as an aggregate of two factors one of which is used for output expansion and the other one for pollution abatement. The pollution-abating factor gains from strict regulations. The capacity factor benefits from lax regulation but it can be helped in a more efficient way by means of low consumption taxes.[19]
- Domestic product standards are positively affected environmentalists and by industry lobbies. That industry lobbies seem to like tight environmental standards, has the same reason as in the case of emission taxes. The demand effect can be addressed in a more cost-effective way by relaxing consumption taxes. However, high-quality goods require more of the specific factor for their production than low-quality goods and this raises its remuneration.
- Standards on foreign product quality are influenced by the concerns of domestic environmentalists about domestic and foreign environmental quality. Surprisingly, the influence of supergreen lobbies leads to less restrictive environmental product standards. To interpret this result, recall that an increase in the product quality has two effects. On the one hand, demand is reduced, output goes down, and this improves environmental quality. On the other hand, cleaner products have higher production costs, i.e. they require more inputs. Since one of these inputs is an environmental resource, tighter product standards tend to raise the emission intensity of production. The efficient way to deal with the first effect is a tax on consumption, but not a quality standard. See equation (13b). The remaining second effect can be addressed by a reduction in the product quality standard.

The results derived here can be summarised as follows:

---

19 The result that a competition among pressure groups favours efficient policy instruments has been established by *Becker* (1983, p. 386). For the present model, it can be shown that the combined effects of low consumption taxes and high emission taxes are indeed beneficial to the specific factor. Consider an initial situation without lobbying, i.e. $\lambda^k=0$. Then a marginal increase in λ^k reduces the consumption tax rate and increases the emission tax rate. Using equations (7.A1b) and (7.A1c) from the appendix, one can establish that

$$\frac{dr}{d\lambda^k}=\frac{-d_p\hat{c}_r^2\hat{c}_{ll}-q\hat{c}_{rl}^2}{\left(\hat{c}_{rr}\hat{c}_{ll}-\hat{c}_{rl}^2\right)\left(q\hat{c}_{rr}-d_p\hat{c}_r^2\right)}k/q>0$$

Proposition 4

Lobbying activities of the industry-specific factor result in low consumption taxes on domestic goods, high emission taxes and high environmental quality standards of domestic goods. Green lobbying leads to high taxes on production emissions, on the consumption of domestic and foreign goods and to tighter product quality standards. The influence of supergreen lobbies leads to higher taxes on the consumption of foreign goods and to less restrictive quality standards for these goods.

The results concerning the influence of the industry-specific factor are counter-intuitive and perhaps also counter-factual. They are due to the assumption that the government acts completely rationally and always uses the most efficient instrument to provide protection to th interest group. Owners of pollution abatement capital are supported by standards and taxes that influence the production process. Owners of usual production capital are subsidised by means of low consumption taxes but not by means of any other instruments since their use would cause greater income losses to the general public than subsidisation. Anecdotal evidence, however, suggests that industry lobbies tend to lobby for lax emission taxes and product standards rather than for the converse, the only exception being standards that affect the foreign competitors more severely than the domestic industry itself. The results derived from the theoretical model, therefore, raise the question as to whether the political-support-function model is a realistic description of the impact of idiosyncratic interest groups on the policy-making process.

There are (at least) three candidates for an explanation of the differences between theory and the stylised facts. Two of them concern the foundations of the theoretical model and the third one concerns the empirical evidence. In regard to the empirical evidence, one has to note that observed lobbying activities do not provide a genuine test of the predictions of the model. The model does not predict that industry lobbies are interested in tight standards and taxes but that tight standards and taxes are what they get as a outcome of the political process. And this is a different matter. It is very difficult - if not impossible - to test such a hypothesis empirically. As far as the model framework is concerned, two types of shortcomings may be responsible for counter-intuitive results. On the one hand, real economic agents may act in a much less rational way than the model underlying the political-support-function approach assumes. If this is the case, the rationality assumption has to be substituted by something else. On the other hand, the model lacks some of the aspects that are important in the real policy-making process. Probably the most important of these is obfuscation. See *Magee/Brock/Young* (1989, ch. 18). The political support a policy maker acquires does not only depend on the gains and losses that accrue to different groups in society but also on the visibility of these gains and losses. From the point of view of the policy maker, inefficient policy instruments may be useful if they allow to hide the costs of distortive policies. For this purpose, environmental quality standards and technological product standards may much more useful than price instruments like taxes, that make the costs and benefits of a policy measurable and, thus, more obvious. Obfuscation could be introduced into this model in an ad-hoc fashion rather easily but a behavioural model which models the voter's information problems explicitly would be preferable, albeit more difficult to construct and to solve.

