

Environmental Policy in the Era of Globalization

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Abstract

While in the era of globalization a stronger competition among industries yields efficiency gains, the international competition for attracting new plants is often accused to favor an eco-dumping. Environmental as well as employment policies are a matter of political majorities. The present paper compares different political systems: in a direct democracy voters are straightforwardly asked for their favored policy, whereas in a representative democracy voters can only opt for a political representative who then, in turn, decides on an appropriate policy at a subsequent stage. As globalization has different impacts on the policy equilibrium depending on the type of democracy, we are interested in answering the question whether representative democracies seem to be better prepared for the process of globalization than direct democracies?

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1 Motivation

In the last decades two main phenomena have attained a prominent role in the economic and political debate: people developed a higher sensitivity for environmental degradation such that they are more concerned about the future of the ecological system. At the same time globalization yields a progressive integration of at least the industrialized countries. In addition to the obvious gains of an integrated world people become aware of some of its shortcomings as national policies can no longer ignore the measures other countries carry into practice.

International competitiveness even between countries increases with globalization. While nobody doubts that competition among industries yields an efficiency gain, competition between regions may lead to nowhere. In the recent policy debate the ongoing globalization process is often accused for its trade liberalization and international factor mobility which are seen as the origin for a ruinous environmental competition among countries. Measures to improve the environmental quality or a policy tackling the problem of unemployment fail at least part of their aims as national policies come to have effects beyond a country's border. These 'fiscal & environmental externalities' in combination with an uncoordinated behavior of the regional governments cause a race to the bottom. Thus, globalization seems to enforce environmental as well as problems of unemployment.¹ Furthermore, in case of an international tax competition the fiscal basis for public policy is shrinking.² However, even though an integrated world has its pitfalls it must not have only negative consequences. In what follows we will analyze the impact of globalization on the environment.

If we abstract from globalization, additional difficulties arise when dealing with transboundary pollution and international common property resources because economic activities of a country imply not only fiscal but also negative allocative externalities for other regions. Since non-cooperative governments do not consider these impacts on their neighbors when they decide on their measures, uncoordinated environmental policy in general leads to an inefficiently low level of the environmental quality.³

¹In a recent paper Ulph and Valentini (2001) show that globalization enforces eco-dumping and in case of footloose plants this effect becomes even stronger.

²In a recent survey on globalization Avi-Yonah (2000) pointed out that economic activities become more mobile. This increased mobility in turn resulted in an international competition of sovereign countries who aim to attract these resources by lowering the taxes or other policy measures. Thus globalization seems to enforce the fiscal crisis of the welfare state. For further details of globalization's impact on international policy competition, especially tax competition, see also Tanzi (1996).

³This conclusion is well-known from the literature on externalities and privately provided public

Environmental as well as employment policies are a matter of political majorities. The present paper compares the equilibrium outcome of such policies subject to different political systems: in a direct democracy voters are straightforwardly asked for their favored policy, whereas in a representative democracy voters can only opt for a political representative who then, in turn, decides on an appropriate policy at a subsequent stage.

While in a direct democracy each voter reveals his or her true preference for a policy measure, this need not be the case in a representative democracy. Here, the electorate can use their ballots strategically to avoid at least some negative consequences of globalization. Since the policy competition between neighboring countries typically yields a race to the bottom, voters have an incentive to elect politicians who are more concerned about the ecological system than they are themselves.⁴ This deliberate deviation from voting for politicians who follow up the same preferences as the electorate may become a successful strategy in the era of a growing globalization.⁵ Thus, representative democracies seem to be better prepared for the process of globalization than direct democracies since voting strategically reduces at least a part of the inefficiency which is due to the non-cooperative policy choice among sovereign countries.

In the remainder of this paper we will analyze the economic relation between different types of democracy, transboundary pollution, international policy competition and globalization. Thus the paper is organized as follows: The next section describes the economic framework and voters' preferences. Section 3 analyzes the outcome in a direct democracy and the implication of globalization. The next section discusses in a two-stage game the policy equilibrium in a representative democracy and compares in section 5 this outcome with that under a direct policy regime. Then, a last section concludes with some final remarks.

goods. For an intense survey on that topic see Cornes and Sandler (1996). There is a wide range of literature which shows that green policy elements are often used or are of strategic interest for other than an implementation of an ecologically efficient policy, cf. Barrett (1994) or Hoel (1997), Rauscher (1995) or Ulph (1996).

⁴Voting strategically is a special form of delegation. Thus, Schelling (1960) or Freshtman et al. (1991) are of particular interest for the analysis of delegation in game theory. For an application to environmental problems, see Buchholz and Konrad (1994), Buchholz and Haslbeck (1998) as well as a companion paper of Buchholz et al. (2001).

⁵In a companion paper Gottschalk and Peters (2002) analyze the impact of globalization on the scope of redistributive taxation.

2 Eco taxes, plant location, and voters' preferences

To simplify the analysis our model looks at only two countries (i and j) which are of equal size. Production in these regions gives rise to problems with the environmental quality. Degradation depends on the economic activity x_i of the industry in either country. A first measure of an environmental policy aims at a decline in pollution and favors a direct reduction of production. Here an environmental tax seems to be a promising instrument. Additionally, the revenues from that tax can be used to remove parts of the ecological damage. We concentrate on state operated cleaning activities while we do not include an industry operated investment to enforce an abatement of pollution.

