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On the Political Economy of Green Tax Reforms

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Abstract. This paper offers a political economy model of green tax reforms in which the use of the revenue from the ecotax is an integrated part. We use the model to explain why and when a link between an ecotax and cuts in other non-environmental taxes can be expected. In our model, green tax swaps arise because a producer lobby group, even if the use of the revenue does not affect profits per se, takes an interest in the allocation of revenue from the ecotax. The reason being that the lobby group uses the allocation of the revenue to reduce the "price" of other political favours that it cares a lot about. To this end, the lobby group acts in the best interest of the voters, and to the extent that the voters prefer tax cuts to more public spending, the endogenously generated reform involves income tax cuts on labour income. The paper also analyses the environmental impact of various budgetary procedures and discusses to what extent the revenue from an ecotax can be used to create a constituency in favour of the environmental protection.

Key words: Political economy, green tax reforms, environmental policy, and lobby groups.

JEL classification: D72, D78, H23, and H41.

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1. Introduction

In several recent tax reforms in the Nordic countries (Norway in 1990, Sweden in 1991, and Denmark in 1994), ecotaxes have been part of a more compressive tax reform, in which ecotaxes, to some extent, have replaced ordinary taxes (see, e.g. Pearson, 1995). Also in other European countries, the public finance aspect of ecotaxes has attracted considerable attention in the policy debate (see, e.g. OECD, 1989). The academic interest in green tax reforms, which integrate the public finance aspect with the incentive-correcting aspect of price instruments, has been based on efficiency considerations, and have therefore treated the political system as exogenous. The most important contribution from this body of literature is the hypothesis of the "double dividend" (see, e.g. Repetto et al., 1992, and Nordhaus, 1993). The idea is that a revenue-neutral replacement of a distortionary tax, e.g. on labour, with a correcting tax, e.g. on emission, on top of the beneficial impact on environmental quality, also improves the overall efficiency of the tax system. However, Bovenberg and de Mooij (1994a and 1994b) showed that the hypothesis of the "double dividend" is doubtful. Their point was that an ecotax, besides reducing pollution, also erodes the tax base of the economy by inducing taxpayers to change behaviour. The presence of this "tax base effect" implies that less room is left to reduce distortionary taxes elsewhere in the economy, and the net result may be that the overall cost of raising a given revenue increases. In fact, Goulder (1995), in his survey of the literature, concludes:

> "Although the evidence is mixed, numerical results tend to militate against the strong double-dividend claim" (Goulder, 1995, p. 176).

The purpose of this paper is to explain the link between ecotaxes and income tax cuts as the outcome of an *income distributional* struggle at a political market. By doing so, we move away from the efficiency-based modelling of green tax reforms (associated with the hypothesis of the "double dividend"), and in the direction of a positive theory of green tax reforms in which the reform process is endogenous. We define a green tax reform by two dimensions. On one dimension, an ecotax is levied on an externality generating activity. On the other dimension, a revenue rule that allocates the proceeds from the ecotax across income tax cuts and public spending is specified. The focus of our paper is on the revenue rule, and, in particular, we are

interested in why and when the revenue is recycled as tax cuts.

Our basic model is based on Grossman and Helpman (1996).[2] Hence, we consider a small open economy in which two electoral-motivated political parties compete in a democratic election. The theme of the election is environmental policy, and, so, in the election campaign preceding the election the parties adopt a green tax reform as part of their platform. The two parties are subject to political pressure from a producer lobby that organises polluting firms. The lobby group is against the ecotax because it has a negative impact on profits. To further its goal, the lobby group offers campaign contributions the parties. The contributions can be used to influence the vote decision of a group of uninformed voters. The rest of the voters, the informed voters, vote according to the economic consequences of the proposed policy platforms. Hence, they, whom the discharge from the firms harms, favour a high ecotax to the extent that it does not affect their wage income negatively and to the extent that the revenue is used to their benefit.

At the political equilibrium, the political parties are completely captured by the lobby group and have, *de facto*, no policy discretion. Accordingly, subject to a participation constraint, the lobby group can induce the parties to adopt the policy platform that it wants. While the lobby group, of course, asks for a low ecotax, the interesting feature of the equilibrium is that it also takes an interest in the revenue rule, although the rule has no immediate profit-consequences for the firms. In fact, the lobby group acts as an advocate for informed voters in matters concerning the revenue rule. The reason is that it reduces the "price" in terms of campaign contributions of other political favours (a low ecotax) that figure high on the group's agenda. Accordingly, to the extent that voters prefer tax cuts to public spending, the lobby group induces the parties to endorse a green tax reform that replaces income taxes with ecotaxes.

The particular revenue rule implemented in equilibrium depends on the pre-electoral supply of the public good. The pre-electoral supply is determined in a (un-modelled) previous election and is taken as given by the various agents in the political market in the present election. If the supply of the good is sufficiently large, all revenue is recycled as tax cuts. If the supply is of "immediate" size, the revenue is split between tax cuts and public spending. Only if the supply of the public good is extremely low, no revenue is used to cut income taxes. Hence, in economies in which the public sector is large (for political economy reasons), such as those in

[2]The common agency model of politics has been used to study aspects of environmental policy in a number of recent papers, see, e.g. Aidt (1996), Fredriksson (1997a, 1997b) and Schleich (1996).

the Nordic countries, it is not surprising to observe a link between tax cuts and ecotaxes, whereas in other countries in which a substantial demand for public services is still unsatisfied, the link between ecotaxes and tax cuts is less likely to be observed.

In our basic model, the ecotax and the revenue rule are both "for sale" in the election. As a consequence, the government, *de facto*, loses all discretionary power over environmental policy. This may, however, underestimate the autonomy of the supply side of the political market, and it is of interest to explore the effect of a more independent supply side. To this end, we assume that the public finance aspect of the tax reform is kept separate from the incentive-correcting aspect. Before the election, the government commits to a specific budget procedure, and, so, only the ecotax is "for sale" is the election. This commitment technology may arise from a two-layer government structure as in Bhagwati and Feenstra (1982). They assume that a top-layer government (the presidency) is able to ignore special interests, which have captured a bottom-layer government (the Congress), and to use the revenue from a (endogenous) tariff to improve on social welfare. We consider two budget procedures: 1) a public-finance-rule in which the ecotax revenue is considered as an additional source of public finance and 2) a tax-cut-rule in which the ecotax revenue is earmarked to tax cuts elsewhere in the economy. Within this structure, we explore the environmental impact of committing to each of these rules to see if the revenue rule, given the necessary autonomy, can be useful to obtain environmental improvements. The basic insight from this exercise is that the revenue rule can be used to mobilise informed voters to take a greater interest in the reform process. This helps reduce the bias against ecotaxes that arises because producers, but not voters, are organised into a lobby group[3] by creating a constituency in favour of high ecotaxes. Specifically, we find that the tax-cut-rule mobilises the voters to support a high ecotax if the Laffer curve is upwards sloping, while the public-finance-rule does the trick if the Laffer curve is downwards sloping.

