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POLITICAL ECONOMY OF ENDOGENOUS GROWTH (REVISED)

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Political Economy of Endogenous Growth

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Abstract

Using an endogenous growth framework, this paper analyzes the impact of lobbying for public goods on the long run steady-state growth rate of the economy. A *socially optimal* level of lobbying can be found to exist in the absence of a social planner. Atomistic households, however, *exceed* this level by viewing taxes as fixed, ignoring the aggregate tax impact of lobbying via increased public expenditures. Two extensions are presented. In one, anti-tax lobbying is analyzed, drawing parallel results. In another, a quasi-public good is introduced, lobbying for which is based not on altruism, but on private gains, though public gains occur as a side effect.

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Political Economy of Endogenous Growth

I. Introduction

Attempts to explain and understand variations in the long run growth rates across countries, and the related Baumol-De Long debate (Baumol 1986, De Long, 1988) on convergence versus divergence of average productivities across nations, have been accompanied by a re-examination of the neoclassical growth models and the emergence of the new theories of endogenous growth. The major focus of these theories has been to attribute differences in the growth record of countries to endogenous technological change (Romer, 1986, 87, 90), human capital (Lucas 1987, Romer, 1990), or learning by doing (lucas, 1987). Most recently Barro (1990) has developed an endogenous growth model with public goods, with the implication that a key difference in the growth rates among countries is attributable to the role of the public sector.

However, countries also differ significantly in their political and institutional structure and the importance of institutions in economic analysis is being increasingly acknowledged by economists. Thus, political and institutional differences may play an equally significant role in explaining why countries may grow at different rates even in the long run. This paper is a first attempt to provide an endogenous growth model that seeks to explain variations in long-run growth rates by differences not only of the production technologies but also of political and institutional structures across countries. The specific institution that we incorporate into the endogenous growth

model is that of *lobbying*, i.e. the ability of agents to influence the government policy instruments by means of lobbying.

The distinguishing feature of the endogenous growth literature has been its reliance on the theory of externalities. This characterization is seen in all the models cited earlier. Existence of externalities calls for a social planner whose task is to "internalize" the externalities, attaining a higher growth rate than would be possible under a private decentralized economy. Alternatively, however, other institutional arrangements may be envisaged that internalize the externalities but at the same time *retain* the private agents' autonomy. For example, Prescott and Boyd (1987) model an overlapping generation economy in which private agents internalize the decision to invest in human capital in a dynamic coalitions scheme among themselves. In a similar vein, lobbying can be viewed as an institutional mechanism that internalizes public sector externality and yet *retains* the autonomy of the private economy. In the presence of market failure lobbying may be thought of as the process by which agents *reveal* their desire for the provision of public goods. Thus our relevant point of reference is Barro's (1990) analysis of the role of public goods in growth.

We focus on lobbying rather than voting for its analytic simplicity and also to provide a comparative perspective *vis-a-vis* the traditional political economy literature.[1] Specifically, the political

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[1]See for example the important contributions of Tullock (1967), Krueger (1974) Bhagwati (1980, 1982), Findlay and Wellisz (1982), Appelbaum and Katz (1986) and many others.

economy literature has focused on static welfare effects,[2] whereas we focus on dynamic *growth* effects. Also, in the traditional political economy literature, lobbying occurs in the form of rent seeking which is purely redistributive whereas lobbying for public goods in our model is an "externality seeking" activity and has a socially productive dimension.

By adopting Barro's "representative household" approach, we show (i), that in the absence of a social planner, a socially optimum level of lobbying exists[3], and (ii), that individual lobbyists *exceed* this level, i.e. they *overlobby* relative to what is socially desirable. To elaborate, lobbying for public goods internalizes the externality associated with their provision. However, it induces another externality. Because in a balanced-budget economy,[4] the burden of additional government expenditures as a fraction of output drives up the tax rate at the *aggregate* level, this effect will be ignored by

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[2]An exception is a recent paper by Cairns (1989) on dynamic rent seeking. Unlike our model, however, public goods do not enter into Cairns' analysis.

[3]The first best outcome is one where a social planner would spend exactly the same amount in the absence of lobbyists as would be spent by a government that is subject to lobbying pressures. This is Barro's (1990) results. Since in this case, no lobbying cost occurs, the social outcome is a first best one. Our contention, however, is that this first best outcome is an unlikely possibility, in a world where governments frequently react to political pressures.

[4]The analysis may be generalized to the case of a deficit economy if the size of deficit is an exogenous (although not necessarily constant) fraction of the GNP.

atomistic households who see taxes as exogenous. Thus, a negative externality arises which implies that the decentralized optimal lobbying choice *exceeds* its socially optimal level. This issue is analyzed in Section II. We derive many additional results and offer possible explanations for the differences in growth rates among countries and especially as between underdeveloped and industrialized economies.

The issue of lobbying by atomistic agents raises questions about the potential for free ridership regardless of whether lobbying involves a public good or a redistributive public policy (i. e. rent seeking), since even in the latter case some individuals may benefit from the lobbying activities of others. Specifically, when the number of agents is large, the dominant strategy could be no lobbying by any agent, or there may be no dominant strategy. Such issues are discussed in the public choice literature (e.g., Cornes and Sanders, 1986, pp. 132-155). As is recognized in this literature, such unambiguous results are predominantly found in a Cournot-Nash universe where conjectural variations are zero, and the presence of nonzero conjectures can yield different outcomes. (Cornes and Sanders, 1986). Suppose, for example, that lobbying is public knowledge and that each agent fears (conjectures) that her shirking from lobbying might be *replicated* by many (if not all) others in the economy; but if she does lobby, others are less likely to shirk. Then, agents would know that any free ridership could result in a dramatic under-provision of the public good. In this case, the cost of not lobbying to each agent may be high enough to prevent free ridership. Other features, such as *altruism*, attributed to the agents' utility, may also suffice to preclude free ridership. In this context, Douglass North (1981, p. 49)

points to the role of prevailing ideology in a society to overcome free ridership. On the other hand, there is some evidence that points to the role of self-interested groups in influencing public policy when externalities are involved as discussed by Pashigian (1985) on environmental regulation.

Given the possibility of free ridership, Section III extends the analysis of section II to the case where the good in question is an *quasi public good*, so that both a *private* and a *public* component are involved. Lobbying then takes place when there is an agent-specific private gain from the public good in addition to its public benefit. Both the private and the public component of the good enter into the agent's production function, but the agent lobbies only in proportion to her private gains, holding the public benefit of the good as fixed. Public gains to the society then occur in the aggregate only as a side-effect. (This is very similar to Romer's (1990) argument that technological innovations occur by individual producers due to private motives while the external effect (spillovers) of such innovations to society occur as a side-effect.) By allowing for private gains from lobbying, then, it turns out that the earlier *overlobbying* effect which stems from viewing taxes as exogenous, is now countered by *underlobbying* because of viewing the public component of the quasi public good as exogenous. The net effect may then yield over- or underlobbying depending on the size of the externalities involved.

Since taxes are used to finance expenditures on public goods, another extension of Section I deals with a situation where households lobby for tax cuts in place of public goods. This is carried out in Section IV. In this case a reduction in the level of public goods will result at the macro level but atomistic households, acting as

microeconomic agents, ignore this effect and perceive public goods as given (analogous to the earlier situation.) Thus, once again privately optimal lobbying exceeds its socially optimal level. Comparing the second best social efficiency of the two types of lobbying, we find that the conditions under which a socially efficient level of lobbying-for-public-goods can exist are *mutually exclusive* of those that yield the possibility of a socially efficient level of lobbying-for-tax-cuts.

II. Optimal Lobbying and Endogenous Growth

Consider a representative infinitely lived consuming and producing household seeking to maximize the utility function,

$$W = \int_0^\infty U[C(t)]e^{-\rho t}dt \tag{1}$$

where C is consumption and ρ is the rate of time preference. With public goods as a factor of production, but in the *absence* of lobbying, the household budget constraint is one given by Barro (1990):

$$C(t) + \dot{K}(t) = (1-\tau)Y = (1-\tau)f(K,G) \tag{a}$$

where Y = income (output), and K is the capital stock and G is expenditures of the government as an input into the production function (all variables are in *per capita* measures), determined by the constant tax rate, τ, and income:

$$G = \tau Y. \tag{b}$$

With a production function that exhibits constant returns to scale in G and K, but decreasing returns to K alone (since G is given at the

household level), the steady-state per capita growth rate of a "planned economy" in which a benevolent government maximizes equation (1), on behalf of households, subject to (a) and (b) *exceeds*, for all tax rate, the steady-state growth rate of a decentralized economy in which households maximize (1) subject to (a), but ignore equation (b), taking G as given. The planned economy has then internalized an externality (via equation (b)) which the decentralized private economy could not.

Against this background we replace Barro's social planner by households who retain direct maximization of (1), but are able to influence (internalize) G, via *optimal lobbying*. Viewing public expenditures, G, as being influenced by lobbying requires, in principle, that lobbyists know the government's decision rule. In a fully worked out model, this decision rule emerges as the outcome of a political process along the lines of Young and Magee (1986) or others. This is also the case with our two sector generalization of the present model (Mohtadi and Roe, 1990), currently in progress. For the present, however, in order to retain the focus of this paper on the social versus private aspects of lobbying, it is assumed for simplicity that such a decision rule is *already* known to the households. In this case, if β is the fraction of income spent on lobbying, one may write:

$$G = g(\beta, (1-\tau)Y) \qquad (\text{with } g_1, g_2 > 0). \tag{2}$$

Thus government expenditures are a function of the propensity of income spent on lobbying and net after-tax income. An alternative Formulation of $G = g(\beta(1-\tau)Y)$, in which G is a only a function of the total lobbying effort is equally plausible, but does not allow for the separability of the function g that is needed later to make the model

analytically tractable. Besides gaining analytic tractability and simplifying the final results, little is lost by making this assumption. The budget constraint in equation (a) is replaced by:

$$C(t) + \dot{K}(t) = (1-\beta)(1-\tau)Y$$

$$= (1-\beta)(1-\tau)f[K, g(\beta, (1-\tau)Y)]. \qquad (3)$$

In addition to the previous consumption-investment trade-off, equation (3) entails a new trade-off between reduced income (by $1-\beta$) due to lobbying costs versus potentially increased output (and thus income) via the impact of lobbying on per capita public expenditures, G. Each household is therefore a consumer, a producer and a lobbyist. Maximization of (1) subject to equation (3) now means that households are able to *internalize* the externality associated with G, by indirectly affecting its provision.