This discrepancy between theoretical results and anecdotal evidence is not only a deficiency of the model under consideration here. In general, the problem as to why in reality inefficient policy instruments are often preferred over efficient ones is one of the puzzles that remains to be solved by political-economy models of regulation. See *Rodrik* (1994) for an overview. Further research into this direction is needed.

6 Lobbying Activities in the Large-Country Case

Up to now, it has been assumed that the home country is small, i.e. the foreign country is so large that is faces no constraint on the use of the specific factor. This constraint is introduced now. In order to keep the model tractable, assume that consumption now does not affect environmental quality significantly and there are no taxes on consumption and no environmental quality standards.

Total differentiation of equations (1), (1'), (2) and (2') yields

$$(14)\qquad \begin{pmatrix} 1 & 0 & -\hat{c}_r & 0 \\ 0 & 1 & 0 & -\hat{C}_R \\ d_p\hat{c}_r & d_P\hat{c}_r & q\hat{c}_{rr} & 0 \\ D_p\hat{C}_R & D_P\hat{C}_R & 0 & Q\hat{C}_{RR} \end{pmatrix} \begin{pmatrix} dp \\ dP \\ dr \\ dR \end{pmatrix} = \begin{pmatrix} \hat{c}_t & 0 \\ 0 & \hat{C}_T \\ -q\hat{c}_{rt} & 0 \\ 0 & -Q\hat{C}_{RT} \end{pmatrix} \begin{pmatrix} dt^e \\ dT^e \end{pmatrix}.$$

The results of the comparative-statics analysis are given in appendix 2. They are straightforward and intuitive:

- Prices are raised by high emission taxes. Production of the good affected directly by such a tax becomes more costly and part of this cost increase is passed through to the consumer. This raises demand for the substitute good and, therefore, its price is raised as well.
- Higher emission taxes reduce emissions by the industry affected directly and raise the emissions in the country producing the substitute good. The first effect is intuitive and the second one can be explained by the increased demand for the substitute good.
- High emission taxes raise the remuneration of the specific factor of the industry producing the substitute good. The effect on the remuneration of the specific factor employed in the industry directly affected by the tax increase is ambiguous. The underlying rationality is the same as before. There is a positive substitution effect and a negative demand effect.

A benevolent government maximises the sum of consumer surplus, profits, the income of the specific factor, the tax revenue and the utility derived from environmental quality.

$$(15)\qquad w = -\varepsilon(p,P;\upsilon) + pq - \hat{c}(r,t^e,b)q + rk + t^e e + u(-ae),$$

$$(15')\qquad W = PQ - \hat{C}(R,T^e,B)Q + RK + T^e E + U(-AE).$$

Each country chooses its emission tax rate, t^e and T^e, respectively. Differentiation of w and W and the use of Shephard's lemma and of the first-order conditions of profit maximisation to eliminate some of the terms yields the necessary conditions for optimal environmental policies:

$$(16)\qquad t^e = au + Q\frac{dP}{dt^e}\Big/\frac{de}{dt^e},$$

$$(16')\qquad T^e = AU' - Q\frac{dP}{dT^e}\Big/\frac{dE}{dT^e}.$$

Environmental policy has a terms-of-trade effect. Similar results have been derived in other papers in a general-equilibrium framework. See *Markusen* (1975), *Rauscher* (1991a), and *Krutilla* (1992). The foreign country uses high emission taxes to raise its export price. The home country has an incentive to use low emission tax rates in order to keep the import price low. This may be called environmental dumping since the emission tax rate does not cover the

marginal environmental damage. However, this policy is applied to an import-competing industry that does not sell its output on foreign markets. Thus the term "dumping" is a bit misleading.