We organise the remainder of the paper as follows. In section 2, we describe the model. In section 3, we characterise the political equilibrium. In section 4, we analyse the environmental impact of the two budget procedures. In section 5, we discuss some generalisations of the model,

[3]This asymmetry is related to the income distributional and environmental impact of a reform. Typically, the losers, here the firms in a particular industry, are few in number and have a high stake in the reform. On the other hand, the winners are typically a large group of voters, each having a small stake in the reform (the improvement in the environmental quality per capita is small). From Olson (1965) and others, it is well-known that it is less difficult to the few losers to take collective action than it is to the many winners.

and in section 6, we provide a conclusion.

2. The Model

2.1. The Economic Model

Consider a small open economy in which n identical firms produce the good x sold at a competitive world market at the price p^*. We normalise the number of firms to one. The private good is produced using labour, l, raw materials, r, and a specific capital good, k. The domestic prices on labour and raw materials are w and z, respectively. The profit function of the representative firm is

$$\pi(p^*,w,z)=\max_{l,r}\ p^*q(l,r;k)-wl-zr \tag{1}$$

where q(.,.) is a standard neoclassical production function. We interpret profit as the return to specific capital. From the profit function, we derive the demand for labour and raw materials using Hotelling's Lemma:

$$\begin{aligned} -\frac{\partial\pi}{\partial z}&=r(p^*,w,z)\\ -\frac{\partial\pi}{\partial w}&=l(p^*,w,z) \end{aligned} \tag{2}$$

The labour market is competitive. We assume that the labour supply is fixed and equal to $\bar{l}$. Equilibrium in the labour market implies that $\bar{l}=l(p^*,w,z)$. Solving this condition yields the equilibrium wage rate as a function of z and p^*:

$$w^*=w(z,p^*),\ \ where\ \ \frac{dw}{dz}=-\frac{l_z}{l_w}=-\frac{\pi_{w,z}}{\pi_{w,w}} \tag{3}$$

By convexity of the profit function, $\pi_{w,w}>0$. Hence, labour and raw materials are complements if $\pi_{w,z}>0$ and substitutes if $\pi_{w,z}<0$.

Raw materials are traded at the world market at the price z^*. As a by-product, the use of

raw materials pollutes the environment. We assume that the emission of the waste (e.g. smoke) is an increasing, convex function of the use of raw materials.[4] Emission harms the consumers/voters of the economy. We assume that the environmental damage per capita is given as

$$d=G(r(.)) \qquad \textbf{(4)}$$

where G is an increasing, convex function. Convexity of the damage (emission) function is according to empirical evidence. The domestic price of raw materials, z, differs from the world market price due to an ecotax, t, i.e. $z=z^{*}+t$.[5]

2.2. The Political Model

Our modelling of the political market follows Grossman and Helpman (1996). Hence, three types of agents are active in the political market: two groups of voters, two political parties and one lobby group. In an upcoming election the theme is a green tax reform.[6] The reform has of two elements:

* a tax levied on the use of raw materials (the ecotax).
* a rule that specifies the use of the revenue (the revenue rule).

Either the revenue enters the general pool of public funds and is used to increase the supply of a public good or it is recycled to the taxpayers as cuts in the tax on labour income or it is used in any mixture of the two. In the following, we consider each of the three political agents in turn.

The Voters

[4] We assume that emission per unit of raw material is outside the control of the firm, and, so, the firms responses to the ecotax only by substituting raw materials for labour. However, it would be easy to extent the model to include a simple abatement technology that allows the firm to reduce emission per unit of raw material in response to the ecotax. While this would affect the nature of the equilibrium ecotax, it does not affect our conclusions about the revenue rule.

[5] Since the firms have no abatement technology at their disposal, it is of no consequence if we think of the ecotax as being levied at raw materials themselves as a product charge or on emission as a discharge fee.

[6] It is beyond the scope of this paper to explain how and why election themes aries. We simply take it as given that the theme differs from election to election, and that it, in the election that we are considering, happens to be environmental policy.

The economy has a continuum of voters with measure 1. Some voters are informed and some are uninformed about the consequences of environmental policy. Voters with index $k\in[0,n_I]$ are informed, whereas those with index $k\in[n_I,1]$ are uninformed. The measure of informed (uninformed) voters is n_I (n_U) with $n_I+n_U=1$. The voters have to cast their vote for one of two political parties in an election. The two parties, A and B, announce a binding policy platform during the election campaign preceding the election. The platform contains the party's stance on a green tax reform, (t_j,ϕ_j), j=A,B, where t_j is the ecotax and ϕ_j is the share of revenue, $t_jr(.)$, that party j promises to recycled to the voters as tax cuts, while $(1-\phi_j)$ is the share it promises to use on public spending. Before the tax reform, the supply of the public good is $\bar{g}$, which is financed by a proportional tax on labour income, τ.[7] We assume that the status quo, $(\bar{g},\tau)$, is taken as given by the various political agents, and return to the matter of how it is determined below. After the reform, the income tax under party j can be written as a function of t_j and ϕ_j:

$$\tau(\phi_j,t_j)=\frac{\bar{g}-\phi_j r(.)t_j}{w(.)} \qquad \textbf{(5)}$$

Likewise, the supply of the public good is[8]

$$g(t_j,\phi_j)=\bar{g}+(1-\phi_j)t_j r(.) \qquad \textbf{(6)}$$

Each informed voters evaluates the economic consequences of the two policy platforms in his voting decision. The ecological tax reform has three effects on the well-being of the typical informed voters.[9] First, the voters are wage earners and supply one unit of labour to the competitive labour market. The total supply of labour is $\int_0^1 1dk=1\equiv\bar{l}$. Hence, informed voters are concerned with environmental policy to the extent that it affects the return to labour. Second, the

[7]Since labour supply is fixed and we have no initial (i.e. before the election) ecotax imposed on raw materials, the only economic distortion in the model is the externality associated with the use of raw materials. Hence, without any political distortions, a first-best solution could be achieved by implementing a Pigouvian tax. Moreover, the "tax base effect" is absent in our model simply because the ecotax has no tax base to erode. It is easy to show that a "tax base effect" associated with a pre-existing ecotax does not affect our conclusions about the revenue rule.

[8]It is implicitly assumed that one unit of revenue (which, in principle, since we consider a real economy is measured in units of the private good) can be transformed into one unit of the public good. More generally, a cost may be associated with this transformation. Extending the model to allow for this is straight forward and does not alter our results.

[9]We assume that informed voters own no claims to specific capital, and, so, they do not care about profits per se. However, it would be of no consequence to our results concerning the revenue rule to assume that voters own capital.

proceeds from a tax reform affects well-being of the voters via the cut in the income tax and/or via the change in the supply of the public good. Third, the environmental impact of the tax reform is, of course, of concern to the voters due to the damage that pollution does to them.