Expenditures G are financed by taxes. In Barro's analysis, the tax rate τ is either fixed, or set by the government to maximize present value of the consumer utility streams or equivalently the growth rate. In either case, once τ is set by the government, it is exogenous to the decision on expenditures, G, and in fact drives the latter. By contrast taxes here are *driven* by the lobbyists' demand for government expenditures via a modified version of equation (b), i.e:

$$\tau = G/Y = g(\beta, (1-\tau)Y)/f[K, g(\beta, (1-\tau)Y)] \qquad (4)$$

The role of the government in equation (4) is thus a passive one. On the one hand, its sets expenditures in response to lobbying activities; on the other, it adjusts the tax rate to balance the budget. Individual households, however, do not perceive the aggregate

consequence of lobbying on the tax rate *at the margin*, via its effect on the level of public expenditures. Thus, as atomistic agents, they treat τ as *given*, ignoring equation (4) in their optimization decision, while the tax rate does change as a result of *collective* lobbying by all agents. We believe that this way of modeling lobbying behavior reflects the reality rather accurately, as evidenced anecdotally, by the recent U.S. budgetary experience, where lobbyists favor specific expenditure increases to their constituency at the going tax rates, and yet the tax rate inevitably rises in response to budgetary pressures brought about by increased expenditures.

Before solving the optimization problem we note an implicit constraint imposed on Y in equation (3) through the dependence of Y on G and in turn G on Y, i.e.:

$$Y = f[K, g(\beta, (1-\tau)Y)] \tag{5}$$

Following Barro (1990), we shall adopt a Cobb-Douglas technology with constant returns to scale in order to capture the steady-state properties of the growth process:

$$Y = f[K,G] = K^{\alpha}G^{1-\alpha} \tag{6}$$

Substituting from equations (2) into (6) we find:

$$Y = K^{\alpha}[g(\beta, (1-\tau)Y)]^{1-\alpha} \tag{7}$$

The "political technology" that maps one dollar of lobbying expenditures to G dollars of public expenditures is represented by the function $g(\beta, (1-\tau)Y)$. To simplify the analysis, but without loss of generality, we assume that g is separable, such that:

$$g(\beta, (1-\tau)Y) = (1-\tau)Y\gamma(\beta) \tag{8}$$

As pointed earlier, besides gaining analytic tractability, little is lost by making this assumption. Since $g_1 > 0$, it follows that $\gamma' > 0$. Further, we shall assume that γ is concave in β ($\gamma'' < 0$) [Also, for technical reasons, discussed below, we assume that γ is steep near the origin ($\lim_{\beta \to 0} \gamma'(\beta) = \infty$).] Concavity of γ is both necessary and sufficient for G to be concave in βY, i.e. for the public sector expenditures to show *diminishing returns* to lobbying effort and follows from the fact that $\partial^2 g/\partial(\beta Y)^2 = (1-\tau)\gamma''(\beta)/Y$. Diminishing returns to lobbying effort occur because of political constraints on the state. Such constraints render incremental increases in G more costly at higher levels of G, causing G to show diminishing returns with higher lobbying effort, βY.

Substituting for $g(\beta,(1-\tau)Y)$ from equation (8) into (7) and simplifying the result permits us to express Y as a function of K and β directly:

$$Y = K[(1-\tau)\gamma(\beta)]^{(1-\alpha)/\alpha} \tag{9}$$

Equation (9), which we may call the "reduced form" production function, shows that incorporating lobbying raises the returns to capital from its original decreasing return (equation (6)) to constant returns in equation (9). Constant returns obtain since lobbying has positive impact on output via its impact on G (equation (2)) and thus Y (equation (6)), given K. Thus, a given stock of capital is associated with higher levels of output Y in the presence of lobbying, increasing the total returns to capital.

Since $G = (1-\tau)Y\gamma(\beta)$ and Y is given by (9) the tax rate, τ, in equation (4) becomes:

$$\tau = \gamma(\beta)/(1+\gamma(\beta)) \tag{10}$$

Note that $\tau_\beta > 0$. This equation now clearly shows that the tax rate is lobbying-driven. Moreover, since $0 \leq \tau \leq 1$, it follows that $0 \leq \gamma(\beta) \leq 1$. [We allow for the possibility of finite G even in the absence of lobbying such that $0 \leq \gamma(0)$. See below.]

Privately Optimal Lobbying: Equilibrium Path

Substituting for Y from equation (9) into the expression following the first equality in (3), the budget constraint is re-expressed as:

$$C(t) = (1-\beta)(1-\tau)^{1/\alpha}K(t)[\gamma(\beta)]^{(1-\alpha)/\alpha} - K(t) \tag{11}$$

The three variables β, C and K are chosen by the now consumer-producer-lobbyist households, for given τ. Substituting for C from equation (11) into equation (1) transforms the choice variables from C to K, and β so that the integrand becomes $U[C(t)] = V(t,\beta,K,\dot{K})$. Application of Euler's equation for K and β, to the transformed integrand, and using an iso-elastic utility function,

$$U(C) = [C^{1-\sigma}-1]/(1-\sigma), \tag{12}$$

one finds:

$$\lambda \equiv (\frac{\dot{C}}{C})^* = \frac{1}{\sigma}\left[(1-\beta)(1-\tau)^{1/\alpha}[\gamma(\beta)]^{(\frac{1-\alpha}{\alpha})} - \rho\right], \tag{13}$$

and,

$$\frac{\gamma'(\beta^*)}{\gamma(\beta^*)}(1-\beta^*) = \frac{\alpha}{(1-\alpha)} . \tag{14}$$

The second order condition requires that the integrand V be strictly concave in β and K.[5] Appendix (ii-1) shows that this is globally

[5]Note that unlike static optimization this is a second order *necessary*

satisfied in K and locally satisfied in β. It is important to note that β^* in equation (14) not only maximizes the utility streams W but also the growth rate λ. (From equation (13) the $\partial\lambda/\partial\beta = 0$ reproduces equation (14); additionally, $\lambda_{\beta\beta}$ is negative[6].) For β^* in (14) to exist, it is sufficient that the political technology be steep near the origin ($\lim_{\beta \to 0} \gamma'(\beta) \to \infty$) (Appendix ii-2). With this assumption, the function γ does not need to be (though it can be) zero at the origin, i.e. $\gamma(0) \geq 0$, which implies that some finite investments on public goods can (though need not) occur even in the absence of lobbying.

In equation (13), λ is the household's *expected* growth rate since it is based on the household's view of a fixed τ. τ, however, varies in the aggregate, responding to the collective lobbying effort. To reconcile this, household expectations must be *realized* at *equilibrium*, yielding a tax rate, τ_0, that corresponds to this expectation-realization condition. Before discussing this, however, note that the constancy of τ at the micro level and its variability at the macro level means that in addition to the positive externality of G, internalized by lobbying, lobbying itself introduces a negative externality on society (via taxes) which is *not internalized*. Thus the social marginal value of lobbying for aggregate growth will differ from its private marginal value for household growth rate. In particular, substituting from equation (10) into the value of τ in (13), the aggregate growth rate for the society, $\hat{\lambda}$, becomes:

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condition for the concavity of W. For further discussion of this point see M Kamien and N. Schwartz (1981), pp. 37-42.

[6]This follows from using the $C_{\beta\beta} < 0$ condition in Appendix ii-1.

$$\hat{\lambda} = \frac{1}{\sigma}\left[(1-\beta).[\frac{1}{1+\gamma(\beta)}]^{\frac{1}{\alpha}}\ [\gamma(\beta)]^{(\frac{1-\alpha}{\alpha})} - \rho\right] \tag{15}$$

More on the comparison of λ and $\hat{\lambda}$ later. For the moment, note that equilibrium occurs when agents find the true tax rate where the perceived growth rate, for optimum β^*, $\lambda(\beta^*;\tau)$ equals the aggregate growth rate, $\hat{\lambda}(\beta^*)$, evaluated at β^*, i.e.:

$$\lambda(\beta^*;\tau) = \hat{\lambda}(\beta^*) \tag{16}$$

The left hand side $\lambda(\beta^*;\tau)$ is given by equation (13) and the right hand side by equation (15). Setting the two equal, it follows that the tax rate satisfying (16) is:

$$\tau_o = \gamma(\beta^*)/(1+\gamma(\beta^*)) \tag{17}$$

The equilibrium growth rate is:

$$\lambda_0 = \frac{1}{\sigma}\left[(1-\beta^*)(1-\tau_0)^{1/\alpha}[\gamma(\beta^*)]^{(\frac{1-\alpha}{\alpha})} - \rho\right], \tag{13'}$$

where τ_0 is given by equation (17). Equation (13′) shows that household consumption grows at a steady state rate and has no transitional dynamics, because λ depends on the parameters, α and τ (assumed fixed by the household) and β. This steady state growth will of course imply that the capital stock also grows at the same rate.

To examine the impact of production technology on optimal lobbying, we implicitly differentiate equation (14) to find:

$$\frac{d\beta^*}{d\alpha} = \frac{\gamma^2}{[-\gamma' + (1-\beta)\gamma''].\gamma - (1-\beta)\gamma'^2}.\frac{1}{(1-\alpha)^2} < 0.$$

Result 1a. As the share of capital in aggregate output increases, the optimal propensity to lobby for public goods declines.

A higher capital share implies a lower share of the public sector in output. This reduces the incentive to lobby for G. If a higher share of capital implies a lower intensity of lobbying, how does it affect the equilibrium growth rate? Using the envelope theory, $d\lambda_0[\beta^*(\alpha),\alpha]/d\alpha = \partial\lambda_0/\partial\alpha$, which means that only the explicit dependence of λ_0 on α matters. Then from equation (13)' and (17) we find that $\partial\lambda_0/\partial\alpha = -(\lambda_0+\rho/\sigma).\ln[\gamma(\beta^*)/(1+\gamma(\beta^*)]/\alpha^2$ which is positive. To summarize:

Result 1b: The equilibrium growth rate is an increasing function of the private capital productivity parameter ($\partial\lambda_0/\partial\alpha > 0$), and thus a decreasing function of the public investment productivity parameter.

These results provide a possible explanation for the observed variations in growth rates across countries. For example, evidence generally suggests that underdeveloped economies tend to have a larger share of public to private investments than industrialized economies.[7] Correspondingly, some underdeveloped economies seem to have experienced lower rates of growth than the industrialized economies, as suggested by the Baumol-De Long debate (Baumol, 1986; De Long, 1988). Result 1b corroborates this finding, while result 1a suggests that this experience is simultaneously associated with a high extent of interest group lobbying among underdeveloped economies. (See also result 5 below.)