The environmental tax levied on the output of the industry has two impacts. First, the tax reduces the profitability and consequently the level of production. However, in an integrated world production or plants can easily be shifted to countries where the eco tax is comparatively moderate. Thus, taxes induce a second decision. The locational choice of a firm does not only depend on the level of the tax rate but also on the differences in tax rates between neighboring countries. The driving force behind this decision is the motive to reduce the costs of production which naturally includes the motive of avoiding taxation as far as possible. To reduce the complexity of our analysis we assume that the whole tax system with its tax rates remains unchanged in both countries, while the eco tax is endogenous and may differ between the regions.

To simplify the model we concentrate on the reduced form of the aggregated decision of the industry.⁶ The aggregated economic activity in country i and j is given by

$$\begin{aligned}x_i &= 1 - \alpha(t_i - t_j) - \beta t_i, & \text{country's production,} \\x_i + x_j &= 2 - \beta(t_j + t_i), & \text{joint production.}\end{aligned}\tag{1}$$

The parameters α and β characterize the extent of different impacts on production. $\alpha \geq 0$ gives us a measure for globalization where $\alpha = 0$ stands for autarky. The higher α the more flexible are the firms when making up their mind on the locational choice. If α increases the costs of a move from one country to another are reduced, the differences in the tax liability are of primary importance and the aggregated production level takes care of the course of globalization. $1 \geq \beta > 0$ in

⁶Applying the same type of a reduced form to a problem of international competition can be found in Gottschalk and Peters (2002). However, they are more concerned about tax competition while the present paper concentrates on environmental policies. Nevertheless, some of the underlying economic mechanisms are closely related.

turn reflects the direct impact of the eco tax. Although globalization yields a growing interdependence of international economic activities and intensifies competition among countries an increase of the domestic eco tax has a stronger impact on the production level at home than an increase of the difference in both tax rates, i.e. $\beta \geq \alpha$.

Globalization, however, does only affect the size of production in either country while the joint activities of both countries together are independent of α . Thus, the extent of the eco tax determines the level of production, whereas globalization emphasizes the question where to produce and stands for a shift of an essential part of the countries' production abroad according to the differences in the environmental tax.

In each country the economic activity of its industry causes pollution which in turn damages the ecological system at home as well as abroad. The damage measures the loss in the environmental quality and captures the size of destroyed forests, loss of biodiversity, water quality and other 'facts'. A convex function $D_i(x_i + sx_j) \geq 0$ expresses this interaction between the environment and the economy. It connects environmental degradation in region i to the countries' economic activities. The parameter $s \in [0, 1]$ denotes the spillover between both regions. For an s of nearly one, we analyze a problem with global environmental degradation, while the other extreme with s close to zero represents the case of only local pollution. For analytical simplicity, we restrict the shape of the damage function such that the marginal damage is a linear function of the production levels,⁷ i.e. $D_i = 0.5 [x_i + sx_j]^2$.

However, the ecological degradation shows nothing but the gross damage since the revenues from the eco tax can be used for cleaning activities. While the damage displays the character of a 'public bad' and has its impact at home as well as abroad, the adopted measures to reduce the negative consequences of pollution display local properties only. An example may be the acid rain with its transboundary pollution and the private measures of the forestry in each country. Furthermore, we assume that the success of the cleaning activities exhibits a one-to-one relation to the corresponding expenditures. Thus, the net damage in country i is given by

$$ND_i = 0.5 [x_i + sx_j]^2 - t_i x_i. \quad (2)$$

The environmental quality, therefore, depends on the extent of international production and the rapidly growing process of globalization. While the first effect indicates the usual property of an externality the latter is a consequence of the rising competition between industries worldwide or countries which compete through

⁷This assumption has two aspects. On the one hand it simplifies the game theoretic analysis, and on the other hand it allows for an application of elementary econometric methods to estimate the ecological damage in either country.

environmental measures tackling two opposing aims: attracting international firms to improve the extent of employment and reducing the ecological net damage to an acceptable amount. Thus the political process has to deal with the trade-off between ecology and economy, or employment and environmental quality. Politicians as well as voters aim at maximizing a combination of employment and net damage. Production and employment are assumed to be proportional such that we can normalize the employment coefficient to one.⁸

However, not all voters are alike. They differ with respect to their personal tastes, which balance employment against the environment. Each voters' preference can be represented by a weighted average of both objectives and the relative weight λ_i he or she gives to the employment characterizes the personal preference. Voters and politicians aim at maximizing their own objective

$$Z^i = x_i \lambda_i - \{0.5[x_i + sx_j]^2 - x_i t_i\}. \quad (3)$$

In a representative democracy some of the voters become politicians. In contrast to a recent part of the public choice literature, we assume that politicians do not pursue the goal of being elected only as an end in itself, they follow their own policy issues according to their own preferences.⁹ Thus, a politician as well as a voter is perfectly characterized by its λ_i .

A politician comes to power when she wins every pairwise comparison with all rivals in her country. Since this majority rule underlines the importance of the median voter in the political process, its outcome reflects the voting results in modern democracies in a plausible way. For simplicity, we assume that the political preference is continuously distributed within a certain interval $[0, \bar{\lambda}_i]$ and the median voter displays a preference which gives a higher weight to the environment than to employment, $1 > \lambda_i^m$. Furthermore, symmetry in both countries requires that median voters are identical; $\lambda_i^m = \lambda_j^m = \lambda^m$. The first assumption is sufficient to exclude the case where the optimal eco tax is a subsidy, while the latter assumption is for convenience only. As long as employment is a not too prominent factor in the political debate an adequate policy measure to tackle environmental problems does not completely neglect ecological concerns. From an empirical point of view

⁸We abstract from an explicit consideration of employment which is due to the cleaning activities. Implicitly we assume that βt corresponds to the net effect of taxation on employment, i.e. the expression stands for the reduction in private production (employment in the industry sector) minus the public cleaning activity (employment in the environmental sector).

