Intergenerational Conflicts and the Resource Policy Formation of a Short-Lived Government

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1. Introduction

Most resource and environmental problems have an intertemporal dimension, and the costs and benefits of different actions are distributed asymmetrically through time. For example, the current overuse of a natural resource such as the atmosphere, water, or fisheries may reduce future availability. From a broader point of view, over-extraction or over-catching of a species may endanger the biodiversity of the ecosystem, and this biodiversity is a resource that may be valuable for future generations. Thus, most of the costs associated with current resource usage would be incurred in the future. This is less of a problem if the agents who benefit from usage now were still to be alive in the future, and thus be able to pay for them. On most occasions, however, this is not the case, and the current benefits gained using a natural resource impose costs on future generations who will receive no compensation. Behind the key issue of controlling resource extraction lies these intergenerational trade-offs. It can be seen that some intergenerational conflicts have their roots in intertemporal negative externalities.

Each generation has an interest in the policy outcome set by the regulatory authority. This is because changes in the relevant generation's welfare would be

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sensitive to the policy regulating the depletion of the resource. Then, a generation with a strong preference for a particular policy may be motivated to appeal for collective actions in promoting their interests in resource management. In recent years, these politically motivated movements have had a significant impact on government decision making processes, notably in trade and environmental policies. This paper focuses on a resource management policy which is decided through a political process that integrates the conflicting views of individuals at different stages in their life cycle. The members of each self-interested generation may form a pressure group. This group seeks influence on the policy making process by making a contribution to the policy maker so that its most preferred policy may be implemented.

To address this intertemporal political problem, we present an *OLG* model, where difference in the life cycles of each generation, at a given point of time, lead to different attitudes towards the preservation of a common resource. Individuals in this economy consume two types of goods – clean goods and dirty goods. The dirty goods generate some pollution. The future availability of the resource is affected by current production of the dirty goods due to, for instance, the adverse effects of pollution on the biological growth of the resource. In short, the source of intergenerational conflict is that young individuals want an efficient use of a resource throughout their lives, while old individuals does not care about the externality to the future availability of the resource.

The model has the following aspects: *(i)* in each period, the young and old generation seek to influence the resource policy, and the underlying conflict of interest is resolved by a political process (in real life, collective action to affect the government decision carried out by young and old individuals can be observed in the pressure groups formed by retired people on the one hand and working people on the other one, who try to influence government policy by mean of promising to finance next electoral campaign); *(ii)* the political process is modelled as in GROSSMAN and HELPMAN (1998), and the government is assumed to hold office for one period only (the assumption of a short-lived government is a realistic one since the life-span of the government is usually shorter than the one of the individual in a democratic society); *(iii)* the biological growth of the resource is assumed to be negatively related to the current production of dirty goods due to pollution. The short-lived government's objective is to collect contributions from the pressure groups either for financing the coming election campaign or for personal use.

The *common agency* framework is used in this paper to analyse the resolution of the intergenerational conflict over resource exploitation. Originally proposed by BERNHEIM and WHINSTON (1986) the common agency model describes a situation in which many principals try noncooperatively and simultaneously to influence the policy choice of an agent by offering some contributions. In this structure, it is assumed that the authority is a jurisdictional agent who can enforce the regulation and preservation of resources. His objective is to maximise the sum of contributions obtained from the pressure groups. The opportunistic nature of the politician is characterised by the short term of his office. The young and old generations act as principals who compete with each other by offering contributions to the politician in order to try and secure their most preferred resource preservation policy in each period, given the choice of the other generation.

The model studies a particular class of contribution strategies, which we call *"Take It Or Leave It" (TIOLI)* strategies. These basically restrict the principals' strategy sets: a principal contributes to the politician (the agent) in support of one particular resource policy and contributes nothing in support of any other policy. Given these strategies, the politician's policy choice is simple: he only has to choose the policy proposal associated with the maximum contribution. Thus, the principal who offers the highest contribution would get the policy that she proposes to the politician implemented. In equilibrium, the principal whose proposal is adopted pays as much as the other principal (who made the second highest offer) but also a very small amount to induce the politician to set the policy that she most prefers.

This paper forms part of a growing literature on dynamic common agency, and contains some notable features that distinguish it from previous studies. The major contributions of this paper can be summarised as follows. Firstly, most of the literature on intertemporal resource allocation adopts a classical framework of welfare economics as presented in a series of papers by Howarth (1991, 1996, and 1998) and Howarth and Norgaard (1992, 1993, and 1995). Our approach is a political one as is often the case in modern democratic societies where social problems, such as intergenerational conflicts over a natural resource, can be resolved through political competition between the relevant pressure groups. Second, within the standard OLG structure, the model characterises stationary political equilibria using TIOLI strategies. In this paper, the TIOLI strategies are shown to be a convenient way of characterising equilibria in a complex dynamic game: they are state-independent and look like the bidding style competition observed in auctions. Third, the model by Grossman and Helpman (1998) suggests that politics plays a negative role and that in the long run, competition between self-interested pressure groups will have a devastating effect on the economy. Our model, on the contrary, shows that an economy could preserve more resources for the future through political competition than would be preserved by a social planner. At equilibrium, this is due to relatively little consumption of dirty goods by current generations.[1]

2. Literature Survey

The basic framework used for this paper is related to the works of Grossman and Helpman (1998) and Bernheim and Whinston (1986) as mentioned in the introduction. Grossman and Helpman (1998) analyse the politics of intergenerational redistribution in an OLG model with a short-lived government. Their underlying idea is that each generation of young and old forms a pressure group to influence the intergenerational redistribution policy making of the current government. Characterisation of equilibria in their model is relatively simple because a particular form of linear preference is used and the representative individual works when young and consumes only when old.