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[7]Note that since the production process is normalized to a per capita basis, the share of labor is relegated to a *numeraire* status. Thus, the comparison is between the share of private versus public capital, *not* between private capital, public capital and labor.

Socially Optimal Lobbying: Efficient Path

If an institutional arrangement could bring to bear the social marginal cost of lobbying (via aggregate tax effect) to individual lobbyists what would be the impact of lobbying on aggregate growth? This is a familiar problem of internalizing an externality. One may then search for a nonzero value of β, say β^{**}, that maximizes the society's growth rate, $\hat{\lambda}$, analogous to the value of β^* that maximized λ. Differentiation equation (15) in β:

$$\sigma\partial\hat{\lambda}/\partial\beta = \frac{\gamma(\beta)^{\frac{1}{\alpha}-2}}{[1+\gamma(\beta)]^{1/\alpha}}\left[(\frac{1-\beta}{\alpha})\gamma'(\beta)[1-\alpha - \frac{\gamma(\beta)}{1+\gamma(\beta)}] - \gamma(\beta) \right] \quad (18)$$

Setting $\partial\hat{\lambda}/\partial\beta$ to zero, β must solve the equation:

$$\frac{\gamma'(\beta^{**})}{\gamma(\beta^{**})}(1-\beta^{**}) = \frac{\alpha}{1 - \alpha - \gamma(\beta^{**})/[1+\gamma(\beta^{**})]} \quad (19)$$

Provided that $\gamma(\beta)$ is steep near the origin, Appendices (ii-3) and (ii-4) show that the necessary and sufficient conditions for β^{**} in (19) to exist and to maximize $\hat{\lambda}$ is that $\gamma(\beta^{**}) < (1-\alpha)/\alpha$ or, using (10), that lobbying-driven taxes at the social optimum be such that $\tau(\beta^{**}) < (1-\alpha)$. Thus, a social optimum lobbying exists if the corresponding tax rate is less than the productivity parameter of public investments; otherwise taxes will outweigh the contribution of public good to national output:

Result 2. Given certain conditions, there exists a nonzero level of lobbying that is socially optimum in maximizing aggregate growth rate (in the absence of a social planner that could provide a first best outcome).

It is interesting to compare the privately optimal and the socially optimal lobbying. Comparing β^* and β^{**} directly from equations (14) and (19) does not seem promising. Instead, we follow a different technique, comparing the behavior of $\hat{\lambda}(\beta)$ at β^* with $\lambda(\beta)$ at β^{**}. From equations (13) and (15), which differ only by the constancy of τ in (13) and its replacement with $\gamma(\beta)/[1+\gamma(\beta)]$ in (15), the slope of $\hat{\lambda}$ can be expressed in terms of the slope of λ:

$$\partial\hat{\lambda}/\partial\beta = \left[\frac{1}{(1-\tau)(1+\gamma(\beta)}\right]^{\frac{1}{\alpha}}.\partial\lambda/\partial\beta - \frac{1-\beta}{\sigma\alpha}\left[\frac{\gamma(\beta)^{1-\alpha}}{(1+\gamma(\beta))^{1+\alpha}}\right]^{\frac{1}{\alpha}}\gamma'(\beta) \qquad (20)$$

Since $\partial\lambda/\partial\beta|_{\beta^*} = 0$, it follows from equation (20) that $\partial\hat{\lambda}/\partial\beta|_{\beta^*} < 0$, i.e. $\hat{\lambda}(\beta)$ is *downwardly sloped* at β^*; also, since $\partial\hat{\lambda}/\partial\beta|_{\beta^{**}} = 0$, it follows from (20) that $\partial\lambda/\partial\beta|_{\beta^{**}} > 0$, i.e. $\lambda(\beta;\tau)$ is *upwardly sloped* at β^{**}. Therefore it must be that $\beta^{**} < \beta^*$, as is shown in Figure 1.

Result 3. Private agents' optimal level of lobbying is socially excessive and thus suboptimal, as they view the tax rate as given.

Figure 1 depicts the curves $\lambda(\beta;\tau_0(\beta^*))$ and $\hat{\lambda}(\beta)$[8]. In accordance with equations (16), the peak of the curve λ at β^* coincides with the value of $\hat{\lambda}$ at β^*. Thus $\hat{\lambda}(\beta)$ goes through the maximum of $\lambda(\beta)$. This is the equilibrium rate λ_0 given by equation (13)'. As we see, the *equilibrium* growth rate $\lambda_0(\beta^*)$, is *below* the maximum potential growth rate, $\hat{\lambda}(\beta^{**})$, but β^* itself is *above* β^{**}. Thus:

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[8]For the purpose of drawing the curves near the $\beta = 0$ endpoint, it has been assumed that, $\lim \gamma(\beta) = 0$, as $\beta \longrightarrow 0$. However, this is *only* for illustration and there is no need for $\gamma(\beta)$ and thus G to be zero when no lobbying occurs.

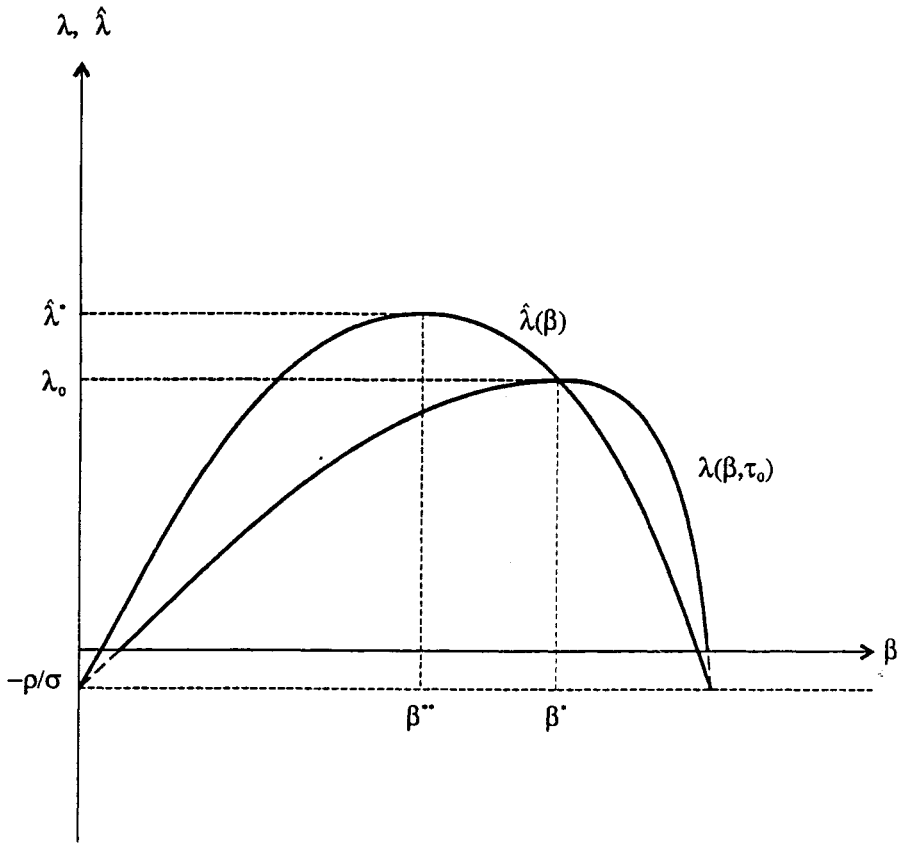


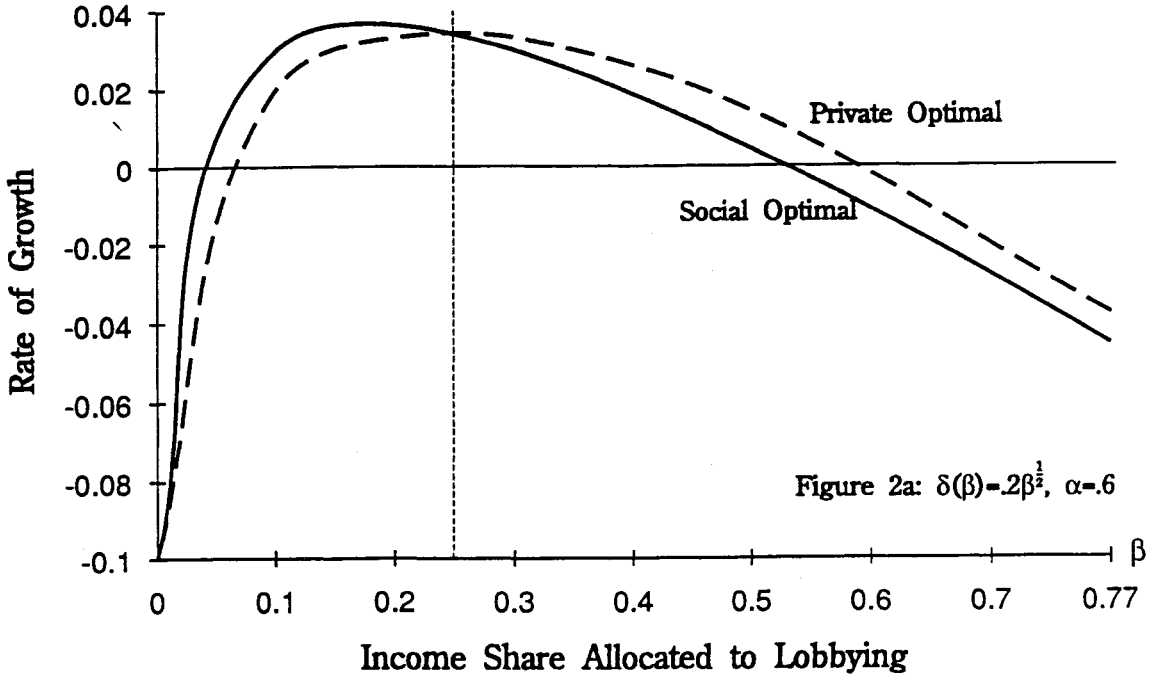
Figure 1. Growth and Lobbying for Public Goods

Result 4. Actual growth rate based on privately optimal lobbying is less than potential aggregate growth under socially optimal lobbying.