⁹Our assumption overestimates the competitiveness of the political process. Perfect competition among all potential politicians favors voting for politicians who do not mimic some political preferences in order to win an election. It is the competition which runs down the scope for rent-seeking. Thus, our analysis exhibits a bias for representative democracies since potential losses are systematically underestimated. Therefore, the present approach can only be used as a benchmark.

the median voter, who is decisive for the adopted policy measure, favors at least a somehow eco-friendly policy.

Before starting the analysis it seems to be promising to describe the second-best policy which is efficient from the perspective of both median voters. In what follows we can compare this benchmark result with the outcome in any political equilibrium. If the eco tax is lower than in the second-best the policy competition yields a race to the bottom or eco-dumping, if not, the result is like eco-protectionism. The second-best tax rates maximizing the sum of median voters' payoff $Z^i + Z^j$ are identical in both countries because of symmetry¹⁰

$$t^{2^{\text{nd}} \text{ best}} = \frac{1 - \lambda^m \beta + \beta(1 + s)^2}{\beta [2 + (1 + s)^2 \beta]} > 0. \quad (4)$$

As expected, the comparative statics show that an efficient eco tax rate i) is independent of globalization. A higher international mobility of plants does under symmetry not really affect the distribution an optimal allocation production should have. Globalization indicates a strategic impact only and is therefore a matter of the international environmental competition, while allocative efficiency remains unchanged when α is varied ($\partial t^{2^{\text{nd}} \text{ best}} / \partial \alpha = 0$).

ii) If the median voters are less concerned about the environment the eco tax becomes not so prominent ($\partial t^{2^{\text{nd}} \text{ best}} / \partial \lambda^m < 0$).

iii) Furthermore, the more effective an environmental tax reduces the economic activities the lower is the optimal tax rate ($\partial t^{2^{\text{nd}} \text{ best}} / \partial \beta < 0$). This argument runs the same line as in literature on optimal taxation, where the efficient tax is the lower the higher the elasticity of the tax base or the distortive effect of taxation.

iv) And finally, the eco tax increases when the transboundary spillover of the pollution becomes stronger ($\partial t^{2^{\text{nd}} \text{ best}} / \partial s > 0$). The environmental externality is intensified the greater s . Similar to the usual Pigouvian tax, a shift in the curve representing the marginal damage yields higher optimal tax rates.

3 Direct democracy: voting on an eco tax

We distinguish two types of voting processes: first, in a direct democracy citizens vote for a certain policy and a majority favors the proposal of the median voter, and second, in a representative democracy citizens delegate the policy choice to a politician by voting for their favorite. In both cases the majority is with the median voter.

¹⁰All other efficient tax rates, which are due do an asymmetric importance of the two median voters, need not be identical. Thus, in asymmetric cases tax rates differ and, therefore, globalization matters. Nevertheless, as a benchmark we refer to a fair division of the efficiency gains only.

In either case of political decision we have to analyze to what extent an eco tax will be implemented by the voting processes. Thus, we look for the Nash equilibrium of a policy game when in two identical countries voters directly make up their mind on the preferred eco tax. This equilibrium, however, although it corresponds to direct democracy, plays a decisive role even in the representative regime where it illustrates the second stage of the policy decision.

In both countries voters differ only with respect to their preference for employment λ . In a direct democracy he or she can straightforwardly determine the policy which will be implemented. The preferred tax rate of a voter maximizes the respective utility function (3). The first-order condition¹¹

$$Z_{t_i}^i = x_i + [\lambda_i + t_i] \frac{\partial x_i}{\partial t_i} - [x_i + s x_j] \left[\frac{\partial x_i}{\partial t_i} + s \frac{\partial x_j}{\partial t_i} \right] = 0, \quad (5)$$

shows the trade-off between a cleaner environment and the loss in employment. For each voter of type λ_i this condition yields an optimal tax rate. Since the objective function Z^i is concave and the preferred tax rate¹² decreases with λ_i voters' preferences are single-peaked. Thus Black's (1948) median voter theorem can be applied. The proposal of the median voter wins every pairwise comparison with rival programs.

The outcome of the political process in country i still depends on the policy chosen in the neighborhood. The international competition between the regions boils down to a competition between both medians. The first-order condition (5) implicitly defines the best response of the median voter¹³ in country i given the environmental policy in the neighboring country j . The reaction curve is linear with slope

$$\frac{\partial t_i}{\partial t_j} = - \frac{Z_{t_i t_j}^i}{Z_{t_i t_i}^i} = \frac{\alpha + [\alpha(1-s) - s\beta][\alpha(1-s) + \beta]}{2(\alpha + \beta) + [\alpha(1-s) + \beta]^2}. \quad (6)$$

In case of a purely local pollution ($s = 0$) tax rates are strategic complements. In absence of any globalization effect ($\alpha = 0$) the environmental policy becomes a strategic substitute. The first case corresponds to the usual property under tax competition, while the latter case exhibits the properties of a subscription equilibrium when pollution is a global common.

For each $s \in [0, 1]$ there exists a critical value of α^{crit} for which the best response exhibits neither the property of being a strategic complement nor substitute. This

¹¹The second-order condition is always fulfilled.