Although our model is inspired by their framework, it follows the general set-up of the typical OLG model. We adopt the common agency model to this and assume well-behaved separable log linear utility functions for each generation. As in Grossman and Helpman's model, we adopt the common agency model developed by Bernheim and Whinston to resolve the conflict between the generations. This framework has been used by several authors to explain environmental or trade policy issues. Among them, Fredriksson (1997) explained how a pollution tax and total pollution are affected by movements in prices and the political influence of the lobbies.

A dynamic version of the common agency model still remains at an initial stage of development. It can provide important and fruitful implications for the solutions of many intertemporal economic problems. Recently, Bergemann and Välimaki (1998) proposed a theoretical model of dynamic common agency with symmetric information. They characterised the *Truthful Markov Perfect Equilibrium* set as a refinement of the Markov perfect equilibria. Their results depend on the assumption of transferable utility for principals and the infinite life span of all the players. Boyce (2000) studies a dynamic common agency which is similar to our resource management problem. He considers natural resource regulation problem in which 'harvester' and 'conservative' groups compete in making contributions to influence a regulator who assigns harvester quotas in each period. The

1 All the proofs are available by the authors upon request.

basic contrasting feature with our model is that BOYCE assumes that each player has an infinite time horizon. This makes his solution relatively simple when utilising the backward induction methodology originally developed by LEVHARI and MIRMAN (1980) to characterise a state independent equilibrium.

3. The Model

3.1. The Economy

We consider an overlapping generation economy in which each generation lives for two periods. There is no population growth and at any given point in time t, there is one representative young individual alive and one representative old. Each individual is endowed with one unit of labour in each period. Labour can be combined with the stock of a common natural resource (S_t) available at period t to produce two goods: a clean good, x_t and a dirty good, y_t. The production technology is represented as follows: $x_t^s = S_t l_{xt}^s$, $y_t^s = S_t l_{yt}^s$, where l_{jt}^s represents the amount of labor input allocated to the production of good j at time t by an individual born at time s The labour endowment of an individual born in period s is divided between the production of the two goods: $l_{xt}^s + l_{yt}^s = 1$. Then, the total amount of the labour input used at time t to produce good j is $l_{jt} = l_{jt}^t + l_{jt}^{t-1}$. So the aggregate production[2] of each good is $x_t = x_t^t + x_t^{t-1} = S_t l_{xt}$ and $y_t = y_t^t + y_t^{t-1} = S_t l_{yt}$. The biological growth of the common natural resource is given by

$$S_{t+1} = S(S_t, l_{yt}^t + l_{yt}^{t-1}) = S_t^{(1-\delta)} \exp(1 - \phi(l_{yt}^t + l_{yt}^{t-1})) \tag{1}$$

where $\delta \in (0,1)$ is the depreciation rate of the resource due to factors other than production of the dirty good and $0 < \phi < 1/(\max l_{yt})$ is the *inverse measure of the effectiveness* of resource preservation. The initial resource endowment available in period 0 is S_0.

Under the uniform government regulation, which we will assume in the sequel, $l_{yt}^t + l_{yt}^{t-1} = 2\lambda_t$, and the law of motion (1) can be re-specified as

2 As one can easily verify, the aggregate production function displays social increasing returns to scale. This assumption is motivated for sake of simplicity and does not influence our results in any crucial way. In addition, the exponential form for the law of motion of the resource availability is chosen to simplify the analysis of the model as will become clear in the sequel of our analysis.

$$S_{t+1} = S(S_t, \lambda_t) = S_t^{(1-\delta)} \exp(1 - \phi(2\lambda_t)). \tag{2}$$

The direct utility function of a representative young individual is defined as $u_Y(x_t^t, y_t^t) = \ln x_t^t + \gamma \ln y_t^t + \beta(\ln x_{t+1}^t + \ln y_{t+1}^t)$ where $\beta \in (0,1)$ is a time preference discount factor. From the direct utility function, we can derive the reduced-form *gross policy preference function* of a representative young individual born at time t with a given resource level S_t as

$$v_Y(S_t) = \theta \ln S_t + \gamma \ln \lambda_t + \ln(1 - \lambda_t) + \beta V(\lambda_t, S_t) \tag{3}$$

where $\theta = 1 + \gamma$ and $V(\lambda_t, S_t)$ is the expected gross policy preference at time $t + 1$ of the current young individual if in period t the policy action was λ_t and the payoff relevant part of history was S_t. So

$$V(\lambda_t, S_t) = 2 \ln S_{t+1} + \ln \lambda_{t+1} + \ln(1 - \lambda_{t+1}),$$

where λ_{t+1} is the expected resource policy function at time t.