Figures 2a and 2b represent the numerical counterparts of figure 1. Both figures are based on a production technology parameter of $\alpha = 0.6$, but differ in the political technology parameter; $\gamma(\beta) = .2\beta^{1/2}$ in figure 2a and $\gamma(\beta) = .4\beta^{2/3}$ in figure 2b. Thus, figure 2b represents a political technology that is *more responsive* to lobbying. In figure 2a the privately optimal lobbying and the equilibrium tax rates are $\beta^*=1/4$ and $\tau_0 = 0.09$; in figure 2b they are $\beta^*=1/3$ and $\tau_0 = .149$. Despite this increase in the tax rate and the lobbying intensity, the more responsive political technology of figure 2b implies a higher equilibrium growth (λ_0) (from 0.038 in figure 2a to 0.059, in figure 2b). Correspondingly the maximum growth $\hat{\lambda}^*$ is also higher in figure 2b than figure 2a.

It is possible to construct a measure of efficiency loss related to the agents' overlobbying, and then study the comparative statics of this measure in steady state. One such measure is the difference between the maximum heights of the two growth expressions, which in Figure 1, is a positive number. Let ℓ represent the difference. Then, $\ell = \hat{\lambda}^* - \lambda_0 = \hat{\lambda}[\beta^{**}(\alpha),\alpha] - \lambda_0[\beta^*(\alpha),\alpha]$. Since $\hat{\lambda}^*$ and λ_0 are maximized at β^{**} and β^*, only the explicit dependence on α matters (by the envelop theory), as was discussed preceding Result 1a. Then repeating the earlier procedure by computing the derivatives from equations (13) and (15) and re-expressing them in terms of λ_0 and $\hat{\lambda}^*$, we find:

$$\frac{d\ell}{d\alpha} = \left|\ln\frac{\gamma(\beta^{**})}{1 + \gamma(\beta^{**})}\right| . [\hat{\lambda}^* + \rho/\sigma] - \ln\left|\frac{\gamma(\beta^*)}{1 + \gamma(\beta^*)}\right| . [\lambda_0 + \rho/\sigma]$$



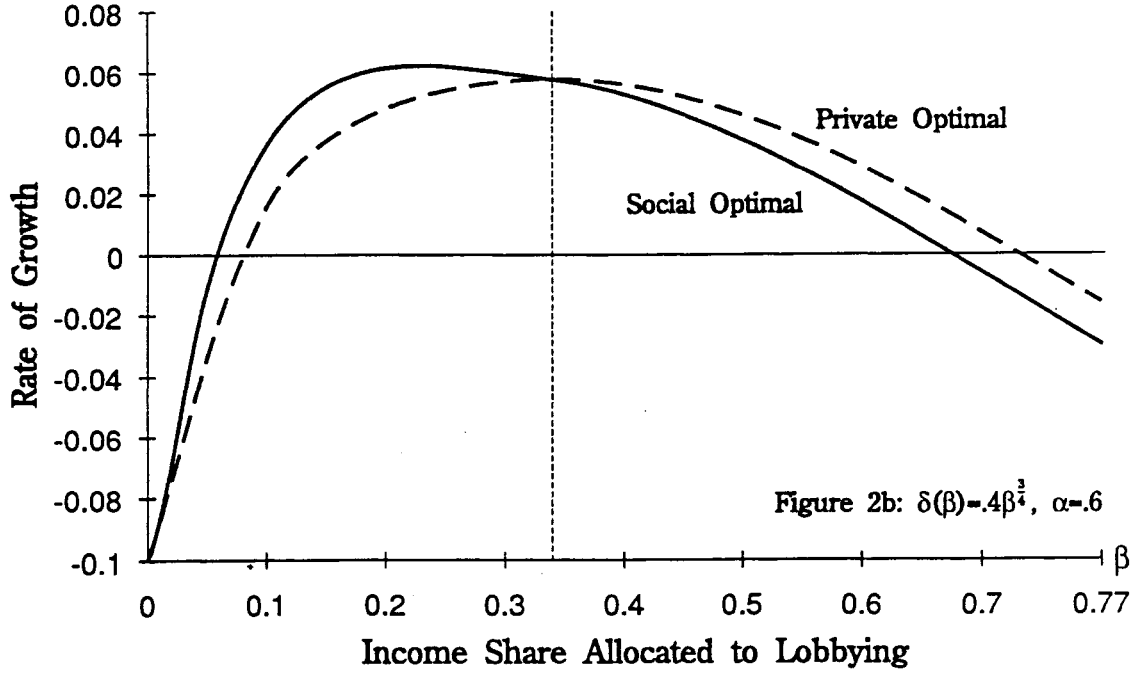


Figure 2. Numerical Simulations

Since $\beta^{**} < \beta^{*}$, and $\hat{\lambda}^{*} > \lambda_0$ it follows that $d\ell/d\alpha > 0$[9]:

Result 5: The efficiency loss of overlobbying for public goods, in terms of reduced growth rate, is greater, the larger is the productivity parameter of capital stock (α) and the smaller is that of public sector ($1-\alpha$).

III. Quasi Public Goods

The preceding analysis is valid either if individuals are altruistic or if the size of coalition is small to rule out free ridership, as we discussed in the Introduction. Of these possibilities the second, i.e. the small size of coalition, may be difficult to sustain in the face of the assumption of atomism which is necessary for the argument that household perceive a fixed tax at the micro level. Thus, if a coalition is large so that the assumption of atomism can be retained, but altruism is not considered a viable assumption, individuals must have a *self-interest* in lobbying for public goods, so that free ridership does not occur. In line with this idea, in this section we assume that there is a individual-specific or private component to public goods as well as a public component. This departure from a pure public good, in addition perhaps to its greater realism, allows for self-interested individuals to affect the extent of the private component of the public good that they see as benefiting

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[9] Since $\beta^{**} < \beta^{*}$, it follows that $\ln \frac{\gamma(\beta^{**})}{1 + \gamma(\beta^{**})} < \ln \frac{\gamma(\beta^{*})}{1 + \gamma(\beta^{*})} < 0$. Taking absolute value of both sides reverses the inequality signs. Multiplying the left side of the first inequality by $\hat{\lambda}^{*} + \rho/\sigma$ and its right by $\lambda_0 + \rho/\sigma$ and noting that $\hat{\lambda}^{*} > \lambda_0$, we find that $d\ell/d\alpha > 0$.

them. However, in the process, the government input is affected at the aggregate by the activity of *all* individuals involved. This latter factor introduces a new externality which we shall discuss below.

Consider a community of n identical households. The production function of each household is given by:

$$y = f(k,g)\Phi(G/y) \tag{1a}$$

where k is the household's capital stock and g is the household's perceived own benefit derived from the public input whose *aggregate* level is G. G is a nondivisible input that also enters into the household production function. Households cannot affect G directly, but it is assumed that they view the ratio of G/y as a constant much along Barro's view (1990 Section IV), in which the benefit one receives from a nondivisible public service is considered proportional to income (though in this case it is the aggregate government input, G, rather than its per capita amount, which is considered proportional to income).

The view that underlies the above formulation of the model is that as households lobby in proportion to their private benefits from the public good (see below), they induce a *collective* pressure on the government for increased G, as will be seen below. G however, is nondivisible and therefore becomes available to *all* households. To illustrate, suppose households in a community desire a new road. Each household's incentive in lobbying the local authorities would then be proportional to its benefit from the introduction of the road, though the road is of course a nondivisible input in that it cannot be constructed on a piece-wise basis.

As each household sees g to be a function of its lobbying effort,

we assume a form similar to that discussed in Section II:

$$g = g(\beta,(1-\tau)y) = (1-\tau)y\gamma(\beta) \tag{2a}$$

where γ possesses the properties discussed earlier. Assuming that y exhibits constant returns in k and g and is increasing in G/Y, we write:

$$y = k^{\alpha}g^{1-\alpha}(G/y)^{\epsilon} \tag{3a}$$

Substitution form (2a) into (3a) gives the "reduced form" production function:

$$y = k[(1-\tau)\gamma(\beta)]^{(1-\alpha)/\alpha}(G/y)^{\epsilon/\alpha} \tag{4a}$$

The household will then maximize equation (1) subject to:

$$c(t) + \dot{k}(t) = (1-\beta)(1-\tau)y \tag{5a}$$

Following the procedure of the previous section, the perceived optimal growth path is:

$$\lambda = \frac{1}{\sigma}\left[(1-\beta)(1-\tau)^{1/\alpha}[\gamma(\beta)]^{\frac{1-\alpha}{\alpha}}(G/y)^{\epsilon/\alpha} - \rho\right], \tag{6a}$$

in which G/y ratio is treated by households as fixed. In this case then the optimal lobbying propensity is given by exactly the *same* equation as Section II:

$$\frac{\gamma'(\beta^*)}{\gamma(\beta^*)}(1-\beta^*) = \frac{\alpha}{(1-\alpha)}, \tag{7a}$$

and the concavity of λ also is governed by the analysis of Section II.

Aggregation and Equilibrium Path:

As mentioned above, nondivisibility of G means that a unique level

of the public input G will be provided in response to the collective pressure of lobbyists. To simplify the analysis, we assume that the same mapping g that converts lobbying effort to g at the household level also operates at the aggregate level, though in general this need not be the case. Since households are identical, aggregate G will be provided by the government according to the following functional form:

$$G = g[\beta, (1-\tau)ny] = (1-\tau)ny\gamma(\beta) \tag{8a}$$

Variable n captures the size of the coalition that is engaged in lobbying. The coalition size is assumed to be a given parameter and thus exogenous. Although n may be related to the population size, growing as the latter does, such a growth would still be exogenous and thus not change the qualitative nature of the results. The tax rate τ is determined as before, $\tau = \gamma(\beta)/(1+\gamma(\beta))$, based on the assumption that only the coalition members are taxed, $G = \tau ny$. The equilibrium tax rate at which expectations are realized is given by:

$$\tau_o = \gamma(\beta^*)/(1+\gamma(\beta^*)) \tag{9a}$$

This equilibrium tax rate, together with the coalition size, uniquely determine the G/y ratio in equilibrium, from (8a) and (9a), and then the equilibrium growth rate, from equation (6a).[10] These equations are:

$$(G/y)_o = (1-\tau_o)n\gamma(\beta^*) = n[\gamma(\beta^*)/(1+\gamma(\beta^*))], \tag{10a}$$

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[10] The constraint that the growth rate λ_0 is ≤ 1, imposes an upper bound on ϵ, i.e., $n^{\epsilon/\alpha}[\gamma(\beta^*)/(1+\gamma(\beta^*))]^{(1+\epsilon)/\alpha}(1-\beta^*)/\gamma(\beta^*) \leq \sigma+\rho$. Thus the externality parameter, ϵ cannot be too large since n may be a large number (For example a value of $\epsilon \cong .2\alpha$ would quickly dampen the value of $n^{\epsilon/\alpha}$ even for very large n.)