¹²Formally, the favored eco tax of each voter depends on λ_i and the change in λ_i can be shown by applying the implicit-function theorem, i.e. $\frac{\partial t_i^*}{\partial \lambda_i} = - \frac{Z_{t_i \lambda_i}^i}{Z_{t_i t_i}^i} = - \frac{\alpha + \beta}{2(\alpha + \beta) + [\alpha(1-s) + \beta]^2} < 0$.

¹³To be correct, the first-order condition of the median requires to set the parameter λ_i in equation (5) equal to the median's valuation λ^m .

yields

$\alpha < \alpha^{\text{crit}} \rightarrow$ strategic substitute, $\alpha > \alpha^{\text{crit}} \rightarrow$ strategic complement.
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α^{crit} increases with s such that $\alpha^{\text{crit}} \in [0, \beta^2]$.¹⁴ For local environmental problems, $s = 0$, the critical value is zero too. In case of global commons the value is β^2 .

Proposition 1 *Existence and uniqueness.*

Given all our assumptions the policy equilibrium between the medians exists and is unique.

Proof. Voters' payoff is twice continuously differentiable in both tax rates and strictly concave in its own strategy. According to Friedman (1986), this yields the existence of continuous best-response functions. The slope for these best-response functions does not exceed one, i.e. $\left| \frac{\partial t_i}{\partial t_j} \right| < 1$, which consequently guarantees uniqueness. ■

Symmetry of the countries and median voters in combination with the uniqueness of the Nash equilibrium yields a tax rate¹⁵ in either region of

$$t^* = \frac{1 - (\alpha + \beta)\lambda^m + \alpha(1 - s^2) + (1 + s)\beta}{\alpha + \beta [2 + \alpha(1 - s^2) + (1 + s)\beta]} > 0. \quad (7)$$

Proposition 2 *Eco-dumping in either case.*

Comparing the second-best eco tax with the equilibrium under a direct democracy yields a too soft environmental policy. Thus, in our case eco-protectionism is impossible and the policy competition game shows positive 'fiscal & environmental externalities' at least in equilibrium.

Proof. Considering all our previous assumptions with respect to the parameters $(\alpha, \beta, \lambda^m, s)$, a comparison of the second-best and the policy equilibrium proves (after some tedious algebra) the relation $t^{2^{\text{nd}} \text{ best}} > t^*$. ■

Usually the policy game displays positive 'fiscal & environmental' externalities. Thus, the taxes in the Nash equilibrium are inefficiently low compared to the second-best eco tax.

Proposition 3 *Comparative statics of the policy equilibrium.*

i) Eco taxes are lower when voters have a more intense preference for employment (higher λ^m). Obviously, 'greener' preferences are correlated with a stronger environmental policy ($\partial t^ / \partial \lambda^m < 0$).*

¹⁴For the critical value α^{crit} the numerator in equation (7) vanishes. Applying the implicit-function theorem to this numerator proves the sign of the comparative statics in s : $\frac{d\alpha^{\text{crit}}}{ds} > 0$.

¹⁵The calculation of the equilibrium tax rate uses symmetry ($t_i = t_j$), which we can insert in equation (5).

ii) *The ongoing process of globalization (increase in α) reduces the extent of the environmental measures. Eco-dumping deteriorates the effectiveness of a non-cooperative policy ($\partial t^*/\partial \alpha < 0$).*

iii) *If the environmental degradation becomes a global problem (the spillover parameter s increases and thus the pollution externality turns out to be more important) the change in the equilibrium tax rates can have either sign. For a local pollution where s does not exceed $\frac{\beta}{2\alpha}$, the taxes increase with s . Thereafter, for nearly global externalities the eco tax proves to be lower ($\partial t^*/\partial s \leq 0$).*

Proof. According to our assumptions the sign of the above derivatives can easily be checked. ■

While the first two properties are intuitively clear the comparative statics for the spillover s has a priori no intuition. Nevertheless, the sign can easily be explained. From Pigouvian taxation we know that the optimal tax rate increases if the curve representing the marginal damage is shifted upwards. In equilibrium¹⁶ this marginal damage can be expressed by $D' = x [\alpha(1 - s^2) + \beta(1 + s)]$, which adopts its maximal value for $s = \frac{\beta}{2\alpha}$. As long as the marginal damage increases with the pollution externality the eco tax rises too.

But why are in the policy game the comparative statics with respect to s not alike those in the benchmark case of an efficient eco tax, $D' = x(1 + s)^2\beta$? The main distinction traces back to the difference in the points of view. While efficiency considers both payoffs the policy game favors a single median voter neglecting the impact on the competitor. Therefore, in the latter case globalization in combination with the environmental spillover plays a decisive role. For a small s the marginal damage increases as the pollution externality grows. Hence, as expected, the equilibrium tax rate increases too. This argument follows the same line as the classical Pigou tax. The eco tax as well as the marginal damage attains its maximum for $s = \frac{\beta}{2\alpha}$. Thereafter, for a nearly global pollution marginal damage and the equilibrium taxes become even smaller.

In a direct democracy the above properties of the policy game yield an incentive to opt for higher taxes. However, voters cannot commit to such a strategy. Strategies which implement less inefficient taxes are credible if and only if the decisive vote is with politicians who are 'greener' than the median voters themselves. The intuition behind this argument runs as follows: If instead of the median voters some 'green' (or slightly 'greener') politicians have the power to implement their favored policy, the equilibrium tax rates are higher than before under direct democracy. Therefore, each voter including the median voter has an incentive to vote for politicians

¹⁶Recall that in equilibrium $t_i = t_j$, which then implies an identical extent of production in either region, $x_i = x_j = x$.

who have less intense preferences for employment (or more intense preferences for environmental measures).¹⁷ As long as the democratic process uses a direct policy regime voters cannot commit to these favored strategies. But what about the outcome of a representative democracy? Is voting for a favored politician a successful way to commit to higher taxes as it seems to be?