Equations (16) and (16') constitute a Nash equilibrium in which both governments take as given the emission tax rates in the other country and choose their best responses. This non-cooperative equilibrium is not efficient since there are external effects of environmental policies in one country on the other country's welfare. These external effects are

$$(17) \qquad \frac{dw}{dT^e} = -Q\frac{dP}{dT^e} < 0,$$

$$(17') \qquad \frac{dW}{dt^e} = Q\frac{dP}{dt^e} > 0.$$

Thus, we have

Proposition 5

Benevolent governments choose a less than Pigouvian emission tax rate in the home country and a higher than Pigouvian emission tax rate in the foreign country. The home country would benefit if the foreign government reduced the tax rate. The foreign country would benefit if the home government raised the emission tax rate.

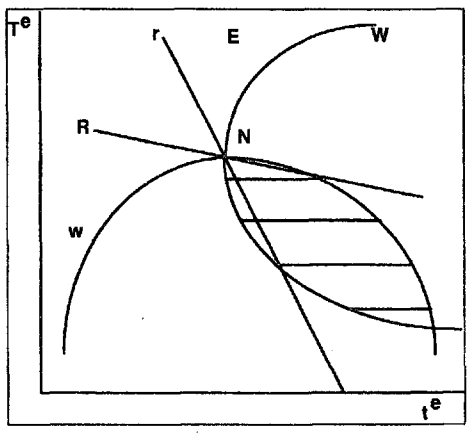

Figure 1: Non-cooperative environmental policies

This is represented graphically in figure 1. It is assumed here that emission taxes are strategic substitutes, i.e. the reaction curves are negatively sloped.[20] This may be interpreted as aggressive behaviour by the two governments. An increase in the foreign country's emission tax

20 See *Rauscher* (1991b) for conditions that are sufficient for negatively sloped reaction curves in a model with international factor mobility. There, the same kinds of externalities turn up.

rate is bad for the home country. The home government reacts by reducing its own emission tax rate, which is bad for the foreign country. The foreign country reacts in a similar "tit-for-tat" fashion to tax reductions in the home country.[21] This is shown in a (t^e,T^e) diagram where r and R are the reaction functions of the home and the foreign governments, respectively, N is the Nash equilibrium and w and W are the corresponding iso-welfare lines whose shapes follow from equations (17) and (7,17'). The shaded area denotes the potential of Pareto improvements. Both countries could be better off if the home country increased its emission tax rate and the foreign country reduced its tax rate.

Now the effects of regulatory capture are investigated. The domestic and foreign political-support functions are

$$\tilde{w} = w + \lambda^k rk + \lambda^g(-ae) + \lambda^s(-AE), \tag{18}$$

$$\tilde{W} = W + \Lambda^k rk + \Lambda^g(-AE) + \Lambda^s(-ae). \tag{18'}$$

Maximisation with respect to the emission tax rates, t^e and T^e, yields the following results.

$$t^e = au' + \lambda^g + \left(Q\frac{dP}{dt^e} + \lambda^s A\frac{dE}{dt^e} - \lambda^k k\frac{dr}{dt^e}\right)\Big/\frac{de}{dt^e}, \tag{19}$$

$$T^e = AU' + \Lambda^g + \left(-Q\frac{dP}{dT^e} + \Lambda^s a\frac{de}{dT^e} - \Lambda^k k\frac{dR}{dT^e}\right)\Big/\frac{dE}{dT^e}. \tag{19'}$$

The impacts of the lobbies on the outcome of the political process follow directly the comparative static results:

Proposition 6

Green lobbying tends to bias emission taxes upwards. This is mitigated if environmentalists care about foreign environmental quality. The impact of the specific factor's lobbying is ambiguous.

The first part of this proposition is intuitive. The consideration of supergreen interests in the policy-making process leads to lower taxes since low emission taxes in one country reduce the demand for the substitute commodity and, therefore, the emissions discharged in the other country. The ambiguity in the impact of the specific-factor interests follows from the opposite signs of the two effects tax changes on the remuneration of the specific factor.

The results stated in proposition 6 refer to the case where the emission tax rate in the other country is given. I.e., the proposition shows into which direction the a country's reaction curve is moved by the process of regulatory capture. The effect on the non-cooperative equilibrium can be investigated most easily by means of diagrammatic methods. This is done in figure 2 where it has been assumed that emission taxes are strategic substitutes and where only one country is affected by regulatory capture. Regulatory capture in both countries can be analysed easily by looking at combinations of the shifts in the reaction curves.