Assuming that voters have quasi-linear preferences, we can write the indirect utility of an informed voter k as

$$v_k(t_j,\phi_j)=w(t_j)(1-\tau(t_j,\phi_j))+CS(p^*)+H(g(t_j,\phi_j))-G(r(t_j,w(t_j))) \qquad \textbf{(7)}$$

where CS(p^*) is consumers' surplus from consumption of the private good. H is the (per capita) utility from consumption of the public good. We assume that H is an increasing, concave function. Informed voter k votes in favour of party A only if $v_k(t_A,\phi_A)-v_k(t_B,\phi_B)\geq\beta^k$. β^k measures the ideological superiority of party B compared with party A. So, it captures an un-modelled ideological component of party B's platform. We assume that β follows a uniform distribution defined on the interval $[-\frac{1}{2}\lambda,\frac{1}{2}\lambda]$, $\lambda>0$, with distribution function Λ. The probability that voter k votes in favour of party A is $\Lambda(v_k(t_A,\phi_A)-v_k(t_B,\phi_B))$. With a continuum of voters, the law of large numbers implies that the fraction, s_I, of informed voters voting for party A is $\frac{1}{n_I}\int_0^{n_I}\Lambda(.)dk$. We assume that the group of informed voters is homogeneous, i.e. $v_k(.)=v(.)\ \forall k$. Combine this with the assumption about uniformity to get:

$$s_I=\tfrac{1}{2}+\frac{\lambda}{n_I}\int_0^{n_I}v(t_A,\phi_A)dk-\frac{\lambda}{n_I}\int_0^{n_I}v(t_B,\phi_B)dk=\tfrac{1}{2}+\lambda(v(t_A,\phi_A)-v(t_B,\phi_B)) \qquad \textbf{(8)}$$

While campaign rhetoric cannot manipulate informed voters, the vote decision of uninformed voters can be manipulated. Hence, the two political parties launch an election campaign aiming at capturing uninformed votes. We assume that the fraction of uninformed voters that votes for party A, s_U, is a linear function of the difference between the campaign spending of the two parties, i.e. $s_U=\tfrac{1}{2}+y(C_A-C_B)$, where y is a positive constant.

The two Parties and the Government

The two political parties seek to maximise their representation in parliament. Accordingly, they choose a binding policy platform before the election to maximise their total

share of votes. Adding up the votes of informed and uninformed voters, the total share of votes for party A is $s=(1-\alpha)s_I+\alpha s_U$, where $\alpha=\frac{n_U}{n_I+n_U}$. The share of votes in favour of party B is, of course, 1-s. After the election the parties form a government. The legislative process is not modelled explicitly, but we assume that the actual policy outcome is a compromise between the positions of the two parties. For simplicity, we assume that the policy compromise is $t=st_A+(1-s)t_B$ and $\phi=s\phi_A+(1-s)\phi_B$. The government runs a balanced budget.

The Producer Lobby Group

A producer lobby group provides campaign contributions to the two political parties. In doing so, it seeks influence on the policy platforms of the two parties. It is free to seek influence on the size of the ecotax as well as on the revenue rule. The lobby group's objective is to maximise expected industry profit net of political contributions:

$$W=s\pi(t_A,w(t_A))+(1-s)\pi(t_B,w(t_B))-C^A(t_A,\phi_A)-C^B(t_B,\phi_B) \qquad \textbf{(9)}$$

where C^j is the contribution to party j. The contribution to a party is contingent on the reform that the party adopts in its platform. As opposite to an individual firm, which takes the wage rate as given, the producer lobby group internalises the effect of the ecotax on the wage bill of its members. Finally, we assume that capital claims are so concentrated that capital owners are a very small fraction of the voters. Therefore, they solely get their political voice represented via the lobby group.

The Status Quo

To focus on the main issue of this paper, namely a green tax reform, we assume that $\bar{g}$ and the corresponding rate of income tax, τ, are exogenously given from the past. We can think of the present election as one in a sequence of many elections, and let the status quo be the outcome of a previous election in which government spending was the main theme[10]. If the political market for government spending is not distorted by lobby groups with special interests, then $\bar{g}$ is chosen by the parties to please informed voters, i.e. $\bar{g}=g^*=\underset{g}{argmax}\ v(g;.)$, where, by equation

[10]This, of course, leaves open the question of why different elections have different themes. It is, however, beyond the scope of this paper to get into the issue. Our point is that the status quo could have been generated within a context that is perfectly consistent with our present model.

(7), g^* is characterised by:

$$\frac{\partial H}{\partial g}(g^*)=1 \qquad \textbf{(10)}$$

However, the political market for government spending is likely to be highly distorted. If a lobby group favouring a particular high level of government spending is organised, then the status quo is biassed upwards, i.e. $\bar{g}>g^*$, and the other way around if the opposite is true. Hence, a priori, it is hard to say anything about the status quo level of government spending, and it is reasonable to treat $\bar{g}$ as an exogenous variable in the forthcoming discussion.

3. The Political Equilibrium

The political market operates in two stages. In a first stage, before the election campaign takes off, the lobby group offers campaign contributions to influence the platforms of the parties. That is, the lobby group offers a contribution schedule to each party that is contingent on the policy platform of the party. In a second stage, the two parties independently and simultaneously announce their platform (t_j, ϕ_j) taking as given the contribution schedules offered by the lobby group. After the election, the parties form a government that implements the policy compromise. We look for a subgame perfect equilibrium, and therefore we solve the game by backwards induction.

In stage two, each party confronts a contribution schedule, $C^j(t_j,\phi_j)$, and endorses the policy, (t_j,ϕ_j), that maximises its share of seats in parliament, i.e.

$$(t_j^o,\phi_j^o)=\underset{t_j,\phi_j}{argmax}\ (1-\alpha)[\tfrac{1}{2}+\lambda(v(t_j,\phi_j)-v(t_{-j},\phi_{-j}))]+\alpha[\tfrac{1}{2}+\gamma(C^j(t_j,\phi_j)-C^{-j}(t_{-j},\phi_{-j}))] \qquad \textbf{(11)}$$

In stage one, the lobby group is involved in a bilateral bargaining with each of the two parties. Each party can, of course, disregard the lobby group and choose the policy platform that maximises its share of informed votes, i.e. $(t^*,\phi^*)=\underset{t_j,\phi_j}{argmax}\ v(t_j,\phi_j)$. The outside option is the same for the two parties. The lobby group has to offer party j a contribution that gives the party at least the same political support as the outside option. The participation constraint for party j is:

$$(1-\alpha)[\tfrac{1}{2}+\lambda(v(t_j,\phi_j)-v(t_{-j},\phi_{-j}))]+\alpha[\tfrac{1}{2}+y(C^j-C^{-j})]$$
$$\geq(1-\alpha)[\tfrac{1}{2}+\lambda(v(t^*,\phi^*)-v(t_{-j},\phi_{-j}))]+\alpha[\tfrac{1}{2}-yC^{-j}] \quad \textbf{(12)}$$

Rewrite the constraint to get:

$$C^j \geq u[v(t^*,\phi^*)-v(t_j,\phi_j)],\ j=A,B,\ \textit{where}\ u=\frac{(1-\alpha)\lambda}{\alpha h} \quad \textbf{(13)}$$