4 Representative democracy: voting for a politician

In a representative democracy each voter anticipates the policy implication of his or her voting for a politician. Hence, the political process can be described by a two-stage game. First, all citizens make up their mind which politician to vote for, and afterwards these elected representatives implement their favored environmental policy. The overall political equilibrium can be determined by backward induction.¹⁸

Consequently we have to solve the second stage of the policy game first. For this we need a description of the Nash equilibrium when both politicians may have different tastes. Thus, we distinguish between politicians of country i and j which pronounce employment at possibly different levels λ_i and λ_j . These two representatives of the electorate in the neighboring countries are now engaged in the competitive decision making on the eco tax. As the Nash equilibrium is unique and the payoff functions are twice continuously differentiable the equilibrium tax rates $t_i^*(\lambda_i, \lambda_j)$ and $t_j^*(\lambda_i, \lambda_j)$ depend on the exogenous preference parameters of the politicians. When voters decide which politician should win the election they have to consider the impact their ballot has on the subsequent policy game. Hence, each voter is interested in the following comparative statics.

Proposition 4 *Eco tax and politicians' preferences.*

If the taste of a politician for environmental concerns becomes even stronger, the equilibrium tax rates of the international competition in the policy game change.

¹⁷In a companion context Hoel (1991) asked whether measures to reduce global environmental problems can be improved by taking unilateral actions of a single country. However, the political choice over this enlarged action has to be credible. Perhaps, the election of a political representative can justify a commitment for actions, which the median voter himself or herself would never have chosen.

¹⁸In case of voting for politicians even the median voter may use the ballot strategically. By opting for someone who has at least a slightly different taste the electorate anticipates the policy equilibrium of subsequent stages. Thus voters are rational and do not act myopically. First experimental investigations support backward induction as a good proxy for human decision making, see Aymard and Serra (2001).

i) In the politician's own country the eco tax rises as expected.

ii) In the neighboring country the cross effect on the competitor's policy depends on the strategic interaction between both regions. If tax rates are strategic complements the cross impact goes in the same direction as the own policy. Whereas, if the policy game is indicated by strategic substitutes, tax rates change in opposite directions.

iii) The direct impact of a change in preferences on the tax rate in the home country always dominates the cross impact on the equilibrium policy in the neighboring region

$$\left| \frac{dt_i}{d\lambda_i} \right| = \left| \frac{dt_j}{d\lambda_j} \right| > \left| \frac{dt_i}{d\lambda_j} \right| = \left| \frac{dt_j}{d\lambda_i} \right|. \quad (8)$$

Proof. i) The comparative statics show the expected sign. A higher preference for employment in country i (λ_i increases) turns out to favor a more gentle environmental policy in that country¹⁹

$$\frac{dt_i}{d\lambda_i} = \frac{dt_j}{d\lambda_j} = -\frac{\alpha + \beta}{\det} \{2(\alpha + \beta) + [\alpha(1 - s) + \beta]^2\} < 0, \quad (9)$$

ii) while the cross impact on the policy in the neighboring region is a priori indeterminate

$$\frac{dt_i}{d\lambda_j} = \frac{dt_j}{d\lambda_i} = -\frac{\alpha + \beta}{\det} \{\alpha + [\alpha(1 - s) - s\beta][\alpha(1 - s) + \beta]\} \begin{matrix} \geq \\ \leq \end{matrix} 0. \quad (10)$$

However, a close look at the equation above shows that for strategic complements the term on the right hand side becomes negative (cf. numerator of equation (6) in the previous section). For strategic substitutes the sign changes in the opposite direction.

iii) A comparison of the terms in equations (9) and (10) above proves our conjecture. The direct impact of a change in preferences on the environmental policy dominates the impact on neighbor's policy.■

When a voter delegates the choice on an adequate policy measure to a politician this voting for a favored type or preference has two distinct effects on the policy

¹⁹To determine the equilibrium of the international competition in the environmental policy, we evaluate equation (5) for both politicians of type λ_i and λ_j . The comparative statics in the political attitude for employment yields

$$\begin{pmatrix} dt_i \\ dt_j \end{pmatrix} = -\frac{1}{\det} \begin{bmatrix} Z_{t_j t_j}^j & -Z_{t_i t_j}^i \\ -Z_{t_j t_i}^j & Z_{t_i t_i}^i \end{bmatrix} \begin{bmatrix} Z_{t_i \lambda_i}^i & 0 \\ 0 & Z_{t_j \lambda_j}^j \end{bmatrix} \begin{pmatrix} d\lambda_i \\ d\lambda_j \end{pmatrix}$$

$$\begin{pmatrix} dt_i \\ dt_j \end{pmatrix} = \frac{\alpha + \beta}{\det} \begin{bmatrix} Z_{t_j t_j}^j & -Z_{t_i t_j}^i \\ -Z_{t_j t_i}^j & Z_{t_i t_i}^i \end{bmatrix} \begin{pmatrix} d\lambda_i \\ d\lambda_j \end{pmatrix},$$

where the determinate of the first matrix is always positive. This is equivalent to having a stable or unique equilibrium in the policy game on environmental taxes. The latter we have shown in the previous section.

outcome. As expected, if a 'greener' politician comes into power the resulting policy gives priority to a stronger eco tax in that country. However, in an integrated world elections have an impact even abroad and not only at home. Thus, the policy measure adopted in the neighboring country will also be affected. Nevertheless, the direction the elections in country i will have on the eco tax in j decisively depends on the strategic interaction between both regions in the policy game. If taxes are strategic substitutes a shift of i 's reaction curve to the left (higher preferences for employment) has two opposing effects on the tax rates. While the eco tax in i becomes more gentle, j 's environmental policy is growing rather tough, see figure 1b below. In case of strategic complements it turns out that both taxes vary in the same direction, see figure 1a. Complementarity stands for strategies which reinforce each other, while strategic substitutes have the property that the more aggressive one chooses the eco tax the softer the opponent reacts to this choice. For substitutes the policy choices display a de-escalation.