and[11],

$$\lambda_o = \frac{1}{\sigma}\left[(1-\beta^*)(1-\tau_o)^{1/\alpha}[\gamma(\beta^*)]^{(\frac{1-\alpha}{\alpha})}(G/y)_o^{\epsilon/\alpha} - \rho\right]. \qquad (11a)$$

Social Optimum and the Efficient Path:

The efficient path is derived based on the notion that in the aggregate, τ and G/y depend on the level of lobbying according to equation (9a) and (10a) for any β (allowing us to drop the subscript o and superscript *). As in Section II, this concept of efficiency is again a second best concept and is based on the assumption that the socially optimal allocation of public goods by a social planner--i.e. free of lobbying costs--is improbable, though clearly socially superior in theory. Substitution from (9a) and (10a) into the equation for λ (eq. 6a) gives:

$$\hat{\lambda} = \frac{1}{\sigma}\left[(1-\beta).[\frac{1}{1+\gamma(\beta)}]^{\frac{1}{\alpha}} \quad [\gamma(\beta)]^{(\frac{1-\alpha}{\alpha})} [n\frac{\gamma(\beta)}{1+\gamma(\beta)}]^{\frac{\epsilon}{\alpha}} - \rho\right] \qquad (12a)$$

The nature of the trade-offs in this expression is worth noting. In analogy to Section II, the first two terms respectively capture the negative impact of lobbying on growth via resource use and taxes, and the third term captures the positive impact of lobbying on growth via the household-specific benefits of the public public good, g. In

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[11]The dependence of λ_0 on n, via equation (10a), points to the appearance of what is known as "scale effects" in determination of steady-state growth. (An example of such scale effects is Romer's (1990) analysis of the role of human capital). While this may be an important issue in its own right, its discussion here would take us beyond the scope of this paper and is not therefore pursued further.

addition, the fourth captures a new effect. This is the impact of privately motivated lobbying on the total availability of public input, G. The value of β^{**} that maximizes $\hat{\lambda}$ is give by:

$$\frac{\gamma'(\beta^{**})}{\gamma(\beta^{**})}(1-\beta^{**}) = \frac{\alpha}{1 - \alpha + \frac{\epsilon - \gamma(\beta^{**})}{1+\gamma(\beta^{**})}} \tag{13a}$$

Note that this expression reduces to the equivalent expression in Section II for $\epsilon=0$. Provided that $\gamma(\beta)$ is steep near the origin, as before, Appendices (iii-1) and (iii-2) show that the necessary and sufficient conditions for β^{**} to exist and to maximize $\hat{\lambda}$ is that political technology at β^{**}--or its required tax--is bounded from above such that $\gamma(\beta^{**})/[1+\gamma(\beta^{**})] = \tau(\beta^{**}) < 1 - \alpha/(1+\epsilon)$. This is more relaxed condition than in Section II, but reduces to that when $\epsilon = 0$.

In order to compare the socially and privately optimal lobbying, we focus once again on the slopes of λ at β^{**} and of $\hat{\lambda}$ at β^{*}. The two slopes are related through the following relation:

$$\partial\hat{\lambda}/\partial\beta = [\frac{n\gamma/(1+\gamma)}{G/y}]^{\frac{\epsilon}{\alpha}}[\frac{1}{(1-\tau)(1+\gamma)}]^{\frac{1}{\alpha}} \cdot \partial\lambda/\partial\beta -$$

$$- \frac{1-\beta}{\sigma\alpha}[\frac{\gamma^{1-\alpha+\epsilon}}{(1+\gamma)^{1+\alpha+\epsilon}}]^{\frac{1}{\alpha}}\gamma' + \frac{(1-\beta)\epsilon}{\sigma\alpha}[\frac{\gamma^{1-2\alpha+\epsilon}}{(1+\gamma)^{1+\alpha+\epsilon}}]^{\frac{1}{\alpha}}\gamma' \tag{14a}$$

This relation is analogous to equation (20) but it contains an extra third term introduced by the presence of the external effect, ϵ. At β^{*} the first term on the right hand side vanishes, leaving the sign of $\partial\hat{\lambda}/\partial\beta$ to be determined by sum of the second term--which is analogous to Section II and captures the negative effect of overlobbying by private household's viewing of the tax rate as fixed--and the third term. This

terms is new and captures the positive effect of the public good on the economy. The existence of this term implies a shift rightward of the $\hat{\lambda}$ curve in Figure 1, as shown in Figure 3, so that the slope of $\hat{\lambda}$ at β^* is less negative than before (Figure 3a), or even positive (Figure 3b). The consequence is that the value of β^{**} is larger than it was in Section II when the external effect was absent. If the external effect is sufficiently large, the $\hat{\lambda}$ curve shifts so far to the right as to cause β^{**} to *pass* the value of β^*, a possibility shown in Figure 3b. Thus the extent of overlobbying relative to the social optimum falls, and may even turn into underlobbying, the larger is externality coefficient ϵ, capturing the degree of publicness of G. Atomistic households overlobby to the extent they ignore aggregate tax variations driven by the total level of lobbying in the society, but underlobby to the extent they ignore public (external) benefits derived from lobbying. We can find when β^{**} stays to the left of β^* and when it surpasses β^* by evaluating equation (14a) at β^* and simplifying to get:

$$\partial\hat{\lambda}/\partial\beta|_{\beta^*} = \frac{1-\beta}{\sigma\alpha}\left[\frac{\gamma^{1-\alpha+\epsilon}}{(1+\gamma)^{1+\alpha+\epsilon}}\right]^{\frac{1}{\alpha}}.\gamma'.[-1+\epsilon/\gamma]$$

Therefore, if the externality is such that $\epsilon < \gamma$, $\partial\hat{\lambda}/\partial\beta|_{\beta^*} < 0$ and therefore $\beta^{**} < \beta^*$. On the other hand, if the externality parameter is large, i.e., $\epsilon > \gamma$ (but not so large that growth rate exceeds unity--see note 12), $\partial\hat{\lambda}/\partial\beta|_{\beta^*} > 0$ and therefore $\beta^{**} > \beta^*$. To summarize this discussion:

Result 6. Atomistic households overlobby to the extent they see taxes as fixed, but underlobby to the extent they ignore public (external) benefits derived from lobbying. Overlobbying dominates if the external effect is small ($\epsilon<\gamma$) and underlobbying dominates if it is large ($\epsilon>\gamma$).

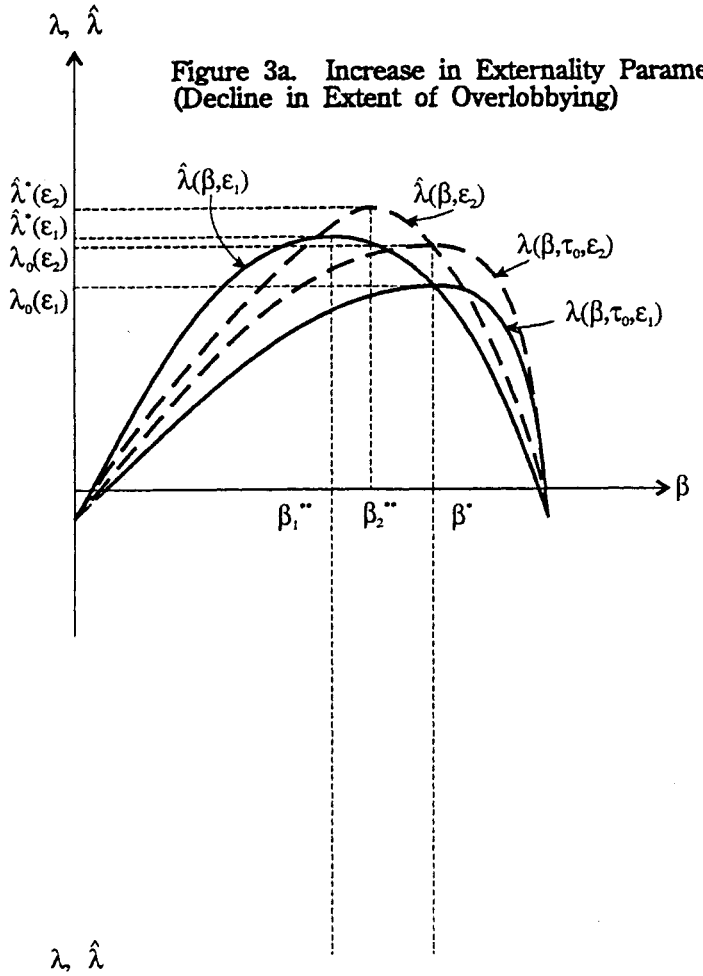

Figure 3a. Increase in Externality Parameter: $\varepsilon_2 > \varepsilon_1$
(Decline in Extent of Overlobbying)

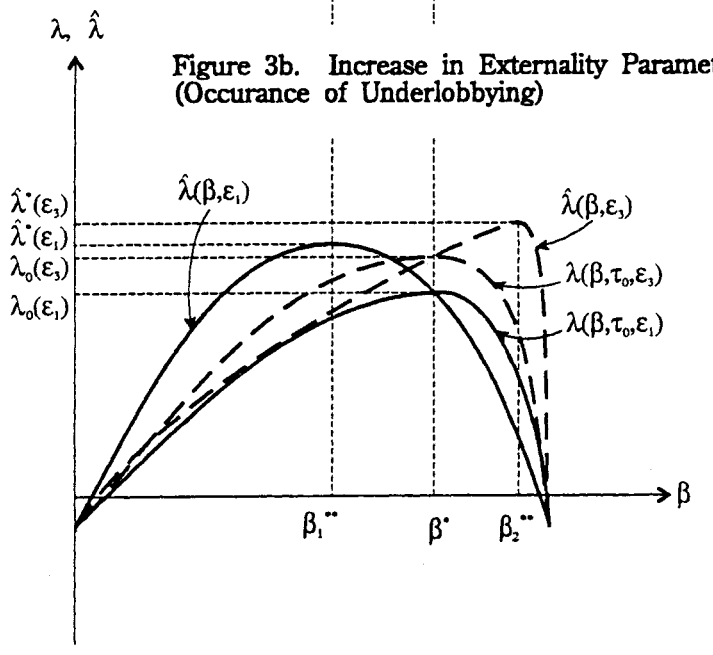

Figure 3b. Increase in Externality Parameter: $\varepsilon_3 > \varepsilon_2 > \varepsilon_1$
(Occurance of Underlobbying)

Figure 3. Growth and Lobbying for Quasi Public Goods

IV. Growth Under Lobbying to Reduce the Tax Rate

It is equally possible that agents lobby to reduce the tax rate. Individual households perceive a *given* level of public goods, but the aggregate provision of the public good is affected at the economy-wide level as a consequence of the efforts of all households to reduce the tax rate. The fact that households ignore this externality means that privately optimal lobbying by households exceeds its socially optimal levels. The analysis is therefore similar to Section II, but in reverse fashion. Since the provision of the public good is now given, the issue of free ridership does not arise, at least with respect to G, and hence the distinction between Section II and III is irrelevant, in so far as the question at hand is taxes and not G. This is the reason for returning to Section II, as the reference point for the analysis. Finally, it is not possible to model simultaneous lobbying for tax cuts and increase in the provision of public goods in a single representative household model, since that would entail contradictory objectives. Such a model, however, can be worked out in the context of a two household model. But this goes beyond the scope of this paper.