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21 The term "tit for tat" does not have a game theoretic meaning here. Tit-for-tat strategies in a game theoretic sense are possible only in repeated games but not in this static one-shot game.

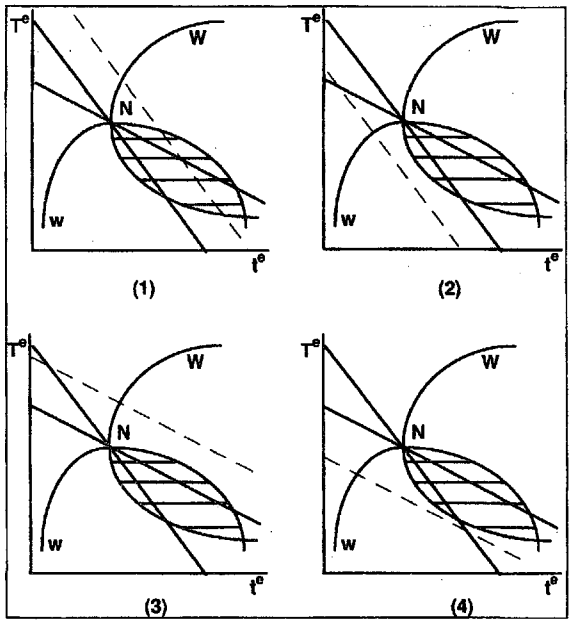

Figure 2: The Impact of Regulatory Capture on Environmental Policy in the Nash Equilibrium

In figure 2, the solid lines represent welfare maximising behaviour and the dashed lines represent shifts in the reaction curves due to the influence of idiosyncratic interests on the policy-making process. Four scenarios are depicted:

1 Domestic greens and/or industry lobbies are successful in driving the emission tax rate up. The new equilibrium represents a Pareto improvement. Both countries are better off. The reason is that the home country's welfare maximising tax rate is too low. It is raised by interest group influence. This is beneficial for the foreign country and it reacts by raising its own emission tax rate and this in turn is beneficial to the home country. If the shift in the reaction curve were larger than in the diagram, the home country or both countries could lose.

2 Domestic industry lobbies and/or supergreens are successful in reducing the emission tax rate. Both countries are worse of in the new Nash equilibrium. By reducing the emission tax rate, the home country increases the negative externality it imposes on the foreign country and the foreign country reacts in a way detrimental to the home country's welfare.

3 Foreign lobbies raise emission taxes. Since they have been to large already, this is bad for the home country and the home country reacts by reducing its tax rate in order to mitigate the terms-of-trade effect of the foreign tax increase. Both countries are worse off.

4 Foreign lobbying reduces emission taxes. This is beneficial to the home country. The home country raises its tax rate, which is beneficial to the foreign country. In this diagram, however, this positive effect is not sufficient to offset the negative effect which is due to the deviation from the socially optimal policy in the foreign country but a case in which both countries are better off is also conceivable (like a scenario in which both countries lose).

Additional scenarios are conceivable if there are lobbies in both countries. For instance, if green lobbies are strong in both countries and are able to accomplish tax increases, then the foreign country is likely to be better off and the home country is likely to be worse off than in a scenario where both governments maximise social welfare. If, on the other hand, industrial lobbies benefit from low emission tax rates and their lobbying is successful, then the home country may benefit whereas the foreign country may lose.

Proposition 6

The effects of regulatory capture on in an international environmental policy game are ambiguous. Both countries may gain, both countries may lose or one country may gain whereas the other loses compared to a situation without regulatory capture.

It is interesting that lobbying activities can lead to Pareto superior results compared to situations in which lobbies are inactive and a benevolent government maximises social welfare. The underlying reasons is that these lobbies internalise a part of the externalities resulting from the international policy game - of course, without the intention to do so.

As a corollary, one can conclude that institutional settings that reduce interest group influence in the policy making process are undesirable in such a situation. But is this realistic? Probably not very much. The reasons are the following ones. Firstly, the behavioural model underlying the political-support function approach is a model of bribery in which lobbying activities take the shape of mere transfers. The costs of rent seeking, i.e. the allocation of productive resources towards the non-productive activity of influencing the distribution of wealth and income, are neglected. Thus an important source of welfare losses is missing in this model. Secondly, it is questionable, whether real governments use environmental policies to influence the terms of trade. If they don't, there are no externalities in the international policy game that could be internalised by the lobbies. Thirdly, the empirical evidence suggests that the trade effects of environmental regulation are rather small. This implies that areas of Pareto improvements are small as well and that it becomes unlikely that they are hit when lobbies enter the arena. Finally, one may argue that emission tax rates are not the first-best policies and that additional policy instruments be introduced into the model. If export taxes and subsidies are feasible, then they are used to affect the terms of trade. Industry lobbies interested in high tariffs or large export subsidies would aggravate the prisoners' dilemma of optimal tariff policies. Environmentalists would lobby for inefficiently high emission taxes. This suggests that, in a first-best world, lobbying is not beneficial.