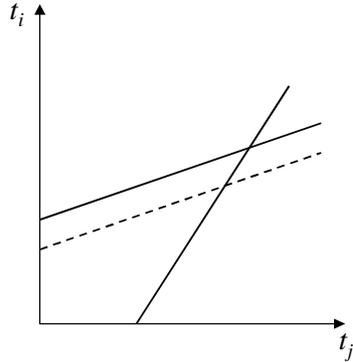


Fig. 1a: strat. compl.

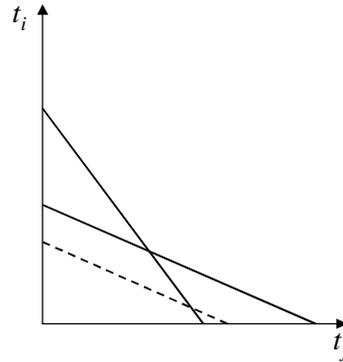


Fig. 1b: strat. subst.

Independent of the strategic relation between both regions a stronger preference for environmental concerns in country i yields a reduction of the ecological damage at home D_i , while the impact in the neighboring region is indeterminate. Hence, voting exhibits an externality which may have either sign.

We are now prepared to analyze the first stage of the entire game. Given the outcome of the election in the neighboring country, whom should we vote for?

$$\begin{aligned}
 Z^{iv} &= x_i[\lambda_i^v + t_i] - 0.5[x_i + sx_j]^2 \rightarrow \max_{\lambda_i} \\
 \text{s.t. } & t_i(\lambda_i, \lambda_j) \text{ and } t_j(\lambda_i, \lambda_j)
 \end{aligned}
 \tag{11}$$

For each voter of type λ_i^v this condition yields a preferred politician λ_i . Since the objective function Z^i is concave and the preferred type of a politician is increasing in λ_i^v the median-voter theorem can be applied, i.e. similar types vote for similar politicians.²⁰

In the previous section we stated that a direct democracy suffers from a too low eco tax. We therefore expected that voting for a more eco-friendly politician may be a good strategy for an improvement upon the Nash equilibrium under the direct policy regime. However, until now we do not know whether $\lambda^m > \lambda$ is an equilibrium in a representative democracy. For an answer we look at the first-order condition

$$Z_{t_i}^{im} \frac{\partial t_i}{\partial \lambda_i} + Z_{t_j}^{im} \frac{\partial t_j}{\partial \lambda_i} = 0, \quad (12)$$

which shows the main trade-off between a higher payoff through an adjustment of the eco tax at home or abroad. The question, whether an eco-friendly or a more employment oriented politician is median voter's favorite, needs some further transformations. By replacing $Z_{t_i}^{im}$ through the usage of equation (5), which characterizes the first-order condition from the subsequent stage of the game, we get an expression for the deviation of median voter's and politician's preference

$$\lambda^m - \lambda_i = \frac{Z_{t_j}^{im} \frac{\partial t_j}{\partial \lambda_i}}{\alpha + \beta \frac{\partial t_i}{\partial \lambda_i}}. \quad (13)$$

The first fraction on the right hand side of the equation is always positive since, as we have shown in the previous section, our model is characterized by positive 'fiscal & environmental externalities', $Z_{t_j}^{im} > 0$. Consequently, all our conclusions focus on the second fraction. While the denominator remains negative irrespective of the parameters (α, β, s) , the numerator's sign depends on the strategies at the second stage of the game, either they are strategic substitutes or complements.

Proposition 5 *Whom should we vote for?*

i) If tax rates are strategic complements, the median favors an eco-friendly politician, i.e. $\lambda < \lambda^m$.

²⁰Single peakedness requires a monotone change in the choice of the voters λ_i^* when their characteristic (the parameter λ_i^v) varies:

$$\frac{\partial \lambda_i^*}{\partial \lambda_i^v} = - \frac{\partial \left[Z_{t_i}^i \frac{\partial t_i}{\partial \lambda_i} + Z_{t_j}^i \frac{\partial t_j}{\partial \lambda_i} \right] / \partial \lambda_i^v}{\partial \left[Z_{t_i}^i \frac{\partial t_i}{\partial \lambda_i} + Z_{t_j}^i \frac{\partial t_j}{\partial \lambda_i} \right] / \partial \lambda_i} = \frac{\beta \frac{\partial t_i}{\partial \lambda_i} + \alpha \left[\frac{\partial t_i}{\partial \lambda_i} - \frac{\partial t_j}{\partial \lambda_i} \right]}{\text{soc}} > 0.$$

Since the denominator is negative (concavity of the objective function), the numerator is decisive for the sign of the derivative. The latter is positive because the direct impact always dominates the cross impact.

ii) In case of environmental measures being strategic substitutes the sympathy of the median is with a politician who focuses on employment instead of the environment, i.e. $\lambda > \lambda^m$.

iii) In the symmetric voting equilibrium both countries are governed by politicians of the same color. They are either less green than the median, or both are even greener.