The direct utility function of a representative old living in time t is given by

$$u_O(x_t^{t-1}, y_t^{t-1}) = \ln x_t^{t-1} + \ln y_t^{t-1}.$$

Then the gross policy preference function has the following form:

$$v_O(S_t) = 2 \ln S_t + \ln \lambda_t + \ln(1 - \lambda_t). \tag{4}$$

The parameter γ (> 0) captures the relative *"green preference"* of a new born young individual. If $\gamma < 1$ ($\gamma > 1$), the individual takes less (more) pleasure in consuming dirty goods when young, and so, the individual is said to have a green (an anti-green) preference.

This asymmetry in each generation's preference function is motivated by the fact that the old and the young may have different attitudes towards resource depletion and the accompanying environmental consequences. This difference, in turn, may have resulted from underlying social norms and shared values between members of society, in which the young and the old may perceive those issues differently.

Next, we analyse the decision-making process for the resource allocation policy within this dynamic model. Although, as previously described, we are primarily interested in the political process for the resource allocation policy, we will initially explore policy choices without government intervention and with a hypothetical social planner. This will provide us with the opportunity to compare each of the equilibrium policies that govern the exploitation of the resource under different economic regimes.

3.2. The Unregulated Equilibrium

We begin our analysis by examining the competitive equilibrium of an unregulated economy. In this case, each individual will act on her own behalf without any government interference and subject only to the resource constraint. We assume that the negative externality associated with production of dirty goods is not internalised by the individuals. In adddition we assume that individuals do not have access to any kind of assets which would allow them to accumulate wealth, and so the equilibrium will be autarkic.

Definition 1 ***Competitive Equilibrium:*** *A competitive equilibrium is defined as a collection of sequences* $\{l_{yt}^{t}, l_{yt}^{t-1}, l_{xt}^{t}, l_{xt}^{t-1}\}_{t=0}^{\infty}$ *for each* $t \geq 0$ *such that,* (1), *the allocation solves the maximization problem of each generation for each* $t \geq 0$ *subject to the labor allocation constraints and,* (2), *the production factor market clears in each* $t \geq 0$.

A straightforward computation shows that the competitive equilibrium labour allocations at time t which are employed in the production of dirty goods are given by $(l_{yt}^{t})^{CE} = \gamma/(1+\gamma)$ and $(l_{yt}^{t-1})^{CE} = 1/2$. Hence, the total amount of labour (l_{yt}^{CE}) allocated to the production of dirty goods at time t is

$$l_{yt}^{CE} = (l_{yt}^{t})^{CE} + (l_{yt}^{t-1})^{CE} = \frac{1+3\gamma}{2+2\gamma}, \forall\, t. \tag{5}$$

It is worthwhile to note that l_{yt}^{CE} is time invariant and is an increasing function of the green preference parameter γ.[3] This is quite intuitive: when γ is large, the young individual has an anti-green preference which encourages her to allocate a relatively large portion of her labour endowment to the production of dirty goods, increasing l_{yt}^{CE}.

3.3. The Planner's Solution

The second benchmark case to be examined is the policy rule designed by a benevolent social planner. It is assumed that he has an infinite time horizon and decides in each period how to allocate the consumption of two goods between

3 The time-independent property of the competitive equilibrium holds for any specification of the law of motion as long as the young generation does not internalise the externality.

the generations through a resource policy maximising intertemporal social welfare. The planner's problem is defined as follows:

Definition 2 ***The Social Planner's Problem:*** *The benevolent social planner dictates a sequence of the resource policy* $\{\lambda_t^{SP}\}_{t=0}^{\infty}$ *so as to maximise a discounted sum of the life-cycle utility of all current and future generations,*

$$U^{SP} = \sum_{t=0}^{\infty} \rho^t [\theta \ln S_t + \gamma \ln \lambda_t + \ln(1-\lambda_t) + \tfrac{\beta}{\rho}(2\ln S_t + \ln \lambda_t + \ln(1-\lambda_t))]$$

under the resource constraint in (1). The parameter $\rho \in (0,1)$ *represents the time discount factor of the social planner.*

By means of dynamic optimisation, we find the socially optimal resource allocation policy at time *t*,

$$\lambda^{SP} = \frac{1+m-\sqrt{(1+m)^2 - 4am(a+b)^{-1}}}{2m}, \forall t. \tag{6}$$

where $a \equiv \gamma + \dfrac{\beta}{\rho}$, $b \equiv 1 + \dfrac{\beta}{\rho}$ and $m \equiv \dfrac{2\phi\rho}{1-\rho+\delta\rho}$.

4. The Political Economy Model

At the heart of the resource allocation problem under consideration, there is an intergenerational conflict. The difference in preference of each generation over the government's resource policy arises from two sources. First, in contrast to the old generation, the young generation is always concerned about the impact of production of dirty goods on the future availability of the resource. Second, even if the young generation does not internalise this externality, the fact that it has a green (or anti-green) preference makes its policy preference different from that of the current old generation. The difference in preferences implies that each generation prefers a different policy rule. The policy maker (the government) has to settle this conflict and the way that this is done depends on the nature of the political process. Within a democracy, each individual can express her preference directly in elections and/or through the membership of lobbies. Here, we focus on special interest group politics in which each generation forms a lobby which actively exercises political influence. In real life, collective action to affect the government decision carried out by young and old individuals can be observed in the pressure groups formed by retired people on the one hand and working people on the other one, who try to influence government policy by mean of promising to finance next electoral campaign. The assumption of a short-lived government is a realistic assumption since the life-span of the government is usually shorter than the one of the individual in a democratic society.