Notice that the "minimum" contribution that the lobby group has to give to party j is proportional to the difference between the welfare of informed voters under the platform of party j when the party does and does not give in to the demands of the lobby group. Hence, the lobby group can "buy" a given reduction in the ecotax at a low "price," if informed voters are relatively well-off. The lobby group picks its contribution schedules to maximise its payoff given in equation (9) subject to the participation constraints in equation (13). We assume that the constraints are binding,[11] and, so, the lobby group can effectively, by an appropriate choice of contribution, control the platform decisions. To see this, substitute the participation constraints into $s=(1-\alpha)s_I+\alpha s_U$ to get:

$$s(t_A,\phi_A,t_B,\phi_B)=(1-\alpha)[\tfrac{1}{2}+\lambda(v(t_A,\phi_A)-v(t_B,\phi_B))]$$
$$+\alpha[\tfrac{1}{2}+y(\frac{(1-\alpha)\lambda}{\alpha y}(v(t^*,\phi^*)-v(t_A,\phi_A))-\frac{(1-\alpha)\lambda}{\alpha y}(v(t^*,\phi^*)-v(t_B,\phi_B)))]=\tfrac{1}{2} \quad \textbf{(14)}$$

That is, the number of seats in parliament that the parties get is independent of the policy platform they endorse. Hence, in equilibrium, the lobby group completely captures the two parties. It is the fact that the lobby group faces no competition and that it can commit to the contribution schedule *before* the parties announce their platforms that accounts for the success of the lobby group. Substitute equation (13) into equation (9) to get:

$$[(t_A^o,\phi_A^o),(t_B^o,\phi_B^o)]=\underset{(t_A,\phi_A),(t_B,\phi_B)}{argmax}\ \tfrac{1}{2}\pi(t_A,w(t_A))+uv(t_A,\phi_A)+\tfrac{1}{2}\pi(t_B,w(t_B))+uv(t_B,\phi_B) \quad \textbf{(15)}$$

As pointed out by Grossman and Helpman (1996), the lobby group induces the political parties to behave as if they were maximising a weighed sum of the welfare of the lobby group and the

[11] See Grossman and Helpman (1996) for a discussion of the case in which the constraint does not bind.

group of informed voters. The weight given to the group of informed voters, u, is increasing in the size of the group (1-α). It is also increasing in the concentration of the β^ks (large λ). This is because disregarding the interest of informed voters is expensive (in terms of lost votes) if more voters are indifferent between the parties at the margin. Finally, the more responsive uninformed voters are to campaign rhetoric (large y), the cheaper it is to disregard the group of informed voters.

Calculate the two first order conditions associated with equation (15) to characterise an interior optimum,

$$\begin{aligned} \phi_j&: \; ur(.)t_j[1-\frac{\partial H}{\partial g}(\bar{g}+(1-\phi_j)r(.)t_j)]=0 \\ t_j&: \; \tfrac{1}{2}\frac{d\pi}{dt_j}+u[\frac{\partial w}{\partial t_j}+\phi_j\frac{dR_j}{dt_j}+\frac{\partial H}{\partial g}(\bar{g}+(1-\phi_j)r(.)t_j)(1-\phi_j)\frac{dR_j}{dt_j}-\frac{\partial G}{\partial r}\frac{dr}{dt_j}]=0 \end{aligned} \qquad \textbf{(16)}$$

where $\frac{dR_j}{dt_j}=\frac{dr}{dt_j}t_j+r(.)$, $\frac{dr}{dt_j}=\frac{\partial r}{\partial t_j}+\frac{\partial r}{\partial w}\frac{\partial w}{\partial t_j}<0$ and $\frac{d\pi}{dt_j}=\frac{\partial \pi}{\partial t_j}+\frac{\partial \pi}{\partial w}\frac{\partial w}{\partial t_j}=-r(t_j,w(t_j))-l(t,w(t_j))\frac{\partial w}{\partial t_j}<0$. Notice that we assume that the indirect effect, via the wage rate, of the ecotax cannot ever dominate the direct effect on demand of raw materials and profit. The second order conditions require that H(.), w(.) and the revenue function $R_j(.)=t_jr(.)$ are concave in t_j and that G(.) is convex. The equilibrium values of t and ϕ, t^o and ϕ^o, are derived from equation (16) if they are interior, while the equilibrium level of g is, for given t^o and ϕ^o defined by equation (6). Recall that $\phi\in[0,1]$. Hence, if $\frac{\partial H}{\partial g}(\bar{g})\leq 1$, then $\phi^o=1$ and if $\frac{\partial H}{\partial g}(\bar{g}+r(.)t^o)>1$, then $\phi^o=0$. We assume that $t^o>0$ such that the equilibrium ecotax is characterised by the first order condition.

It follows immediately from the two first order conditions that the two parties endorse the same reform, i.e. $t_j=t^o \;\forall j$ and $\phi_j=\phi^o \;\forall j$. This is because the voters have *ex ante* no bias in favour of any of the parties (the distribution of the β^ks is symmetric). This, in turns, implies that the two parties give the same weight to the interest of the lobby group (½). If a bias, say, in favour of party A were present, then party A could "afford" to give the lobby group more weight than party B, and, hence, the equilibrium platforms would differ.

Although the allocation of the ecotax revenue is of no direct concern to the lobby group, it does take an interest in the matter to the extent that it can use the revenue rule to reduce the "price" of other political favours about which it does care. In fact, from equation (16), we see that the lobby group acts in the best interest of the voters in the sense that it advocates an allocation

of the revenue that fits the preference of informed voters well. The intuition is simple. Recall that the contribution needed to "buy" a given reduction in the ecotax is decreasing in the well-being of informed voters (see equation (13)). Hence, by picking ϕ to maximise the welfare of informed voters, the lobby group implicitly minimises the cost of "buying" a given reduction in the ecotax. To summarise,

> **Proposition 1** The lobby group acts as an advocate for informed voters in matters concerning the revenue rule.

The next proposition characterises the revenue rule in more detail.

> **Proposition 2** If $\bar{g} \geq g^*$, *then* $\phi^o = 1$. If $\bar{g} \in [g^* - r(.)t^o, g^*)$, then $\phi^o = 1 - \frac{g^* - \bar{g}}{r(.)t^o} < 1$. If $\bar{g} < g^* - r(.)t^o$, then $\phi^o = 0$.
>
> **Proof** See the Appendix□

The proposition relates the allocation of the ecotax revenue to the status quo level of government spending. This relationship is driven by the fact that the allocation is chosen to fit the preferences of informed voters. So, the revenue rule aims at equalising the marginal value of tax cuts with the marginal value of public spending, which, of course, depends on the status quo. The proposition has three parts. First, if $\bar{g}$ is greater than g^*, informed voters believe that the supply of the public good is too high in the sense that the marginal value of the good at $\bar{g}$ is less than the marginal value of money. Hence, the revenue is recycled as tax cuts. Second, if $\bar{g}$ is smaller than g^*, but greater than g^*-r(.)t^o, informed voters like more of the public good because the marginal value of the good is greater than 1 at $\bar{g}$. For given t^o, the lobby group asks the parties to adopt the rule that equalises the marginal utility from consumption of the public good with the marginal value of money, i.e. to adopt a ϕ^o that satisfy $g = (1 - \phi^o) r(.) t^o + \bar{g} = g^*$. Hence, the revenue is split between tax cuts and public spending. Finally, if $\bar{g} < g^* - r(.)t^o$, the revenue from the ecotax is insufficient to bring the supply of the public good in line with the preferences of informed voters. The best the lobby group can do is, accordingly, to use whatever revenue is collected to expand the supply of g, i.e. $\phi^o = 0$.