7 Conclusions

1 If single policy instruments are captured by environmentalist interest groups or the lobby supporting the interests of specific factors of production, the biases in environmental policies take the expected directions in most of the cases. Environmentalists lobby for tight product standards and high environmental tax rates. Industry-specific factors are interested in low taxes on consumption. They, however, may benefit from high emission taxes and high product standards if these policies raise the demand for these factors.

2 If environmental regulation as a whole is captured, the policy maker chooses the most efficient means to support the interest groups. The specific factor is supported by low taxes on consumption and high taxes on emissions. Green interests are supported by high taxes on both consumption and emissions from production and by strict product quality standards.

Supergreen interests are supported by high taxes on the consumption of foreign goods and lax quality standards for these goods

3 In the large-country case where the governments play an non-cooperative game in emission tax rates, regulatory capture may mitigate or amplify the problems arising from the prisoners' dilemma of the tax game. With regulatory capture, none, one or both of the countries may be better off than without.

4 In a setting where rent-seeking costs are taken into account and where first-best policies are available, regulatory capture tends to reduce the welfare of all countries involved.

5 Future research should aim at providing a coherent and behaviourally well-founded theory of "obfuscation" to explain why inefficient policy instruments are often preferred over efficient ones by rational policy makers.

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A Appendix: Comparative Static Results

A1 The Small-Country Case

From equation (4), we have

(A1a) $$\frac{dp}{dt^c}=\frac{q\hat{c}_{rr}}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}\begin{cases}>0\\<1\end{cases}$$

(A1b) $$\frac{dr}{dt^c}=\frac{-d_p\hat{c}_r}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}<0,$$

(A1c) $$\frac{dp}{dt^e}=\frac{q(\hat{c}_t\hat{c}_{rr}-\hat{c}_r\hat{c}_{rt})}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}>0,$$

(A1c) $$\frac{dr}{dt^e}=-\frac{q\hat{c}_{rt}+d_p\hat{c}_r\hat{c}_t}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}},$$

(A1e) $$\frac{dp}{d\omega}=\frac{q(\hat{c}_\omega\hat{c}_{rr}-\hat{c}_r\hat{c}_{r\omega})}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}>0,$$

(A1f) $$\frac{dr}{d\omega}=-\frac{q\hat{c}_{r\omega}+d_p\hat{c}_r\hat{c}_\omega}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}},$$

(A1g) $$\frac{dp}{dP}=\frac{-d_P\hat{c}_r^{\,2}}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}>0,$$

(A1h) $$\frac{dr}{dP}=\frac{-d_P\hat{c}_r}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}>0,$$

The effects on the quantities are obtained via the demand functions, i.e.

(A2a) $$\frac{dq}{dt^c}=\frac{qd_p\hat{c}_{rr}}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}<0$$

(A2b) $$\frac{dQ}{dt^c}=\frac{qD_p\hat{c}_{rr}}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}>0,$$

(A2c) $$\frac{dq}{dt^e}=\frac{qd_p(\hat{c}_t\hat{c}_{rr}-\hat{c}_r\hat{c}_{rt})}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}<0,$$

(A2c) $$\frac{dQ}{dt^e}=\frac{qD_p(\hat{c}_t\hat{c}_{rr}-\hat{c}_r\hat{c}_{rt})}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}>0,$$

(A2e) $$\frac{dq}{d\omega}=\frac{qd_p(\hat{c}_\omega\hat{c}_{rr}-\hat{c}_r\hat{c}_{r\omega})}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}<0$$

(A2f) $$\frac{dQ}{d\omega}=\frac{qD_p(\hat{c}_\omega\hat{c}_{rr}-\hat{c}_r\hat{c}_{r\omega})}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}>0,$$