Proof. Considering (9) and (10) the sign exhibits the properties stated in the proposition. ■

To understand the results shown above we demonstrate the driving forces by sticking to figure 2. If the eco taxes at the subsequent stage are strategic complements the median voter of country i can either vote for a politician who is of the same type, or there is a distinct vote for a 'greener' politician. Given an arbitrary politician in the competing region our median voter has to consider the reaction function $R_j(t_i)$. A self-representation would end in the Nash equilibrium and a payoff which is lower than in the Stackelberg point. The latter maximizes i 's payoff given the opponent's best responses. To implement the Stackelberg equilibrium the median voter depicts a specific type or preference out of the set of politicians. The favorite of the median is indicated by a reaction function which hits through the Stackelberg point, here the red line. However, a shift of the best responses to the right requires a higher concern about the environment or a lower λ than that of the median voter λ^m .

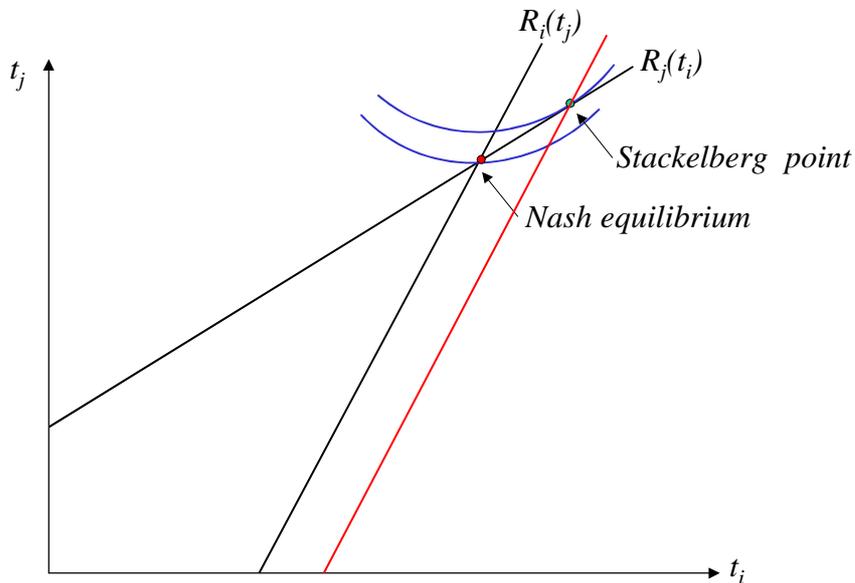


Fig.2: Voting and complements

As figure 2 shows the median voter prefers a politician with greener preferences than his or her own. The successful strategy has a positive impact on the subsequent

eco tax rates. Complementarity yields higher taxes on both sides. Since the international competition in environmental measures is a race to the bottom inefficiency of the entire game will be reduced through a representative democracy.

However, these positive news decisively depend on the strategic interaction of the eco taxes at stage two. In case of substitutes the decision of the median voter follows the same lines. But as we will see in figure 3 the Stackelberg point lies to the left of the Nash equilibrium. Hence, voting for the favored politician shifts the best-response function to the left which requires a stronger preference for employment as that of the median voter. The strategy here is to enforce more intense measures abroad while at home the politician implements a laxer eco tax. If both sides symmetrically follow the same strategy inefficiency cannot be reduced. Thus, the representative democracy in that case is counterproductive.

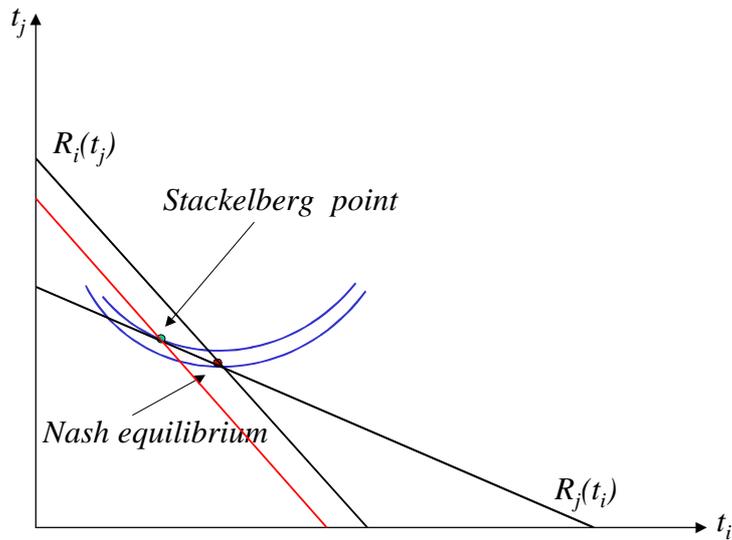


Fig.3: Voting and substitutes

More general: whether the politician who wins the majority of votes is more or less conscious of the environment depends only on the type of strategic interaction between the eco taxes in both regions. The latter dependency, however, decisively changes with globalization and thus the main characteristics of the pro's and con's when comparing the different policy regimes are not fixed forever. In the next section we will see which implications globalization have on the best institutional choice for tackling environmental problems in an international context.

5 How globalization changes the efficacy of the political processes?

Since the main impact on the equilibrium outcome stems from the strategic interaction at the second stage of the game, we should analyze how this impact depends on globalization. As we have shown in section 3, there exists a critical value α^{crit} where the strategic properties change from substitutes to complements. This critical value, however, increases with the extent of the environmental externality s . In all cases, strategic substitutes prevail for globalization not being too strong. The higher α the sooner eco taxes become strategic complements.