It is assumed in each period that the young and the old organise lobbies, which we refer to as the *Y*-group and the *O*-group, respectively. The two lobbies seek to influence the government's resource policy by means of contribution payments. It is assumed that the contribution is financed by a membership fee, and that the fee is paid as a proportion, c_{it}, of the goods produced by the members at time t. So, the total contribution is $C_{it} = c_{it}\left(x_t^i + y_t^i\right) = c_{it}S_t$, where $i \in (Y,O)$ represents a lobby.[4] Each lobby offers the government a contribution schedule $c_i(\lambda_t, S_t) \in [0,1]$ which depends on the payoff relevant part of history as represented by the state variable S_t and the policy rule λ_t. Hence, a contribution strategy for lobby i is a mapping which assigns for every possible policy action λ_t of the government a nonnegative reward contingent on the payoff relevant history of the game. The two lobbies represent the preferences of the membership sincerely, and the net policy preference function for the *Y*-group can be represented as:

$$n_Y(\lambda_t, S_t) = \theta \ln S_t + \gamma \ln \lambda_t + \ln(1-\lambda_t) + \theta \ln(1 - c_Y(\lambda_t, S_t)) + \beta N(\lambda_t, S_t) \qquad (7)$$

where the expected net policy preference for period $t+1$ is given by

$$N(\lambda_t, S_t) = 2\ln S_{t+1} + \ln \lambda_{t+1} + \ln(1-\lambda_{t+1}) + 2\ln((1-c_O)\lambda_{t+1}, S_{t+1}).$$

The net policy preference function for the *O*-group is

$$n_O(\lambda_t, S_t) = 2\ln S_t + \ln \lambda_t + \ln(1-\lambda_t) + 2\ln(1 - c_O(\lambda_t, S_t)). \qquad (8)$$

The government is assumed to be short-sighted and opportunistic. There is an election in each period, and the objective of the politician is to collect the

4 We assume that government is interested in collecting maximum amount of the two goods from the generations, no matter what is the share of each of them. In other words, government is not endowed with any green preference and, from its point of view, the two goods are perfect substitutes. This justifies the contribution functions adopted through the paper, where each generation offers the government an aggregate bundle of the two goods and not a two-dimensional vector specifying the amount of each good.

maximum contributions from the lobbies to finance the next election campaign. Therefore, in each period, a new government, which is only concerned with the total contribution that it can extract from the lobbies, comes into office. This combination of short-sightedness and opportunism implies that the government has no incentive to internalise the externality unless it is rewarded by the *Y*-group for doing so. We assume that the government implements the policy rule at no cost. The objective function of the government of period t is assumed to be

$$G(\lambda_t, S_t) = S_t\{c_Y(\lambda_t, S_t) + c_O(\lambda_t, S_t)\} \tag{9}$$

where S_t is given from the past.

4.1. Political Equilibria

In order to study the political equilibrium outcome, it is convenient first to define the notion of a best response for the two lobbies, active at a given point in time. We use the notation "^" to denote equilibrium values of the relevant variables and functions.

Definition 3 ***Best Response:*** *For* $t \geq 0$, *the contribution function* $\hat{c}_Y(\lambda_t, S_t)$ *is a best response to the contribution function* $\hat{c}_O(\lambda_t, S_t)$ *if the Y-group active in period t cannot find an alternative contribution function,* $\overline{c}_Y(\lambda_t, S_t)$, *such that*

$$n_Y(\overline{\lambda}_t, S_t) > n_Y(\widehat{\lambda}_t, S_t) \tag{10}$$

where for $t \geq 0$,

$$\hat{\lambda}(S_t) = \arg\max_{\lambda_t} \hat{c}_Y(\lambda_t, S_t) + \hat{c}_O(\lambda_t, S_t), \tag{11}$$

$$\overline{\lambda}(S_t) = \arg\max_{\lambda_t} \overline{c}_Y(\lambda_t, S_t) + c_O(\lambda_t, S_t).$$

For $t \geq 0$, *the contribution function* $\hat{c}_O(\lambda_t, S_t)$ *is a best response to the contribution function* $\hat{c}_Y(\lambda_t, S_t)$ *if the O-group active in period t cannot find an alternative contribution function,* $\underline{c}_O(\lambda_t, S_t)$, *such that*

$$n_O(\underline{\lambda}_t, S_t) > n_O(\lambda_t, S_t) \tag{12}$$

where $\hat{\lambda}_t(S_t)$ is defined in equation (11) and

$$\underline{\lambda}(S_t) = \arg\max_{\lambda_t} c_Y(\lambda_t, S_t) + \underline{c}_O(\lambda_t, S_t). \tag{13}$$

We can now introduce the definition of Political Equilibrium.