To summarise, our political economy explanation for the link between ecotaxes and

income tax cuts has two components. First, the lobby group acts as an advocate for the voters (proposition 1), and, second, to the extent that the voters prefer tax cut to public spending, the ecological tax reform involves a tax swap. According to proposition 2, the voters prefer tax cuts if $\bar{g}$ is sufficiently high. Hence, our analysis implies that in societies with a high level of public spending, it is more likely to observe a green tax swap than in societies with a large unsatisfied demand for public services. This may explain why recent tax reforms in the Nordic countries have had elements of a green tax swap.

For given ϕ^o, we can rewrite the first order condition for the ecotax to get:

$$t^o(\phi^o)=\frac{½(r(.)+l(.)\frac{\partial w}{\partial t})-u\frac{\partial w}{\partial t}+u\frac{\partial G}{\partial r}(\frac{\partial r}{\partial t}+\frac{\partial r}{\partial w}\frac{\partial w}{\partial t})-u[\phi^o+(1-\phi^o)\frac{\partial H}{\partial g}]r(.)}{u(\frac{\partial r}{\partial t}+\frac{\partial r}{\partial w}\frac{\partial w}{\partial t})[\phi^o+(1-\phi^o)\frac{\partial H}{\partial g}]} \qquad \textbf{(17)}$$

We see that the equilibrium ecotax is a weighted average of the interests of informed voters and the lobby group. The lobby group would, of course, like a low ecotax because it has a direct, negative effect on profit. This is captured by the term $½r(.)$. Moreover, the lobby group internalises the indirect effect that the ecotax has on the wage rate of the economy ($½l(.)\frac{\partial w}{\partial t}$). If labour and raw materials are complements ($\frac{\partial w}{\partial t}>0$), then the demand for a low tax is modified.[12] This is because a higher domestic price of raw materials reduces the demand for labour *and* the wage rate. Thereby, the wage bill of firms is decreased. On the other hand, if the two inputs are substitutes ($\frac{\partial w}{\partial t}<0$), then the wage concern reinforces the profit concern. An informed voter has three concerns. First, he is concerned about his wage income ($-u\frac{\partial w}{\partial t}$). If the two inputs are compliments (substitutes) he favours a low (high) ecotax because it leads to a high wage. Second, he is concerned about the use of the revenue ($-u[\phi^o+(1-\phi^o)\frac{\partial H}{\partial g}]r(.)$). This effect adds to the ecotax because informed voters value the tax cuts or the extra supply of the public good associated with the reform. Third, since the discharge of emission does harm, he is concerned with the environmental impact of the use of raw materials. This is captured by the term $u\frac{\partial G}{\partial r}(\frac{\partial r}{\partial t}+\frac{\partial r}{\partial w}\frac{\partial w}{\partial t})$, and adds to the size of the ecotax. Hence, although the parties have no immediate interest in environmental protection, the fact that they are electoral-motivated and informed voters have a "green preference" leads of a *political internalisation* of the economic externality.

[12] Recall that we assume that the derived effect via the wage rate is never large enough to outweigh the direct effect from the ecotax itself on profit and demand of raw material.

The principle of political internalisation of externalities is discussed in Aidt (1996) where we point out that the internalisation can also take place because special interest groups advocate in favour of environmental protection.

4. Constituency Building via the Revenue Rule

In the previous section, the electoral-motivated political parties were captured completely by special interests, and had discretion to decide neither the level of the ecotax nor the allocation of the revenue. This may, however, underestimate the autonomy of the supply side of the political market, and it is of interest to explore the effect of a more independent supply side. To this end, we assume that the public finance aspect of the tax reform is kept separate from the incentive-correcting aspect. Before the election, the government commits to a specific budget procedure, and, so, only the ecotax is "for sale" is the election. This commitment technology may arise from a two-layer government structure as discussed by Bhagwati and Feenstra (1982). They assume that a top-layer government (the presidency) is able to ignore special interests, which have captured a bottom-layer government (the Congress), and use a tariff revenue to improve on social welfare.

We consider two budget procedures: 1) a public-finance-rule in which the revenue from the ecotax is considered as an additional source of public finance ($\phi \equiv 0$) and 2) a tax-cut-rule in which the revenue is earmarked to tax cuts on labour income ($\phi \equiv 1$). We focus on the environmental impact of the two rules, and analyse to what extent the rule can be used to improve, in terms of environmental quality, on the outcome of the underlying political game. To ease the exposition, we assume that $\bar{g}=g^*$, and, so, the voters prefer tax cuts to public spending.

Proposition 3 Suppose the Laffer curve is concave. Then $t^o(\phi \equiv 1) > t^o(\phi \equiv 0)$ if and only if $\frac{\partial R^o}{\partial t}(t^o(\phi \equiv 1)) > 0$.

Proof See the Appendix□

Corollary 1 If the Laffer curve is upwards (downwards) sloping at $t^o(\phi=1)$, then environmental quality is higher (lower) under a tax-cut-rule than under a public-finance-rule.

Corollary 2 The tax-cut-rule always raises more revenue than the public-finance-rule.

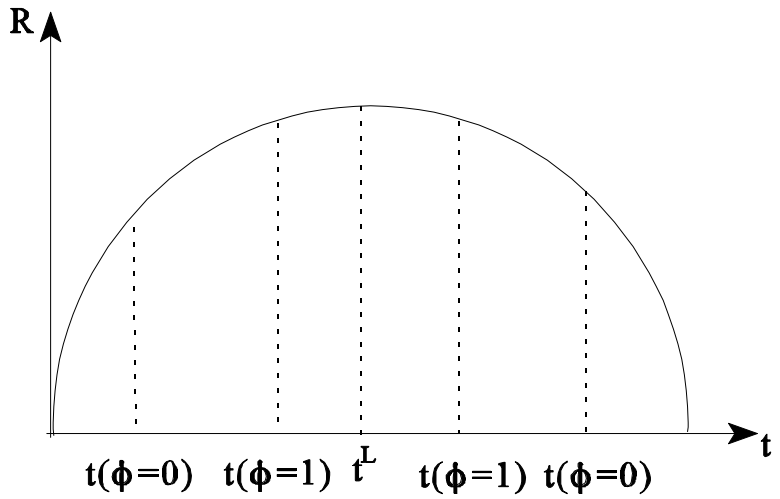

Figure 1. The Laffer curve.