(A2g) $$\frac{dq}{dP}=\frac{qd_P\hat{c}_{rr}}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}>0,$$

(A2h) $$\frac{dQ}{dP}=\frac{\hat{c}_r^{\,2}\left(d_pD_P-d_PD_p\right)+qD_P\hat{c}_{rr}}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}<0.$$

Domestic emissions, e, are determined by Shephard's lemma: $e=\hat{c}_t q$. It follows that

$$\frac{de}{dt^e}=q\hat{c}_{tt}+q\hat{c}_{tr}\frac{dr}{dt^e}+\hat{c}_t\frac{dq}{dt^e},$$

and the effects of the other policy parameters can be determined in an analogous fashion. It follows that

(A3a) $$\frac{de}{dt^c}=\frac{qd_p(\hat{c}_t\hat{c}_{rr}-\hat{c}_r\hat{c}_{rt})}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}<0,$$

(A3b) $$\frac{de}{dt^e}=\frac{q^2\left(\hat{c}_{rr}\hat{c}_{tt}-\hat{c}_{rt}^{\,2}\right)+qd_p\left(\hat{c}_t^{\,2}\hat{c}_{rr}+\hat{c}_r^{\,2}\hat{c}_{tt}-2\hat{c}_r\hat{c}_t\hat{c}_{rt}\right)}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}<0,$$

(A3c) $$\frac{de}{d\omega}=\frac{q^2\left(\hat{c}_{rr}\hat{c}_{t\omega}-\hat{c}_{rt}\hat{c}_{r\omega}\right)+qd_p\left(\hat{c}_\omega\hat{c}_t\hat{c}_{rr}+\hat{c}_r^{\,2}\hat{c}_{t\omega}-\hat{c}_r\hat{c}_\omega\hat{c}_{rt}-\hat{c}_r\hat{c}_t\hat{c}_{r\omega}\right)}{q\hat{c}_{rr}+d_p\hat{c}_r^{\,2}}$$

(A3d) $$\frac{de}{dP}=\frac{qd_P(\hat{c}_t\hat{c}_{rr}-\hat{c}_r\hat{c}_{rt})}{q\hat{c}_{rr}+d_p\hat{c}_r{}^2}>0.$$

For the effects on foreign emissions, we obtain

(A4a) $$\frac{dE}{dt^c}=\hat{C}_T\frac{dQ}{dt^c}>0,$$

(A4b) $$\frac{dE}{dt^e}=\hat{C}_T\frac{dQ}{dt^e}>0,$$

(A4c) $$\frac{dE}{d\omega}=\hat{C}_T\frac{dQ}{d\omega}>0,$$

(A4d) $$\frac{dE}{d\Omega}=\hat{C}_T\hat{C}_\Omega\frac{dQ}{dP}+\hat{C}_{T\Omega}Q,$$

(A4e) $$\frac{dE}{dT^c}=\hat{C}_T\frac{dQ}{dP},$$

(A4f) $$\frac{dE}{dT^e}=\hat{C}_{TT}+\hat{C}_T{}^2\frac{dQ}{dP}.$$

A2 The Large-Country Case

From equation (14), we have

(A5a) $$\frac{dp}{dt^e}=\frac{q(\hat{c}_t\hat{c}_{rr}-\hat{c}_{rt}\hat{c}_r)\left(Q\hat{C}_{RR}+\hat{C}_R{}^2D_P\right)}{q\hat{c}_{rr}\left(Q\hat{C}_{RR}+\hat{C}_R{}^2D_P\right)+\hat{c}_r{}^2\left(d_pQ\hat{C}_{RR}+\hat{C}_R{}^2\left(d_pD_P-d_PD_p\right)\right)},$$

(A5b) $$\frac{dP}{dt^e}=\frac{-q\hat{C}_R{}^2D_p(\hat{c}_t\hat{c}_{rr}-\hat{c}_{rt}\hat{c}_r)}{q\hat{c}_{rr}\left(Q\hat{C}_{RR}+\hat{C}_R{}^2D_P\right)+\hat{c}_r{}^2\left(d_pQ\hat{C}_{RR}+\hat{C}_R{}^2\left(d_pD_P-d_PD_p\right)\right)},$$