Definition 4 ***Political Equilibrium:*** *A political equilibrium is a sequence of contribution functions* $\{c_O(\lambda_t, S_t), c_Y(\lambda_t, S_t)\}_{t=0}^{\infty}$ *and a sequence of resource policies* $\{\lambda(S_t)\}_{t=0}^{\infty}$ *such that:*

(1) *The contribution functions and the policy actions are feasible, i.e., for all i and t,* $\hat{c}_i(\lambda_t, S_t) \in \Omega_i$ *and* $\lambda_t \in [0,1]$ *where* Ω_i *is the set of all feasible contribution functions of group i.*

(2) *For all* $t \geq 0$,

$$\hat{\lambda}(S_t) = \arg\max_{\lambda_t} \hat{c}_Y(\lambda_t, S_t) + \hat{c}_O(\lambda_t, S_t). \tag{14}$$

(3) *For all* $t \geq 0$, *the contribution function* $\hat{c}_Y(\lambda_t, S_t)$ *is a best response to* $\hat{c}_O(\lambda_t, S_t)$ *and vice versa.*

The definition of the equilibrium is basically a standard definition of a subgame perfect Nash equilibrium in a dynamic common agency game with perfect information, with the restriction that strategies can only depend on the current state S_t. Without further restrictions on the space of the feasible contribution functions that the lobbies can employ, this game will have multiple political equilibria. We will identify a particular type of political equilibrium by restricting the feasible contribution strategies to the class of so called *"Take-It-Or-Leave-It" (TIOLI)* contribution functions. Formally, we define a TIOLI contribution function as follows:

Definition 5 ***TIOLI Contribution Function:*** *A TIOLI contribution function* $\hat{c}_i(\lambda_t, S_t)$ *is a function of the following type:*

$$\hat{c}_i(\lambda_t, S_t) = \begin{cases} \hat{c}_i(S_t) & \text{if } \hat{\lambda}(S_t) = \lambda^i(S_t) \\ 0 & \text{otherwise} \end{cases} \tag{15}$$

where $\lambda^i(S_t)$ *is the policy proposal of group i where* $i \in \{Y, O\}$.

We see from the definition of the TIOLI contribution function that a lobby group offers the government a payment only if it implements the resource policy asked for by the group. Then, following from definition (14), the optimal resource policy rule of the government active in period t takes the following form if the lobbies use TIOLI contribution functions:

$$\hat{\lambda}(S_t) = \begin{cases} \lambda^O(S_t) & \text{if } c_O(S_t,\lambda_t) \geq c_Y(S_t,\lambda_t) \\ \lambda^Y(S_t) & \text{if } c_O(S_t,\lambda_t) < c_Y(S_t,\lambda_t). \end{cases} \tag{16}$$

4.2. Characterisation of Equilibria

First, consider the policy proposals made by the two groups. The O-group is not concerned about the future and so, for a given contribution payment, $\hat{c}_O(S_t,\lambda_t)$, and keeping the strategy of the Y-group constant, it proposes the policy that maximises its net payoff given by equation (8), i.e.,

$$\lambda^O(S_t) = \arg\max_{\lambda_t} n_O(\lambda_t, S_t). \tag{17}$$

A simple calculation shows that the policy proposal from the O-group will be $\lambda^O(S_t) = \lambda^O = 1/2$. On the other hand, the Y-group is concerned about the welfare of its member in period t as well as in period $t+1$, and so, it has to anticipate correctly the political equilibrium in period $t+1$ and take into account how current play affects resource availability tomorrow. Looking one period ahead, the Y-group foresees that $\lambda(S_{t+1}) = \hat{\lambda}_{t+1}$ and that $c_i(\lambda(S_{t+1}), S_{t+1}) = \hat{c}_i(\hat{\lambda}_{t+1}, S_{t+1})$. Taking the contribution strategy of the current O-group as given, for given $\hat{c}_Y(S_t,\lambda_t)$, it proposes the following policy

$$\lambda^Y(S_t) = \arg\max_{\lambda_t} n_Y(\lambda_t, S_t) \tag{18}$$

where $n_Y(\cdot)$ is given by equation (7). Solving this optimization problem yields

$$\lambda^Y = \frac{(\theta + C) - \sqrt{(\theta + C)^2 - 4C\gamma}}{2C} \tag{19}$$

where $\theta = (1+\gamma)$ and $C \equiv 4\phi\beta$.[5] It follows directly from the equation (11) that the government, faced with the TIOLI contribution strategies which are associated with the policy proposals given by $\lambda^O = 0.5$ and (19), implements the following policy rule:

$$\hat{\lambda}(S_t) = \begin{cases} \lambda^O & \text{if } c_O(S_t, \lambda_t) \geq c_Y(S_t, \lambda_t) \\ \lambda^Y & \text{if } c_O(S_t, \lambda_t) < c_Y(S_t, \lambda_t). \end{cases} \tag{20}$$

To close the characterization of the political equilibrium in period *t*, we need to specify the payments that go with the two proposals. To this end, we introduce the notion of *willingness to pay*.