In Figure 1, we draw the Laffer curve of the economy, and show, contingent on whether the economy is to the right or to the left of the Laffer point, the ecotax rates under the two types of revenue rules. Corollary 2 can be seen immediately from the Figure, whereas corollary 1 follows directly from proposition 3 because emission is decreasing in the ecotax.

The intuition behind the proposition and the two corollaries are the following. Informed voters prefer to get the (marginal) revenue from the ecotax recycled as tax cuts rather than as extra public spending ($\bar{g}=g^*$). Hence, if the revenue is recycled as tax cuts, they support, *ceteris paribus,* an environmental policy that brings in more revenue than if a public-finance-rule is used. Consequently, in equilibrium, the tax-cut-rule always raises more revenue than the public-finance-rule. This, in turn, implies that the tax-cut-rule leads to a higher ecotax and a larger improvement in environmental quality than the public-finance-rule if the economy it to the left of the Laffer point, and vice versa if not.

We notice that the slope of the Laffer curve at $t^o(\phi=1)$ is crucial to the results. Define the revenue maximising ecotax as $t^L = -r(.)/\frac{dr}{dt}$, and rewrite equation (17),

$$t^{o}(\phi \equiv 1) - t^{L} = \frac{-\tfrac{1}{2}\frac{d\pi}{dt} - u\frac{\partial w}{\partial t} + u\frac{\partial G}{\partial r}\frac{dr}{dt}}{u\frac{dr}{dt}} \qquad \textbf{(18)}$$

We notice that, *ceteris paribus*, the economy is to the left of the Laffer point if the social marginal damage from emission is small, labour and raw materials are substitutes, and the direct effect of the ecotax on profit is large in absolute value. On the other hand, if emission does substantial harm at the margin, labour and raw materials are complements and the profit effect is small, the economy might be to the right of the Laffer point.

To summarise, if the economy is at the upwards sloping part of the Laffer curve, the tax-cut-rule mobilises informed voters to take a greater interest in environmental protection. If, on the other hand, the economy is to the right of the Laffer point, it is the public-finance-rule that creates a *constituency among informed voters* in favour of high environmental standards. Overall, the revenue rule can be used to pursue environmental (and revenue goals) independently of electoral goals by mobilising informed voters to take a greater interest in policymaking. That is, by increasing informed voters' stake in the reform, the bargaining positions of the two parties are improved because their outside options are better. In turn, to the benefit of the environment, it becomes more expensive for the lobby group, in terms of campaign contributions, to buy a given environmental discount.

5. Generalisations and Extensions

5.1. The Supply of the Public Good

In the basic model of section 2 and 3, we assume that the government can transform one unit of revenue into one unit of a public good. Thereby, we disregard two types of effects. First, we disregard that the production of the public good, like the private good, may be associated with a negative externality. Second, we disregard that the production of the public good affects the allocation of resources in the private sector to the extent that the production process demands inputs that are also used in the private section. In this section, we include the two effects in our model to investigate whether our results are robust.

The Extended Model

We assume that the public good, g, is produced using labour and capital, the latter being in fixed supply. The technology is described by $g=F(l^g;K)\equiv f(l^g)$. The production function, f, is strictly increasing and concave. As an unindented by-product, public production emits pollution to the environment. Damage per capita is described by D=D(g). The damage function, D, is increasing and convex.

The demand for labour has two sources. First, the private sector demands labour according to $l^x(w,z,p^*)$. Second, the public sector demands $l^g=f^{-1}(g)$ units of labour to produce g units of the public good. With a fixed labour supply, the equilibrium condition in the labour market is: $\bar{l}-l^g=l^x(w,z,p^*)$. Hence, we can write the equilibrium wage rate as $w=w(z,g,.)$, where

$$\frac{dw}{dg}=-\frac{\frac{\partial f^{-1}}{\partial g}}{l_w^x}>0 \qquad \textbf{(19)}$$

Notice that the demand from the public sector pushes up the wage rate of the economy. Hence, the production of g is also associated with an economic externality: a wage externality.

Before the reform, a proportional wage-tax finances the pre-electoral supply of the public good, $\bar{g}$, i.e. $\tau=f^{-1}(\bar{g})$. After the reform, the revenue from the ecotax is split between income tax cuts and production of the public good. The "after" reform income tax rate under party j is:

$$\tau(t_j,\phi_j,\bar{g})=\frac{f^{-1}(\bar{g})w(t_j,g_j)-\phi_j r(t_j,w(t_j,g_j)))t_j}{w(t_j,g_j)} \qquad \textbf{(20)}$$

The funds available to cover the cost of buying labour to produce the public good if party j's platform is implemented is $M_j=w(t_j,g_j)f^{-1}(\bar{g})+(1-\phi_j)r(t_j,w(t_j,g_j))t_j$. The budget constraint, accordingly, reads:

$$M_j=w(t_j,g_j)f^{-1}(g_j) \qquad \textbf{(21)}$$

Equation (21) implicitly defines g_j as a function of t_j and ϕ_j. For given t_j, the following differential equation characterises the relationship between gj and ϕ_j:

$$\frac{dg_j}{d\phi_j} = \frac{-r(t_j, w(t_j, g_j))t_j}{\frac{\partial w}{\partial g_j}[f^{-1}(g_j) - f^{-1}(\bar{g})] + w(t_j, g_j)\frac{\partial f^{-1}}{\partial g_j} - (1-\phi_j)\frac{\partial r}{\partial w}\frac{\partial w}{\partial g_j}t_j} \quad \textbf{(22)}$$

The higher the share of the ecotax revenue allocated to tax cuts is, the lower is the supply of the public good, i.e. $\frac{dg_j}{d\phi_j} > 0$. The objective function of an informed voter reads

$$v = w(t_j, g_j)(1 - \tau(t_j, \phi_j, g_j)) + H(g_j) - G(r(t_j, w(t_j, g_j)) - D(g_j) \quad \textbf{(23)}$$

If the only source of revenue to finance the supply of the public good were an income tax, informed voters' most-preferred level of the public good is g*, where $g^*(t_j) = \max_g w(t_j, g)(1 - f^{-1}(g)) + r(t_j, w(t_j, g))t + H(g) - G(r(t_j, w(t_j, g))) - D(g)$ st. $\tau = f^{-1}(g)$. Notice that g* depends on t_j because the marginal cost of providing the public good depends on the ecotax. The following first order condition characterises $g^*(t_j)$:

$$\frac{\partial v}{\partial g} = \frac{\partial w}{\partial g}(1 - f^{-1}(g)) + -w(t,g)\frac{\partial f^{-1}}{\partial g} + \frac{\partial H}{\partial g} + \frac{\partial r}{\partial w}\frac{\partial w}{\partial g}t_j - \frac{\partial G}{\partial r}\frac{\partial r}{\partial w}\frac{\partial w}{\partial g} - \frac{\partial D}{\partial g} = 0 \quad \textbf{(24)}$$