(A5c) $$\frac{dr}{dt^e}=\frac{-q\hat{c}_{rt}\left(Q\hat{C}_{RR}+\hat{C}_R{}^2D_P\right)-\hat{c}_t\hat{c}_r\left(d_pQ\hat{C}_{RR}+\hat{C}_R{}^2\left(d_pD_P-d_PD_p\right)\right)}{q\hat{c}_{rr}\left(Q\hat{C}_{RR}+\hat{C}_R{}^2D_P\right)+\hat{c}_r{}^2\left(d_pQ\hat{C}_{RR}+\hat{C}_R{}^2\left(d_pD_P-d_PD_p\right)\right)},$$

(A5d) $$\frac{dR}{dt^e}=\frac{\hat{C}_RD_pq(\hat{c}_r\hat{c}_{rt}-\hat{c}_t\hat{c}_{rr})}{q\hat{c}_{rr}\left(Q\hat{C}_{RR}+\hat{C}_R{}^2D_P\right)+\hat{c}_r{}^2\left(d_pQ\hat{C}_{RR}+\hat{C}_R{}^2\left(d_pD_P-d_PD_p\right)\right)}.$$

Using the demand functions, we obtain

(A5e) $$\frac{dq}{dt^e}=\frac{q(\hat{c}_t\hat{c}_{rr}-\hat{c}_{rt}\hat{c}_r)\left(d_pQ\hat{C}_{RR}+\hat{C}_R{}^2(d_pD_P-d_PD_p)\right)}{q\hat{c}_{rr}\left(Q\hat{C}_{RR}+\hat{C}_R{}^2D_P\right)+\hat{c}_r{}^2\left(d_pQ\hat{C}_{RR}+\hat{C}_R{}^2\left(d_pD_P-d_PD_p\right)\right)},$$

(A5f) $$\frac{dQ}{dt^e}=\frac{qD_pQ\hat{C}_{RR}\left(\hat{c}_t\hat{c}_{rr}-\hat{c}_{rt}\hat{c}_r\right)}{q\hat{c}_{rr}\left(Q\hat{C}_{RR}+\hat{C}_R{}^2D_P\right)+\hat{c}_r{}^2\left(d_pQ\hat{C}_{RR}+\hat{C}_R{}^2\left(d_pD_P-d_pD_p\right)\right)}.$$

Finally, emissions, e and E, are determined by Shephard's lemma. $e=\hat{c}_tq$ and $E=\hat{C}_TQ$. It follows that

$$\frac{de}{dt^e}=q\hat{c}_{tt}+q\hat{c}_{tr}\frac{dr}{dt^e}+\hat{c}_t\frac{dq}{dt^e},$$

$$\frac{dE}{dt^e}=Q\hat{C}_{TR}\frac{dR}{dt^e}+\hat{C}_T\frac{dQ}{dt^e}.$$

The previous results can be inserted and this yields

(A6a) $$\frac{de}{dt^e}=\frac{q^2\left(\hat{c}_{rr}\hat{c}_{tt}-\hat{c}_{rt}{}^2\right)\left(Q\hat{C}_{RR}+\hat{C}_R{}^2D_P\right)+q\left(\hat{c}_{tt}\hat{c}_r^2+\hat{c}_t^2\hat{c}_{rr}\right)\left(d_pQ\hat{C}_{RR}+\hat{C}_R{}^2\left(d_pD_P-d_pD_p\right)\right)}{q\hat{c}_{rr}\left(Q\hat{C}_{RR}+\hat{C}_R{}^2D_P\right)+\hat{c}_r{}^2\left(d_pQ\hat{C}_{RR}+\hat{C}_R{}^2\left(d_pD_P-d_pD_p\right)\right)},$$

(A6b) $$\frac{dE}{dt^e}=\frac{qQD_p\left(\hat{c}_r\hat{c}_{rt}-\hat{c}_t\hat{c}_{rr}\right)\left(\hat{C}_R\hat{C}_{RT}-\hat{C}_T\hat{C}_{RR}\right)}{q\hat{c}_{rr}\left(Q\hat{C}_{RR}+\hat{C}_R{}^2D_P\right)+\hat{c}_r{}^2\left(d_pQ\hat{C}_{RR}+\hat{C}_R{}^2\left(d_pD_P-d_pD_p\right)\right)}.$$

The effects of the regulation of the foreign industry, T^e can be obtained by analogous reasoning since the model is symmetric.