Lemma 6 ***Willingness to Pay:*** *The willingness to pay of the two groups active in period t is independent of S_t. In particular, the O-group's willingness to pay to achieve $\lambda^O = 0.5$ is*

$$c_O^{\max}(\beta,\gamma,\phi) = 1 - \exp\{\frac{1}{2}[\ln(1-\lambda^Y) + \ln\lambda^Y - 2\ln(\frac{1}{2})]\} \tag{21}$$

while the Y-group's willingness to pay to achieve λ^Y is

$$c_Y^{\max}(\beta,\gamma,\phi) = 1 - \exp\{\theta^{-1}[\theta\ln(\frac{1}{2}) - \ln(1-\lambda^Y) - \gamma\ln\lambda^Y] + \theta^{-1}4\beta\phi(\lambda^Y - \frac{1}{2})\}. \tag{22}$$

We can now introduce the following Proposition.

Proposition 7 *Suppose that the old and young generation lobby the government using the TIOLI strategies and that the resource policy function is given by equation* (20). *Then the following constitute stationary political equilibria.*

5 We rule out another positive root which is larger than 1/2 since we assume that the *Y*-group is more conservative than the *O*-group in the sense that it has to foresee availability of the resource when it becomes old. Simple calculation shows that the condition $0 < \gamma < A/2 + 1$ is needed for this assumption.

(1) *For arbitrary small* $\varepsilon > 0$,

$$\begin{aligned}
\hat{\lambda} &= \lambda^{O} \\
\hat{c}_Y(\lambda) &= \begin{cases} 0 & \text{for } \hat{\lambda} \neq \lambda^{Y} \\ c_Y^{\max} & \text{for } \hat{\lambda} = \lambda^{Y} \end{cases} \\
\hat{c}_O(\lambda) &= \begin{cases} 0 & \text{for } \hat{\lambda} \neq \lambda^{O} \\ c_Y^{\max} + \varepsilon & \text{for } \hat{\lambda} = \lambda^{O}, \end{cases}
\end{aligned} \tag{23}$$

if and only if $c_O^{\max} > c_Y^{\max}$.

(2) *For arbitrary small* $\varepsilon > 0$,

$$\begin{aligned}
\hat{\lambda} &= \lambda^{Y} \\
\hat{c}_Y(\lambda) &= \begin{cases} 0 & \text{for } \hat{\lambda} \neq \lambda^{Y} \\ c_O^{\max} + \varepsilon & \text{for } \hat{\lambda} = \lambda^{Y} \end{cases} \\
\hat{c}_O(\lambda) &= \begin{cases} 0 & \text{for } \hat{\lambda} \neq \lambda^{O} \\ c_O^{\max} & \text{for } \hat{\lambda} = \lambda^{O}. \end{cases}
\end{aligned} \tag{24}$$

if and only if $c_O^{\max} \leq c_Y^{\max}$.

In the light of equation (23) and (24), it is noticed that the political equilibrium in period t is independent of the amount of the resource inherited from the past.

5. The Comparative Statics Analysis

5.1. Comparative Statics for the Political Equilibria

We now discuss some comparative statics results in order to examine the influence of the key parameter γ on the equilibrium policy choice λ. For this purpose, we define the explicit function

$$\psi(\gamma) = c_Y^{\max}(\gamma) - c_O^{\max}(\gamma). \tag{25}$$

Each group's willingness to pay can be expressed as a function of the key parameter and the equilibrium resource policy depends on the sign of the function $\psi(\gamma)$. We will focus on how changes in γ affects the formation of policy. In figure 1, ψ is presented as a function of γ, given the other parameters ($\beta = 1, \phi = 0.2$). We see that there exists two critical values of γ, $\gamma_L \cong 0.210$ and $\gamma_H \cong 1.398$ at which $\psi(\gamma)$ is zero. For values of γ between these roots, the *Y*-group is willing to contribute more than the *O*-group to get its preferred resource policy (λ^Y); for low and high values of γ, the policy choice is λ^O.

Figure 2 illustrates this: for low values of γ ($\gamma < \gamma_L$) the government chooses the resource policy which is preferred by the old, i.e. 0.5; but, for $\gamma \in (\gamma_L, \gamma_H)$, the policy is that supported by the young $\lambda = (\lambda^Y)$. The figure shows that the policy rule $\lambda\,(=\lambda^Y)$ defined in (19) is increasing in γ. Finally, when γ becomes larger than γ_H, the equilibrium policy choice is 0.5 again.

The intuition is as follows. For very low γ, the*Y*-group has a strong green preference and so allocates most of its labour endowment to production of clean goods. However, with the relatively efficient resource preservation technology ($\phi = 0.2$), the *Y*-group is not as sensitive to the government policy choice as the *O*-group. In other words, the *O*-group would be forced to give up consumption of the dirty good if the government enforced λ^Y, which is very small for low γ. The *O*-group would then seek to avoid this by contributing more than the *Y*-group.

A similar explanation applies when $\gamma > \gamma_H$. For $\gamma \in (\gamma_L, \gamma_H)$, the *Y*-group prefers a policy which is lower than 0.5 and would more actively compete with the *O*-group. If the government enforced the resource policy preferred by the *O*-group $\lambda_t = 1/2$, then the *Y*-group has to bear the negative future consequences on the resource stock. They are also forced to consume less of clean goods due to an increase in the dirty goods consumption by the old. Therefore, the *Y*-group would have a strong incentive to make a contribution to the government when $\gamma \in (\gamma_L, \gamma_H)$ and, at equilibrium, outbids the *O*-group.