In this section, households continue to maximize equation (1), but G is now fixed to the individual households. Instead, it is the total tax bill of a representative household which is subject to lobbying:

$$T = \tau Y = \theta(\beta,(1-\tau)Y) \qquad (\text{with } \theta_1,\theta_2<0) \tag{2b}$$

Let $\theta(\beta,(1-\tau)Y)$ assume a separable form in analogy with Section II:

$$\theta(\beta,(1-\tau)Y) = (1-\tau)Y\delta(\beta) \tag{3b}$$

where δ captures the political technology such that $\delta' < 0$, and $\delta'' > 0$;

i.e., δ' declines in absolute value to capture the diminishing returns feature of the political technology, as discussed earlier. Also, δ is assumed steep near zero ($\lim_{\beta \to 0} \delta'(\beta) = -\infty$), for same technical reasons as before. Equations (2b) and (3b) yield:

$$\tau = \delta(\beta)/(1+\delta(\beta)) \tag{4b}$$

[In analogy to the previous case, we assume that $\delta(0) \geq 0$, permitting for the possibility of a tax rate ceiling (< 1), in the absence of lobbying. See below.] Substitution into the budget constraint yields:

$$\begin{aligned} C(t) + \dot{K}(t) &= (1-\beta)[1 - \frac{\delta(\beta)}{1+\delta(\beta)}]Y \\ &= (1-\beta)[1 - \frac{\delta(\beta)}{1+\delta(\beta)}]f(K,G) \end{aligned} \tag{5b}$$

As mentioned, G is now constant at the level of the individual household but is driven, at the macro level--this time *indirectly*--by the lobbying efforts to cut taxes, i.e.:

$$G = \tau Y = \frac{\delta(\beta)}{1+\delta(\beta)}Y \tag{6b}$$

With a constant return to scale technology of Sections II and III, the above equation can be used to yield:

$$G = K[\frac{\delta(\beta)}{1+\delta(\beta)}]^{1/\alpha} \tag{7b}$$

Since atomistic households view G as fixed, this equation does not enter into their maximization decision, but the effect shows up when one searches for a socially optimal growth rate. More on that later. For the present, maximization of (1) subject to (5b)--after its incorporation of the C-D technology--yields a *perceived* optimal growth rate of consumption (and capital stock) of representative household,

and an optimal lobbying propensity, given by:

$$\lambda_\tau = \frac{1}{\sigma}\left[\alpha(1-\beta)\cdot\frac{1}{1+\delta(\beta)}\cdot\left(\frac{G}{K}\right)^{1-\alpha} - \rho\right] \tag{8b}$$

and,

$$-\delta'(\beta^*)(1-\beta^*) = 1+\delta(\beta^*) \tag{9b}$$

Appendix (iv-1) then shows that the second order condition for the maximization of (1) is satisfied in K (globally) and β (locally). Further, as in the earlier case, a β^* that solves equation (9b) will always exist if the political technology is steep near the origin, ($\lim_{\beta \to 0} \delta'(\beta) = -\infty$. See Appendix iv-2).[12]

To find aggregate growth we substitute from equation (7b) into (8b):

$$\hat{\lambda}_\tau = \frac{1}{\sigma}\left[\alpha(1-\beta)\frac{1}{1+\delta(\beta)}\cdot\left[\frac{\delta(\beta)}{1+\delta(\beta)}\right]^{(1-\alpha)/\alpha} - \rho\right] \tag{10b}$$

Then in *equilibrium*, expectations are realized so that:

$$\lambda_\tau(\beta^*;G/K) = \hat{\lambda}_\tau(\beta^*) \ , \tag{11b}$$

which gives,

$$\left(\frac{G}{K}\right)_o = \left[\frac{\delta(\beta^*)}{1+\delta(\beta^*)}\right]^{1/\alpha} \ . \tag{12b}$$

The equilibrium growth rate then becomes, in analogy with Section II.

$$\lambda_{0,\tau} = \frac{1}{\sigma}\left[\alpha(1-\beta)\cdot\frac{1}{1+\delta(\beta)}\cdot\left(\frac{G}{K}\right)_o^{1-\alpha} - \rho\right], \tag{13b}$$

Finally, searching for a socially optimal level of lobbying, β^{**},

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[12]Again, in analogy to Section II, the function δ need not (but may) equal unity at the origin, i.e. $\delta(0) \leq 1$).

that maximizes $\hat{\lambda}_\tau$ in (10b), we find:

$$\frac{\delta'(\beta^{**})}{\delta(\beta^{**})}(1-\beta^{**}) = \frac{\alpha}{\frac{1}{1+\delta(\beta^{**})} - \alpha} \tag{14b}$$

Provided that $\delta(\beta)$ is steep near the origin as before, Appendices (iv-3) and (iv-4) show that the necessary and sufficient condition for β^{**} in (14b) to exist and to maximize $\hat{\lambda}_\tau$ is that $\delta(\beta^{**}) > (1-\alpha)/\alpha$, or equivalently that the optimal tax rate is $\tau(\beta^{**}) > 1-\alpha$. Thus, in contrast to Section II, a socially optimal anti-tax lobbying exists if the corresponding tax rate that is *greater* than the productivity parameter of public investments. This condition is exactly the *reverse* of the corresponding condition in Section II, and the two conditions are therefore *mutually exclusive* of each other. In fact, when $\hat{\lambda}_\tau$ can be maximized, the aggregate growth, $\hat{\lambda}$, in the public goods case, is a monotonically decreasing function of β (seen by replacing the $\tau(\beta^{**}) < 1-\alpha$ condition with $\tau(\beta^{**}) > 1-\alpha$ in equation (18)); and vice versa.

Result 7. Conditions on the production and political technology that allow for a socially efficient anti-tax lobbying to exist, are mutually exclusive of those that can support the existence of a socially efficient pro-public-goods lobbying.

Since τ is a function of the political technology in either model, the inequalities restrictions above are rooted on a comparison of the political and production technologies. Although the actual features of the political and production technologies in different countries can only be known empirically, it is likely that $\tau < .5$ holds for most countries. On the other hand, as was discussed earlier, it may be speculated that less developed countries are likely to have a smaller

share of private investments and a larger share of public investments in their GNP ($\alpha < 1/2$), while the reverse is likely to hold among industrialized economies. Under these circumstances the condition $\tau < 1-\alpha$ holds among developing economies, ruling out the possibility that anti-tax lobbying may be socially efficient, even in a "potential" sense. As for industrialized economies both inequalities can be potentially satisfied in the plausible range of τ and α. Which inequality is *actually* satisfied will depend on the particular political and production technologies that characterize each economy. Finally, note that the parameter restrictions apply only to β^{**} not β^{*} and therefore the private agents' choice of lobbying for *either* instrument is not restricted, regardless of which form of lobbying may be potentially efficient.

Comparison of β^{*} and β^{**} is provided in Figure 4, conditioned on $\tau|_{\beta^{**}} > 1-\alpha$. Otherwise, only the curve λ_τ would be relevant. Figure 4 is drawn according to equation (10b)--which shows that the maximum of λ_τ curve equals $\hat{\lambda}_\tau$--and following the steps of Section II, which show that $\hat{\lambda}_\tau(\beta)$ is *downwardly sloped* at β^{*} ($\partial\hat{\lambda}_\tau/\partial\beta|_{\beta^{*}} < 0$) and $\lambda_\tau(\beta;\tau)$ is *upwardly sloped* at β^{**} ($\partial\lambda_\tau/\partial\beta|_{\beta^{**}} > 0$). Thus, $\beta^{**} < \beta^{*}$, as before. To reduce the tax rate, atomistic agents overlobby relative to a socially efficient level; this time, because they ignore an *induced reduction* the provision of the public goods that stem from the tax cuts. To summarize:

Result 3'. Atomistic agents' optimal lobbying for tax cuts is socially excessive and thus suboptimal, as they ignore the reduction in the provision of public goods that result from their aggregate actions.