The Political Equilibrium

From equation (15), we recall that party j choses its policy platform to maximise:

$$O_j = \tfrac{1}{2}\pi(t_j, w(t_j, g_j)) + uv(t_j, \phi_j, g_j) \quad \textbf{(25)}$$

The two first order conditions are:

$$\frac{\partial o}{\partial \phi_j} = \tfrac{1}{2}\frac{\partial \pi}{\partial w}\frac{\partial w}{\partial g_j}\frac{\partial g_j}{\partial \phi_j} + u[\frac{\partial w}{\partial g_j}\frac{\partial g_j}{\partial \phi_j}(1 - f^{-1}(\bar{g})) + \frac{\partial H}{\partial g_j}\frac{\partial g_j}{\partial \phi_j} + \phi_j\frac{\partial r}{\partial w}\frac{\partial g_j}{\partial \phi_j}t_j - \frac{\partial r}{\partial w}\frac{\partial w}{\partial g_j}\frac{\partial g_j}{\partial \phi_j} + r(t_j, w(t_j, g_j)) - \frac{\partial D}{\partial g_j}\frac{\partial g_j}{\partial \phi_j}] = 0 \quad \textbf{(26)}$$

$$\frac{\partial o}{\partial t_j} = \tfrac{1}{2}\frac{\partial \pi}{\partial r} + \tfrac{1}{2}\frac{\partial \pi}{\partial w}\frac{\partial w}{\partial t_j} + u[(\frac{\partial w}{\partial t_j} + \frac{\partial w}{\partial g_j}\frac{\partial g_j}{\partial t_j})(1 - f^{-1}(\bar{g})) + \frac{\partial H}{\partial g_j}\frac{\partial g_j}{\partial t_j} - \frac{\partial G}{\partial r}(\frac{\partial r}{\partial t_j} + \frac{\partial r}{\partial w}\frac{\partial w}{\partial t_j} + \frac{\partial r}{\partial w}\frac{\partial w}{\partial g_j}\frac{\partial g_j}{\partial t_j}) + \phi_j r(t_j, w(t_j, g_j)) + \phi_j t_j(\frac{\partial r}{\partial t_j} + \frac{\partial r}{\partial w}\frac{\partial w}{\partial t_j} + \frac{\partial r}{\partial w}\frac{\partial w}{\partial g_j}\frac{\partial g_j}{\partial t_j} - \frac{\partial D}{\partial g_j}\frac{\partial g_j}{\partial t_j}] = 0 \quad \textbf{(27)}$$

The two first order conditions and equation (21) determine simultaneously the three variables t_j, g_j and ϕ_j for each party. We assume that, at the equilibrium, the ecotax is strictly positive.

It is easy to see from equations (26) and (27) that proposition 1 still holds true. That is, the two parties adopt the same green tax reform in their platforms. Hence, we disregard the index j in the rest of the section. Use equation (22) to rewrite equation (26)

$$\begin{aligned}\frac{\partial o}{\partial \phi} &= \tfrac{1}{2}\frac{\partial \pi}{\partial w}\frac{\partial w}{\partial g}\frac{\partial g}{\partial \phi} + u\frac{\partial g}{\partial \phi}[\frac{\partial w}{\partial g}(1 - f^{-1}(\bar{g})) + \frac{\partial H}{\partial g} + \phi\frac{\partial r}{\partial w}\frac{\partial w}{\partial g}t \\ &\quad - \frac{\partial G}{\partial r}\frac{\partial r}{\partial w}\frac{\partial w}{\partial g} - w(t,g)\frac{\partial f^{-1}}{\partial g} - \frac{\partial w}{\partial g}(f^{-1}(g) - f^{-1}(\bar{g})) + (1-\phi)\frac{\partial r}{\partial w}\frac{\partial w}{\partial g}t - \frac{\partial D}{\partial g}] \\ &= \tfrac{1}{2}\frac{\partial \pi}{\partial w}\frac{\partial w}{\partial g}\frac{\partial g}{\partial \phi} + u\frac{\partial g}{\partial \phi}[\frac{\partial w}{\partial g}(1 - f^{-1}(g)) + \frac{\partial H}{\partial g} + \frac{\partial r}{\partial w}\frac{\partial w}{\partial g}t - \frac{\partial G}{\partial r}\frac{\partial r}{\partial w}\frac{\partial w}{\partial g} - w(t,g)\frac{\partial f^{-1}}{\partial g} - \frac{\partial D}{\partial g}] \\ &= \tfrac{1}{2}\frac{\partial \pi}{\partial w}\frac{\partial w}{\partial g}\frac{\partial g}{\partial \phi} + u\frac{\partial g}{\partial \phi}[\frac{\partial v}{\partial g}] = 0\end{aligned} \quad \textbf{(28)}$$

From equation (28), we see that if the lobby group does not internalise the wage effect, then the lobby group acts as an advocate for the group of informed voters, and proposition two generalises without any qualifies: if $\bar{g}$ is (weakly) greater than $g^*(t^o)$, then $\phi^o=1$, i.e. the government recycles all revenue as tax cuts; if $\bar{g}$ is smaller than $g^*(t^o)$, then ϕ^o is, if possible, adjusted such that $g^o=g^*(t^o)$; if funds are insufficient, in equilibrium, to obtain $g^o=g^*(t^o)$, then $\phi^o=0$, i.e. the government allocates all funds to the production of g.

However, if the lobby group does internalise the effect on the wage rate, then ϕ^o is, *ceteris paribus*, higher (if possible) than it would otherwise have been. This is because an expansion of g pushes up the wage rate, thereby, increasing the cost of labour to private firms. Hence, in "choosing" ϕ, the lobby group trades off the profit loss associated with the wage externality with the gain associated with the reduction in the price of political favours achieved

by pleasing informed voters. Consequently, although, here, proposition 2 does not generalise directly, it is still true that the tax reform involves tax cuts if the pre-electoral level of the public good is sufficiently high. Hence, our explanation of the link between income tax cuts and ecotaxes is still valid.

Finally, we notice that the physical externality associated with the production of the public good does not affect the revenue rule. Hence, nothing is lost in terms of generality by excluding this effect from the previous sections.

From equation (27), we see that both the physical and economic externality affect, for given ϕ^o, the size of the ecotax. The impact is determined by the sign of

$$\frac{dg}{dt}=\frac{\frac{\partial w}{\partial t}[f^{-1}(g)-f^{-1}(\bar{g})]-(1-\phi)\frac{dR}{dt}}{\frac{\partial w}{\partial g}[f^{-1}(\bar{g})-f^{-1}(g)]+(1-\phi)\frac{dR}{dg}-w(t,g,)\frac{\partial f^{-1}}{\partial g}},\ \textit{where}\ \frac{dR}{dg}=t\frac{\partial r}{\partial w}\frac{\partial w}{\partial g}<0 \qquad \textbf{(29)}$$

The numerator determines the sign of equation (29) because the denominator is negative. The sign of the numerator depends on $\frac{\partial w}{\partial t}$ and the slope of the Laffer curve. If, say, the economy is to the left of the Laffer point and the two inputs are complements, then an increase in t increases the supply of g. This is because the extra ecotax revenue increases the funds available in the public sector for labour purchases, while, at the same time, the price of labour is reduced. Hence, if $\frac{dg}{dt}>0$, then informed voters, *ceteris paribus*, favour a high t. This is because the expansion of g pushes up the wage rate. Moreover, the increase in the wage rate induces firms to decrease domestic production. This is desired by the voters from an environmental point of view. To some extent, these effects are neutralised because the tax base of the ecotax (the use of raw materials) is eroded as the ecotax becomes higher and higher. Of course, if $\frac{dg}{dt}<0$, e.g. because the two inputs are substitutes and the economy is to the right of the Laffer point, the results reverse.