Figure 1: The Function ψ with Respect to γ

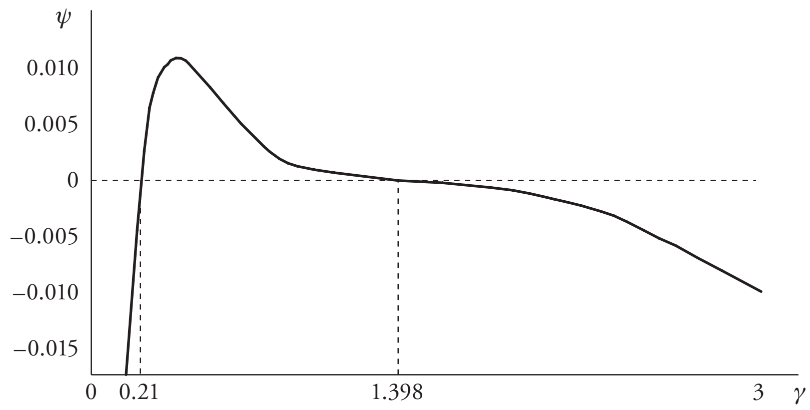
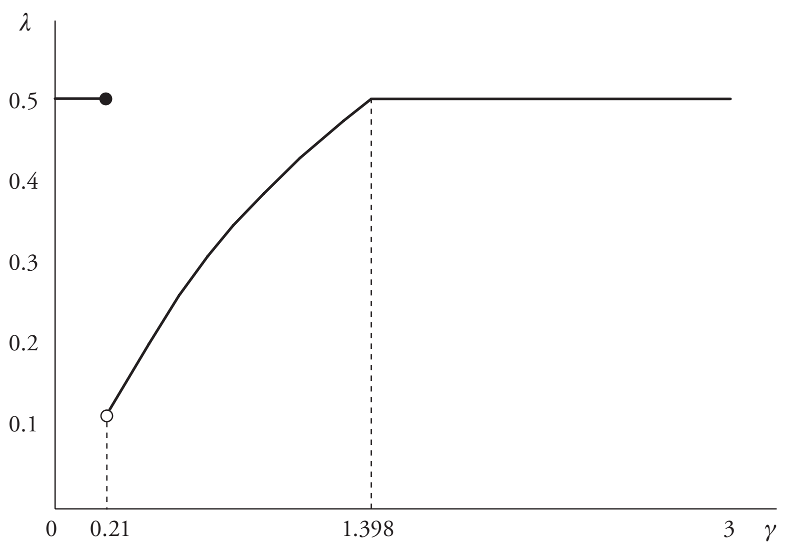


Figure 2: Changes in the Political Equilibrium λ over γ



5.2. Comparison of the Three Regimes

In this sub-section, we compare the equilibrium resource policies that we have examined so far. These are the equilibrium policies emerging at political equilibrium, from the social planner's solution, and from the unregulated economy. To see this, fix the parameter values of $\beta = 1, \rho = 0.85, \phi = 0.2, \gamma = 0.4, \delta = 0.5$. The following values show the steady state levels of the resource stock under the three policy regimes.

Policy Regime	TIOLI (λ^Y)	Social planner's	Unregulated
$\bar{S}$	6.317	5.827	5.396

where $\bar{S}$ denotes a steady state level of the resource. The above table shows that the political equilibrium could generate the largest amount of the long run sustainable resource stock provided that the young generation wins the political competition.[6]

6. Conclusion

This paper focuses on equilibria in the TIOLI strategies. With separable log linear utility functions and the exponential form of the biological growth function of the resource, the TIOLI strategies are state independent. Thus, it is relatively easy to characterise stationary equilibria in TIOLI strategies. However, if we relax these assumptions, then the equilibrium would be more complicated because the equilibrium strategies would be state dependent. If so, we have to further take into account the evolutionary behaviour of the state variable when deriving the equilibrium strategies in each time. This feature contrasts with an equilibrium concept first introduced by Bernheim and Whinston (1986). They considered a particular class of equilibria named *"Truthful"* which is jointly efficient for all the players in the game.

However, Kirchsteiger and Prat (2001) provide an argument in favour of using TIOLI strategies despite the fact that they lead to inefficient outcomes. They argue that people, in general, are not likely to play truthful strategies

6 For the given parameters, the willingness to pay for the *Y*-group is higher than that for the O-group ($c_Y^{\max} > c_O^{\max}$). Thus, the resource policy adopted will be λ^Y.

because they are complex with increasing computational time as the number of principals increase. They go on to propose another equilibrium concept termed *"Natural"* which is motivated by such considerations. The "natural" strategy is similar to the TIOLI strategy used in this article.[7] They provide experimental evidence that "natural" strategies are a better predictor of behaviour than the "truthful" strategies.[8] The experimental shows that the outcome predicted by the natural equilibrium more closely matches real behaviour (in 65% of the matches) than the one predicted (less than 5%) by the truthful equilibrium.