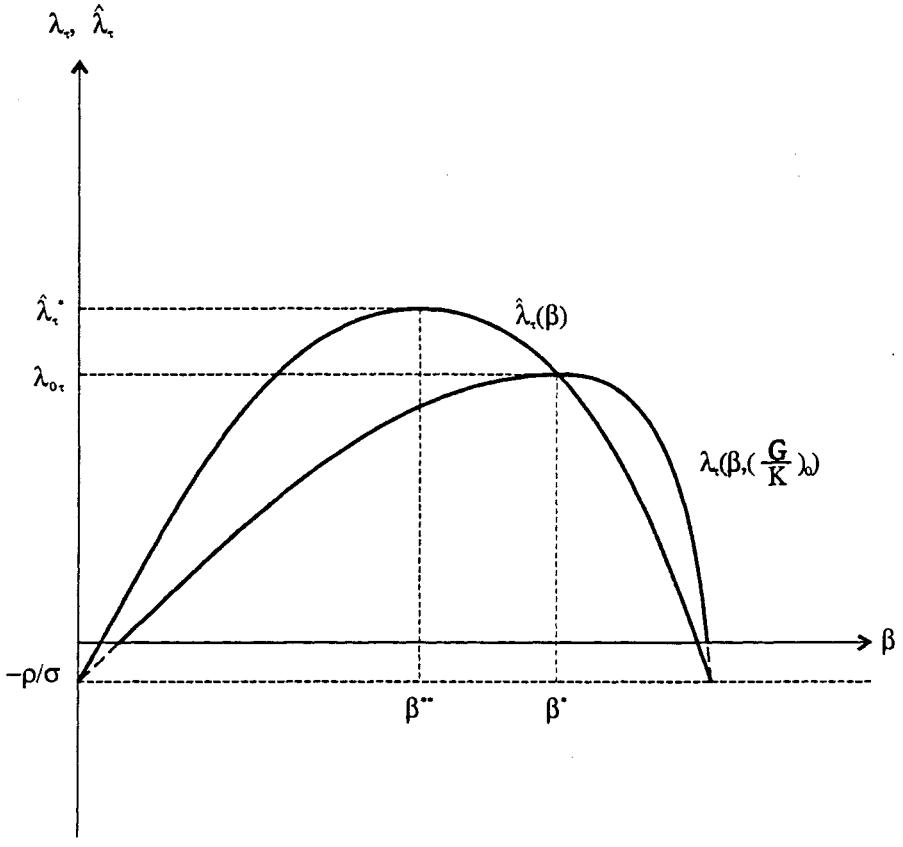

Figure 4. Growth and Lobbying for Tax Cuts

V. *Conclusion*

The traditional literature on public choice and international trade has emphasized the socially undesirable nature of lobbying by focusing on the variants of rent seeking behavior.[13] These results are typically derived from models that are both static and ignore public goods.[14] By contrast, this paper is cast in the dynamic context of an *endogenous growth* model, in which *public goods* are also present. Growth here is a consequence of households choosing among consumption, capital stock, and *lobbying level*.

The paper shows that when lobbying takes place for a public good, there can exist a nonzero level of lobbying that maximizes aggregate growth. This outcome is first best, if a social planner solution is ruled out, and second best if a social planner could deliver the same social optimum level of public good *without* lobbying by the public. The model shows that private agents *overlobby* relative to this social optimum as they ignore the aggregate tax implications of their lobbying activities. Equilibrium growth rate is thus below this aggregate maximum rate. Taxes in this case are driven by the need to finance the public expenditures which are sought by lobbyists. The model predicts a *drop* in intensity of lobbying as the share of private inputs rise relative to public inputs. This finding implies that underdeveloped

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[13] An exception is Bhagwati (1980, 1982) who points that if the *ex-anti* state of the economy is second best, lobbying may be welfare improving.

[14] An exception is a recent paper by Cairns (1989) on dynamic rent seeking. Public goods, however, do not enter into this analysis.

economies with large a share of public relative to private sector should face greater lobbying activity than industrialized economies.

If lobbying is motivated by partly selfish reasons so that free ridership does not become the dominant outcome, the public good may have to entail certain tangible benefits to private agents. Thus, a model of quasi public goods that contains both a private and a public component is developed which predicts both underlobbying and overlobbying as being possible. Which effect dominates depends on the size of the external effect.

Finally when lobbying is aimed at reducing the tax rate rather than increasing the provision of public goods, we still obtain the possibility that a socially efficient lobbying level that maximizes aggregate growth may exist. Agents again overlobby relative to this level, this time because they ignore the under-provision of public goods that result from anti-tax lobbying behavior. Additionally, we find that a socially efficient level of pro-public-goods lobbying *and* anti-tax lobbying *cannot* simultaneously co-exist in the same economy.

A two household extension of this model (Mohtadi and Roe, 1990) in which rival lobbying occurs for a partially excludable public good is currently under investigation. Certain interesting game theoretic results follow. Other modifications and extensions could include the case where individuals lobby from their wealth rather than income. Finally, while lobbying expenditures in this model are not *directly* productive and thus lost to the economy, one may explore the implications of postulating the existence of a sector that "produces" lobbying services on behalf of households. Expenditures by this sector are still largely lost to the economy, and thus the impact on aggregate growth will be unaffected by postulating such a sector.

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Appendices

Appendix ii-1: Second Order Condition on W in Section II

The second order condition requires that:

$$U_{KK} < 0,\ U_{\beta\beta} < 0,\ \text{and}\ \det\begin{bmatrix} U_{KK} & U_{K\beta} \\ U_{\beta K} & U_{\beta\beta} \end{bmatrix} > 0$$

We show that these conditions are globally satisfied in K and locally satisfied in β, at β^*. First, $U_{KK} = U''\ C_K^2 + U'\,C_{KK}$. But from equation (11) it follows that $C_{KK} = 0$. Further, $U'' < 0$ from equation (12). Therefore, $U_{KK} < 0$. Next, $U_{\beta\beta} = U''C_\beta^2 + U'\,C_{\beta\beta}$. But optimization with respect to β [equation (14)] means $C_\beta(\beta^*) = 0$. (THis can be readily verified by differentiation (11) in β and using equation (14) in the result.) Further, from (11) one finds that:

$$C_{\beta\beta} = (1-\tau)^{1/\alpha}\left(\frac{1-\alpha}{\alpha}\right)[\gamma(\beta)]^{\left(\frac{1-3\alpha}{\alpha}\right)}K\Big[-2\gamma(\beta)\gamma'(\beta) + (1-\beta)\left(\frac{1-2\alpha}{\alpha}\right)[\gamma'(\beta)]^2 + (1-\beta)\gamma(\beta)\gamma''(\beta)\Big]$$

This expression is negative at β^*: We divide the analysis into two cases; $\alpha \geq 1/2$, and $\alpha < 1/2$. First, if $\alpha \geq 1/2$, $1-2\alpha \leq 0$, and thus $C_{\beta\beta} < 0$ by the above expression. Second, if $\alpha < 1/2$, $1-2\alpha > 0$. In this case, focusing on the first two terms in the large brackets, note that $C_{\beta\beta} < 0$, if $-2\gamma(\beta) + (1-\beta)\left(\frac{1-2\alpha}{\alpha}\right).\gamma'(\beta) < 0$, i.e., if $[\gamma'(\beta)/\gamma(\beta)](1-\beta) < 2\alpha/(1-2\alpha)$. This inequality is satisfied by the first order condition (equation 14) at $\beta=\beta^*$. It follows that $C_{\beta\beta}(\beta^*) < 0$, and thus $U_{\beta\beta}(\beta^*)$ is negative. Now the determinant, after substituting from above, is:

$$\det\begin{bmatrix} U_{KK} & U_{K\beta} \\ U_{\beta K} & U_{\beta\beta} \end{bmatrix} = U'' \; C_K^2 \; U' C_{\beta\beta} - (U' C_{\beta K})^2 .$$

Since $U'' < 0$, and $C_{\beta\beta} < 0$, the first term is positive. But the second term is actually zero because from equation (11) $C_{\beta K} = C_\beta/K$ and because $C_\beta(\beta^*) = 0$. Thus the determinant in positive. It follows that the second order condition is satisfied for all K and for β^*.

Appendix ii-2: Existence of β^* to Maximize λ

First, the right hand side (RHS) of equation (14) is independent of β while the left hand side (LHS) decreases in β. Moreover, LHS is *above* RHS at β=0 (LHS(0) = $\gamma'(0)/\gamma(0)$ > RHS(0), as $\lim_{\beta \to 0} \gamma'(\beta) \to \infty$) and *below* it at β=1 (LHS(1) = 0 <RHS(1)). Therefore the LHS and RHS curves cross in the domain of $\beta \in (0,1]$, as is depicted in Figure A1.

Appendix ii-3: Existence of β^{**} to Maximize $\hat{\lambda}$

First the LHS of equation (19) is positive. Then for β^{**} to exist it is *necessary* that the RHS of (19) be positive which implies that $\gamma(\beta^{**}) < (1-\alpha)/\alpha$. Further, the RHS of equation (19) is increasing in β but the LHS (same as equation (14)) decreases in β. Moreover, LHS is *above* RHS at β=0 (LHS(0) = $\gamma'(0)/\gamma(0)$ > RHS(0), as $\lim_{\beta \to 0} \gamma'(\beta) \to \infty$) and *below* it at β=1 (LHS(1) = 0 <RHS(1)). Then the two curves must cross in the domain of $\beta \in (0,1]$, as shown in Figure A2.

Appendix ii-4: Concavity of $\hat{\lambda}$

Global concavity of $\hat{\lambda}$ cannot be established in this case. To check for

the local concavity of $\hat{\lambda}$, differentiate equation (18) twice, and use the first order condition on β^{**} (eq. 19) to obtain:

$$\sigma\partial^2\hat{\lambda}/\partial\beta^2|_{\beta^{**}} = \frac{\gamma(\beta)^{\frac{1}{\alpha}-2}}{[1+\gamma(\beta)]^{1/\alpha}} \cdot \Big[[\frac{1}{\alpha(1+\gamma(\beta))} - 1][(1-\beta)\gamma''(\beta)-\gamma'(\beta)]$$

$$- \frac{1-\beta}{\alpha}[\frac{\gamma(\beta)}{1+\gamma(\beta)}]^2 - \gamma'(\beta)\Big]|_{\beta^{**}}$$

In this expression, the last two terms inside the large brackets (second line) are negative. Also, the second product in the first term, $[(1-\beta)\gamma''(\beta)-\gamma'(\beta)]$, is negative. Thus $\partial^2\hat{\lambda}/\partial\beta^2(\beta^{**})$ is negative if the first product is negative, i.e. if $\gamma(\beta^{**}) < (1-\alpha)/\alpha$. This was also the necessary condition for the existence of β^{**}. (Appendix ii-3). It is now also sufficient for concavity of $\hat{\lambda}$ at β^{**}.

Appendix iii-1: Existence of β^{**} in the Case of Quasi Public Goods

This analysis is similar to Appendix ii-3. First note that the LHS of equation (13a) is positive. Thus a *necessary* condition for β^{**} to exist is for its RHS to be positive or that $\gamma(\beta^{**})/[1+\gamma(\beta^{**})] < 1 - \alpha/(1+\epsilon)$. Further, the RHS rises in β and the LHS falls. Moreover, LHS is *above* RHS at $\beta=0$ (LHS(0) $= \gamma'(0)/\gamma(0) >$ RHS(0), as $\lim_{\beta \to 0} \gamma'(\beta) \to \infty$) and *below* it at $\beta=1$ (LHS(1) $= 0 <$RHS(1)). It follows that the two curves cross in the domain of $\beta \in (0,1]$ (The figure resembles A2 and is not repeated here.)

Appendix iii-2: Concavity of $\hat{\lambda}$ in the Case of Quasi Public Goods

Again, only local concavity will be established as in Appendix ii-4.