In sum, we conclude that 1) the endogenously generated link between income tax cuts and ecotaxes is rather general, but 2) whether the revenue rule is set to please informed voters or it is distorted by the presence of the lobby group depend on the objectives of the lobby group. Only if the lobby group is concerned with profits in a narrow sense, i.e. it does not care about the effect of wage changes on industry profit, the lobby group acts as an advocate for the voters in matters concerning the revenue rule.

5.2. The Preference Structure

In the previous sections, we assume that informed voters have quasi-linear preferences. Consequently, the marginal value of income, I, is constant and equal to one. This, of course, bias the revenue rule in favour of tax cuts. However, with a more general specification of preferences such as:

$$v_k(p^*, I) + H(g) - G(r(.)) \qquad \textbf{(30)}$$

it is still true that the lobby group act as an advocate for the group of informed voters in matters concerning the revenue rule. Moreover, if the marginal utility of income is sufficiently high and the marginal utility of the public good is low (e.g. because the pre-electoral level of public spending and the income tax are high), then it is politically optimal to recycle (at least some of) the revenue as tax cuts. Accordingly, although the assumption of quasi-linearity is restrictive, it is not crucial for our conclusions.

5.3. The Tax Base Effect

Our model disregards "tax base effects." The easiest way to capture a "tax base effect" is to assume that there is a pre-existing ecotax, $\bar{t}$. Now, an increase in the ecotax, erodes the tax base of this pre-existing ecotax. Consequently, some ecotax revenue is needed to compensate for the revenue loss associated with the erosion of the overall tax base of the economy, and less revenue is, for given g and ϕ, available to endogenous recycling. This reduces the desirability from the (informed) voters' point of view of a high ecotax, and, so, the equilibrium ecotax (for given revenue rule) is reduced. More important, however, the revenue rule itself is independent of this type of "tax base effect," and, so, proposition 2 still holds true.

6. Concluding Remarks

This paper offers a political economy model of green tax reforms in which the use of the revenue from the ecotax is an integrated part. We use the model to explain why and when a link

between an ecotax and cuts in other non-environmental taxes can be expected. In particular, our model predicts that the link is more likely to be observed in countries in which government spending is a large fraction of the economy than in countries in which it is a small fraction.

The link between ecotaxes and tax cuts elsewhere in the economy arises from the fact that the producer lobby group takes an interest in the issue. We show that if the lobby group is not directly affected by the revenue rule, it acts in the best interest of (informed) voters, and to the extent that they like tax cuts better than extra public spending, the lobby group induces the political parties to adopt tax cuts in their platforms. The lobby group is induced to act as an advocate for informed voters because the "price" that it is going to pay for a given reduction in the ecotax depends on the well-being of these voters. Hence, the lobby group can, by given in to the demands of the voters, use the revenue rule to reduce the "price" of buying a low ecotax. If the revenue rule affects the profits directly, as it is, for instance, the case if the production of the public good affects the wage rate, then the lobby group trades off the interests of the voters against the direct profit-related consequences when it decides which revenue rule to endorse. It is, however, still true that income tax cuts are an integrated part of the reform if public spending is sufficiently high ex ante.

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Appendix

Proof of proposition 2. Fix t^o. Consider the first order condition in equation (16). If $\bar{g} \geq g^*$, then clearly $\frac{\partial H}{\partial g}(\bar{g}+(1-\phi)r(.)t^o)<1 \ \forall \phi \in [0,1]$. Consequently, $\phi^o=1$. If $\bar{g} \in [g^*-r(.)t^o, g^*)$, then the lobby group decreases ϕ until $\frac{\partial H}{\partial g}(\bar{g}+(1-\phi)r(.)t^o)=1$. This happens at ϕ^o that solves $\bar{g}+(1-\phi^o)r(.)t^o \equiv g^*$, i.e. $\phi^o=1-\frac{g^*-\bar{g}}{r(.)t^o}$. Finally, if $\bar{g}<g^*-r(.)t^o$, then we see clearly that $\frac{\partial H}{\partial g}(\bar{g}+(1-\phi)r(.)t^o)>1 \ \forall \phi \in [0,1]$. Hence, the equilibrium revenue is insufficient to cover the expenses needed to obtain g*, and, so, $\phi^o=0$ □

Proof of proposition 3. $t^o(\phi \equiv 1)$ and $t^o(\phi \equiv 0)$ are defined by the following two relations

$$-\tfrac{1}{2}\frac{d\pi}{dt}[t^o(\phi \equiv 1)]+u\left(\frac{\partial w}{\partial t}[t^o(\phi \equiv 1)]-\frac{\partial G}{\partial r}\frac{dr}{dt}[t^o(\phi \equiv 1)]\right) +u\frac{dR}{dt}[t^o(\phi \equiv 1)]=0 \qquad \text{(A1)}$$

and

$$-\tfrac{1}{2}\frac{d\pi}{dt}[t^o(\phi \equiv 0)]+u\left(\frac{\partial w}{\partial t}[t^o(\phi \equiv 0)]-\frac{\partial G}{\partial r}\frac{dr}{dt}[t^o(\phi \equiv 0)]\right) +u\frac{dR}{dt}[t^o(\phi \equiv 0)]\frac{\partial H}{\partial g}[\bar{g}+r(.)t^o(\phi \equiv 0)]=0 \qquad \text{(A2)}$$

Now evaluate (A2) at $t^o(\phi \equiv 1)$ to get:

$$\Lambda \equiv -u\frac{dR}{dt}[t^o(\phi \equiv 1)]\left(1-\frac{\partial H}{\partial g}[\bar{g}+r(.)t^o(\phi \equiv 1)]\right) \qquad \text{(A3)}$$

Since $\frac{\partial H}{\partial g}[\bar{g}+r(.)t^o(\phi^o)]<1$ at $\bar{g}+r(.)t^o(\phi^o)>g^*$, sign Λ=-sign $\frac{dR}{dt}$. By definition, (A2) is zero at $t^o(\phi \equiv 0)$. Hence, by the Second order condition, we conclude that $t^o(\phi^o)>t^o(\phi \equiv 0)$ if $\frac{dR}{dt}[\bar{g}+r(.)t^o(\phi)]>0$, and that $t^o(\phi^o)<t^o(\phi \equiv 0)$ if not□

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