The equilibrium in TIOLI strategy has some interesting similarities with a *Vickery* (second-price sealed-bid) auction. In both cases, the player with the highest valuation wins and pays the bid of the second highest bidder. But, unlike the TIOLI equilibria, the *Vickery* auction is efficient. This is because total surplus which is the sum of the surplus to the seller and to the buyer is maximised, while the payoff of the other buyers are not changed. Thus, the player who bids the highest value will win at a price which is equal to the value of the second-highest bidder, and the allocation would be Pareto-efficient. That is, the winning bid is equal to the largest of the reservation prices and the actual sales price equals the second highest of these reservation prices. In contrast, equilibria in TIOLI strategies are inefficient because the policy choice of the government generates a negative externality that affects the payoff of the generation who loses the political competition. This is because all generations are required to accommodate the uniform policy rule adopted by the government whatever they like it or not.

7 In a common agency game, Natural equilibrium and the TIOLI strategy equilibrium are similar in that each principal makes only one strictly positive offer on the one alternaitve the agent chooses. However, in Natural equilibrim, principals (≥ 2) are divided into two sub-sets groups so that one side supports one alternative that maximises its surplus and the other sider another. That is, each principal contributes only to the alternative supported by her side. But, in the TIOLI strategy equilibrium, each principal has her own alternative which she hopes to contribute. For details, see KIRCHSTEIGER and PRAT (2001).

8 The experiment was conducted in the following ways: first, they design a simple common agency game with two principals and three alternatives. Second, the game was repeated with different players and the choices of strategies by the principals are observed.

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SUMMARY

This paper studies the political economy of resource management in an OLG framework with an intertemporal externality problem. The externality arises because a common resource used for production is depleted by production of "dirty" goods. An intergenerational conflict arises because the young generation cares about the level of current production of dirty goods. This is so because production of dirty goods affects the future availability of the resource. The old, on the other hand, has no such a concern. We assume that they lobby the government to affect the policy choice – an upper limit on the resource use allowed for production of dirty goods – in their favour. Within a dynamic common agency framework, we study stationary equilibria focussing on a particular class of strategies which we called *"Take It or Leave It" (TIOLI)* strategies, where a lobby makes a positive contribution only when her payoff maximising policy is implemented. It is shown that political competition may lead to a "greener" environment policy and to less resource exploitation than in an unregulated economy. More surprisingly, we also find that resource exploitation may be lower in political equilibrium than in an economy run by a social planner.

ZUSAMMENFASSUNG

Dieser Beitrag untersucht die wirtschaftspolitischen Aspekte des Ressourcenverbrauchs in einem Modell mit überlappenden Generationen und einer intertemporalen Externalität. Die Externalität wird durch den Verbrauch einer Ressource zur Produktion von schmutzigen Gütern erzeugt. Ein intergenerationeller Konflikt entsteht, weil die Verfügbarkeit der Ressource für die junge Generation durch die Produktion von schmutzigen Gütern tangiert wird. Die alte Generation hat hingegen keine solchen Bedenken; wir nehmen an, dass sie die Regierung zu beeinflussen versucht, damit die Wahl eines maximalen Ressourcenverbrauchs bei der Erzeugung von schmutzigen Gütern zu ihren Gunsten ausfällt. In einem dynamischen allgemeinen Agenten-Modell untersuchen wir die stationären Gleichgewichte, insbesondere sogenannte „Take It Or Leave It"-Strategien des Lobby-Verhaltens. Es wird gezeigt, dass politischer Wettbewerb zu einer „grüneren" Umweltpolitik und zu weniger Ressourcenverbrauch führen kann als eine unregulierte Wirtschaft. Überraschenderweise könnte der Ressourcenverbrauch überdies tiefer sein in einem politischen Gleichgewicht als in einer Wirtschaft, welche durch einen Sozialplaner bestimmt wird.

RÉSUMÉ

Cet article étudie la politique économique de la gestion des ressources dans un modèle à générations imbriquées avec un problème d'effets externes intertemporels. Ces effets externes se manifestent parce que une ressource commune est consacrée à la production des biens dont un est polluant. Il existe un conflit intergénérationnel car les jeunes (et pas les vieux) se soucient du niveau de production du bien polluant. Ce phénomène est du au fait que la production du bien polluant détermine la disponibilité future de la ressource utilisée. Nous faisons l'hypothèse que les jeunes et les vieux forment des lobbies et offrent au gouvernement des pots-de-vin pour que la politique économique mise en place soit conforme aux leurs intérêts. Dans le contexte d'un modèle dynamique d'agence commune, nous étudions les équilibres stationnaires. Nous faisons en particulier attention à un type particulier de stratégies que nous appelons TIOLI (Take It Or Leave It). Dans ce cadre, un lobby offre une contribution positive seulement dans le cas ou sa politique préférée est mise en place. Nous montrons que la compétition politique peut faire émerger un environnement plus propre et une exploitation inférieure de la ressource par rapport à un contexte concurrentiel. De façon plus surprenante, l'exploitation de la ressource peut être plus faible dans un équilibre politique que dans une économie planifiée.