Let us now analyze the equilibrium taxes under both regimes of democracy. While globalization turns out to have a negative impact on the eco tax at the subsequent policy game (cf. prop. 3), under the representative democracy there is a second impact of globalization on the eco taxes through the choice of a politician. As prop. 5 shows, the representative exhibits lower environmental preferences in case of a moderate globalization. The stronger the impact of an integrated world the more concerned the elected politicians feel about environmental problems.

It turns out that for α below the critical value the politician in power is less concerned about pollution than the median. Thus, comparing the equilibrium taxes under both democratic decision processes, the direct democracy is characterized by higher eco taxes than the representative regime. This relation changes when globalization becomes even stronger. For all parameters α beyond the critical value, the direct democracy suffers from less efficient taxes.

Proposition 6 *Globalization and democracy.*

i) In case of environmental policies being strategic complements both countries' median voters gain from a representative democracy. They prefer voting on politicians over a direct vote on the environmental policy.

ii) For strategic substitutes direct democracy yields a better outcome for the median voters than a representation by a politician.

Proof. Combining prop. 3 and 5 yields the above result.■

For a better understanding we depict the above result within figure 4. The second-best eco tax is independent of globalization and both voting equilibria are characterized by inefficiently low tax rates. However, if we measure inefficiency in terms of deviation from the second-best tax, the direct democracy is less inefficient for a not too strong globalization, and vice versa.

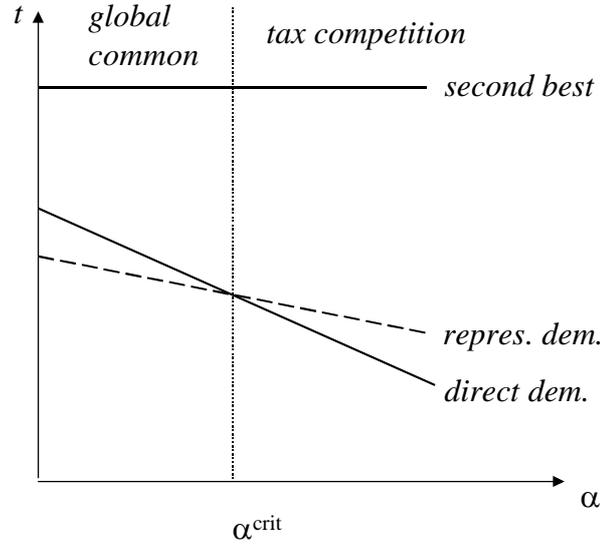


Fig. 4: Efficacy of voting

The main impact on the deviation stems from the strategic interaction of the tax rates. Therefore, we should analyze which economic parameter is the driving force behind these strategic impacts? Amongst others, as the distortive effect of taxation β or the degree of environmental spillover s , globalization α plays a decisive role. The following equation expresses what we have said before,

$$\alpha + [\alpha(1 - s) - s\beta][\alpha(1 - s) + \beta] = \begin{cases} + & \text{strategic complements,} \\ 0 & \text{for } \alpha^{\text{crit}} \\ - & \text{strategic substitutes.} \end{cases} \quad (14)$$

Let us first look at some benchmarks. For $\alpha = 0$ and $s > 0$ there is no competition between the two regions for attracting production, since in that case plants have no locational choice, they are unable to reside abroad. However, both regions suffer from pollution which originates from either country. In that case, the underlying game is that of financing a global common, i.e. the environmental quality. As expected, this game structure displays strategic substitutes.

On the other hand, for $s = 0$ and $\alpha > 0$ the game is characterized by a tax competition between both regions. There is no negative spillover of pollution. The environmental quality does only depend on the production at home. However, by undercutting the neighboring region's eco tax new plants can be attracted. This improves employment and broadens the tax bases, and thus an increase in the revenues from the eco tax rises the cleaning activities.

If we distinguish between strategic complements and substitutes, the underlying games are either of the tax competition type or have global common properties.

Which of the two types prevails depends on the extent of the externality s and the intensity of globalization α . For each spillover s the common pool property dominates the strategic interaction up to the critical value α^{crit} . If globalization becomes strong enough the environmental externality is of minor significance. Hence, globalization changes the character of the game. In the beginning the ecological externality dominates the outcome while with a growing international integration tax competition becomes more and more important.

As we have seen, for global commons the direct democracy is less inefficient than a representative regime, while on the other hand, in the era of globalization the representative form of a political decision making becomes advantageous. Nevertheless, the deviation of an efficient from the equilibrium tax rate increases. Therefore, with a growing international integration of the world economy the ecological problems cannot be dealt with in a non-cooperative process. Uncoordinated behavior is the origin of any inefficiency. However, globalization enforces this deviation from the second-best.

6 Concluding remarks

Although a representative democracy seems to be better prepared for an integrated world and its negative consequences through an intensified international policy competition between neighboring regions, the result should not be stressed too much. The main assumption behind our findings is that we overestimate the competitiveness of the political process. Thus, in our benchmark case we underestimate the scope for rent-seeking activities which are probably present in a representative democracy. Therefore, our model is indicated by a bias for representative regimes, while the positive feature of a direct decision process is systematically suppressed. Nevertheless, the present paper displays that political representation enlarges the scope for strategic behavior. The negative consequences of a race to the bottom are at least partially avoided when strategies become complements. Globalization, in turn, yields a stronger competitiveness of environmental policies such that the underlying strategic implications will grow in the direction of tax competition and the impact of financing a global common vanishes more and more. Hence, eco taxes change their strategic implication while globalization yields an integrated world.

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