Differentiating equation (12a) twice, and using equation (13a) on the first order condition for β^{**} we find:

$$\sigma\partial^2\hat{\lambda}/\partial\beta^2|_{\beta^{**}} = \frac{\gamma(\beta)^{\frac{1+\epsilon}{\alpha}-2}}{\alpha[1+\gamma(\beta)]^{(1+\epsilon)/\alpha}}\Big[[1-\alpha+\frac{\epsilon-\gamma(\beta)}{1+\gamma(\beta)}][-\gamma'(\beta)+(1-\beta)\gamma''(\beta)]$$

$$-(1-\beta)(1+\epsilon)[\frac{\gamma'(\beta)}{1+\gamma(\beta)}]^2-\gamma'(\beta)\Big]|_{\beta^{**}}$$

In this expression, the first product inside the large brackets, is simply the right hand side of the first order condition for β^{**}, i.e. equation (13a) and is positive if the condition for the existence of β^{**} , i.e. $\gamma/[1+\gamma] < 1 - \alpha/(1+\epsilon)$ holds from the previous appendix. Since the second product is negative the entire product is negative in this case. The remaining terms on the second line are clearly negative, rendering $\partial^2\hat{\lambda}/\partial\beta^2(\beta^{**})$ negative when the above condition holds. Thus $\gamma/[1+\gamma] < 1 - \alpha/(1+\epsilon)$ is both the necessary condition for the existence of β^{**} and the sufficient condition for the concavity of $\hat{\lambda}(\beta)$ at β^{**}.

Appendix iv-1: Second Order Condition on W in Section IV

The second order conditions for maximization of W in Section III differ from Section II (Appendix 1) in some respects. First, the term C_{KK} in the U_{KK} expression is now negative. Thus, U_{KK} is still negative; also the term $C_{\beta\beta}$ in $U_{\beta\beta}$ expression, evaluated locally at β^* is:

$$C_{\beta\beta}(\beta^*) = -[\frac{1-\beta}{(1+\delta(\beta))^3}\delta''(\beta).K^{\alpha}G^{1-\alpha}]|_{\beta^*}$$

This expression is negative as $\delta'' > 0$, and $\delta' < 0$, guaranteeing that $U_{\beta\beta}(\beta^*) < 0$. Finally, the determinant expression is the same as in Section II, equaling $U'' C_K^2 U' C_{\beta\beta} - (U' C_{\beta K})^2$. The first term in this expression is positive at β^*, while $C_{\beta K}$ in the second part equals $-\alpha C_\beta/K$ which vanishes locally at β^*. Thus the determinant is positive and the second order condition is locally satisfied in β and globally satisfied in K.

Appendix iv-2: Existence of β^* to Maximize λ_τ

The left and right hand sides of equation (9b) are both decreasing functions of β ($\partial LHS/\partial\beta$, $\partial RHS/\partial\beta < 0$). However LHS is *above* RHS at $\beta=0$ ($LHS(0) = -\delta'(0) \longrightarrow \infty$, as $\lim_{\beta \to 0} \delta'(\beta) = -\infty$), and *below* it at $\beta = 1$ ($LHS(1) = 0 < RHS(1)$). Therefore, the two curves cross in the domain of $\beta \in (0,1]$, as shown in Figure A3.

Appendix iv-3: Existence of β^{**} to Maximize $\hat{\lambda}_\tau$

First note that the LHS of equation (14b) is negative. Thus a *necessary* condition for β^{**} to exist is for its RHS to be negative which implies that $\delta(\beta^{**}) > (1-\alpha)/\alpha$. Unlike previous cases, however, the LHS of equation (14b) is *not* monotonic in β ($\partial LHS/\partial\beta \lessgtr 0$) while the RHS rises in β. However, the two curves will still cross in the domain of β, because the LHS is *below* RHS at $\beta=0$ ($LHS(0) = \delta'(0)/\delta(0) \longrightarrow -\infty$, as $\lim_{\beta \to 0} \delta'(\beta) = -\infty$), and *above* it at $\beta = 1$ ($LHS(1) = 0 > RHS(1)$. This is shown in Figure A4. As shown in the figure, the ambiguity in the slope of $LHS(\beta)$ is necessarily a local phenomenon as shown, owing to the endpoint condition on $\gamma(0)$.

Appendix iv-4: Concavity of $\hat{\lambda}_\tau$

Global concavity of $\hat{\lambda}_\tau$ cannot be established as in Section II. To check for the local concavity of $\hat{\lambda}$, differentiate equation (10b), and use the first order condition on β^{**} (eq. 14b) to obtain:

$$\sigma\partial^2\hat{\lambda}_\tau/\partial\beta^2|_{\beta^{**}} = \frac{\delta(\beta)^{(1/\alpha)-2}}{[1+\delta(\beta)]^{(1/\alpha)+1}}\Big[[1-\alpha(1+\delta(\beta)].[-\delta'(\beta)+(1-\beta)\delta''(\beta)]$$

$$- \alpha\delta'(\beta)[(1-\beta)\delta'(\beta) +1]\Big]|_{\beta^{**}}$$

Next, we use the first order condition on β^{**} (eq. 14b) for a second time, to re-express the term on the second line, above, as:

$$- \alpha\delta'(\beta)[1-\alpha(1+\delta(\beta)]^{-1}[\alpha(\delta(\beta)^2-1)+1]|_{\beta^{**}} \qquad \text{(a)}$$

It can now be shown the $\partial^2\hat{\lambda}_\tau/\partial\beta^2(\beta^{**})$ is negative if $[1-\alpha(1+\delta(\beta^{**})] < 0$, i.e. if $\delta(\beta^{**}) > (1-\alpha)/\alpha$. First, this condition guarantees that the product on the first line of the expression for $\partial^2\hat{\lambda}_\tau/\partial\beta^2(\beta^{**})$ is negative. Next, it also guarantees that the expression $[\alpha(\delta(\beta^{**})^2-1)+1]$ in the expression (a), above, is positive so that expression (a)--which replaces the second line of $\partial^2\hat{\lambda}_\tau/\partial\beta^2$--is the product of three negative terms and is itself negative. To see why $[\alpha(\delta(\beta^{**})^2-1)+1]$ is positive, use the condition $\delta(\beta^{**}) > (1-\alpha)/\alpha$ to find that $[\alpha(\delta(\beta^{**})^2-1)+1] > (1-\alpha)^2/\alpha + (1-\alpha)$ which is itself positive since $\alpha < 1$. Q.E.D. The condition $\delta(\beta^{**}) > (1-\alpha)/\alpha$ was also the necessary condition for the existence of β^{**}. (Appendix iv-3). It is now also sufficient for concavity of $\hat{\lambda}_\tau$ at β^{**}.

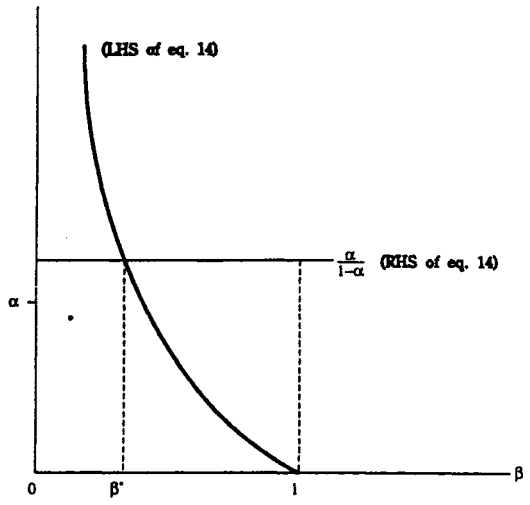

Figure A1

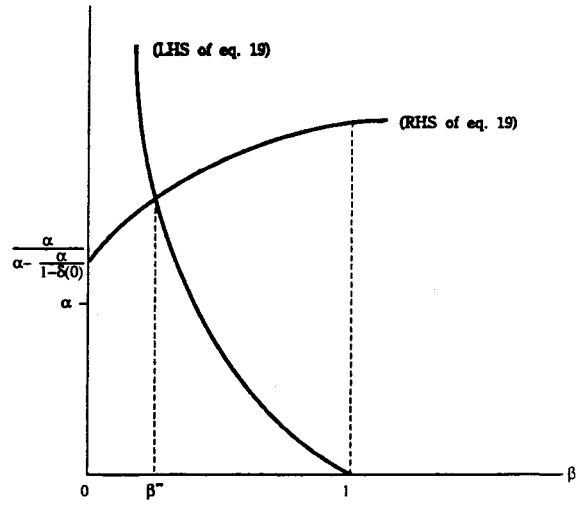

Figure A2

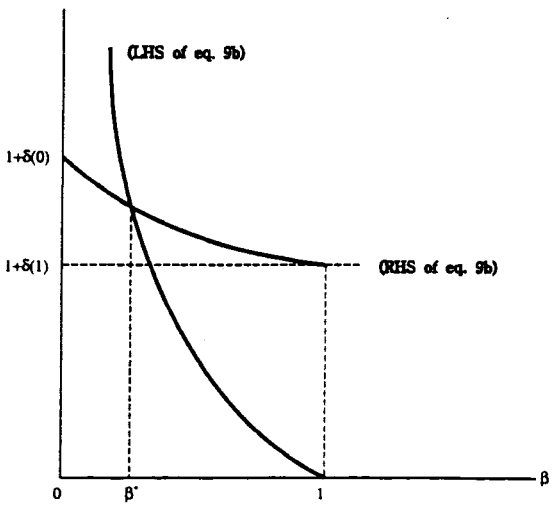

Figure A3

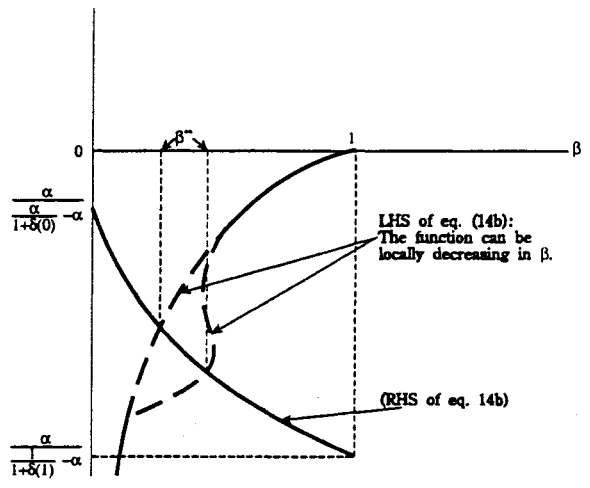

Figure A4