# Political Management of Commons and Anti-commons

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## I. Introduction

The commons problem, or the classic common property dilemma, has been popularized by G. Hardin [1968] who coined the term "tragedy of the commons," though the problem has been familiar to economists at least since Pigou. Constitutional solutions to the commons problem are: (1) the assignment of ownership rights or privatization and (2) the adoption of rules that limit usage. Our emphasis is on majority decision rules. The commons problem arises when a productive resource is indivisible so that individual actions do not incorporate interdependence.

In political or collective choices, personal choices (in anything less than unanimity) necessarily embody externalities. In their already classic book, *Calculus of Consent*, Buchanan and Tullock [1962] discuss such externalities, i.e., external costs, in collective decisions. We use the commons metaphor to analyze basic questions of public economy, such as what resource is overused as the public sector is expanded? This metaphor is based on the empirical observation that, in general tax financing of publicly supplied goods and services, the tax base is the common resource that is subject to over-usage.

The original motivation of our project has been to understand the constitutional aspect of the budget politics in democracy. The project has both positive and normative aspects. In our project the positive aspect of the fiscal process has been analyzed by the commons metaphor. We develop new theoretical elements, "membership externalities" and "anti-commons," which become essential in analyzing fiscal process in majoritarian democracies. The theoretical models are introduced in Buchanan and Yoon [2000a, b].

The normative aspect introduces prudence as rationality, which applies Ainslie's [1992] theory in psychology to the budgetary process.

## II. Commons and Anti-commons

The operation and management of common property resource, "the commons", have been exhaustively examined in economics and political science, both in formal analyses and in practical application. The familiar "tragedy of the commons" suggests stylized illustration. An immobile and indivisible but renewable resource exists (a medieval common pasture, aquifer, fishing ground, internet infra structure) and has economic value if used effectively through the application of units of complementary mobile resources that are themselves valued in their alternative market opportunities. There are no assigned ownership rights to the immobile resource or facility. Free and open access may dissipate most or even all of potential value.

It is necessary to recognize that the familiar "tragedy of commons" usage emerges because separate persons are assigned "rights of usage", the exercise of which create interdependencies that remain outside the explicit calculus of the choice makers. The whole analysis of the commons embodies the presumption that such rights of usage do not extend to "rights of exclusion". The conventional commons problem emerges as more than a single person or agent is assigned usage rights. Interestingly, little attention has been given to the setting where more than one person is assigned exclusion rights, which may be simultaneously exercised.

An anti-commons problem arises when there exist multiple rights to exclude. Michael A. Heller [1998] has examined "The Tragedy of the Anti-commons," especially

in regard to disappointing experiences in efforts to shift from socialist to market institutions in Russia. In an early footnote to his lengthy law review paper, Heller suggests that a formal model of the anti-commons has not been developed. Buchanan and Yoon [2000b] responds to Heller's challenge. We analyze the anti-commons problem in which resources are inefficiently underutilized rather than over-utilized as in the familiar commons setting. The two problems are symmetrical in several aspects.

Geometrical-Algebraic Illustration.

We make a specific example by constructing a geometrical-algebraic example. Consider a large vacant lot adjacent to a country village. Ample parking is available one mile distant. In Figure 1, the marginal value of parking in the adjacent lot, as a function of the number of cars, is shown by the linear relationship $HQ_m$, with the corresponding average value as $HQ_c$. We assume that all potential users are identical. At a zero price, usage is extended to $Q_c$, with all the value of the resource dissipated. Under single ownership, usage is restricted to $Q_m$, with rents maximized through pricing usage at $P_m$. All of the rental value accrues to the owner of the facility (or to the collectivity under efficient management).

If simultaneous usage rights are assigned to more than a single decision-maker, usage is extended beyond $Q_m$, and the location of the Nash equilibrium through independent adjustment by separate users will fall between $Q_m$ and $Q_c$, depending on the number of users. Economists have been almost exclusively interested in these values, which depicts varying degrees of resource wastage under the commons rubric.

Our primary emphasis here is on the anti-commons side of the construction, that is over quantities below $Q_m$ and prices above $P_m$ in Figure 1. This range for equilibrium

emerges when we examine prospects for the assignment of exclusion rights, as contrasted with usage rights. Consider, now, the independent adjustment process when each one of two decision-makers is assigned the right to exclude potential users (cars from the parking lot). What price will A charge for a Green ticket, when she knows that B is allowed, simultaneously, to charge users for a Red ticket, and that users must hold both tickets for entry into the facility?

A Nash equilibrium will be reached at $E_2$* in Figure 1, with each of the two excluders sharing symmetrically in the total rental value, measured by $P_2$*$E_2$*$Q_2$*w. The facility will be under-utilized, the total rental value will be less than that which will be realized under single ownership in which are concentrated both exclusion and usage rights.

We may further specify the example algebraically. When Q measures usage, and P measures the average value product, we get the linear relationship.

$$P = a - bQ \qquad (1)$$

where a and b are constants.

Consider, first, the two person case, where A and B are to be assigned either (a) usage rights or (b) exclusion rights. In either case, explicit collusion will allow for attainment of the efficient solution. We assume, however, that the required mutual trust is absent; hence, joint action is not possible.

(a) Usage rights. If each person is assigned a right to use the facility, but cannot exclude the other from usage, the interaction will converge on an equilibrium that is analogous to Cournot-Nash duopoly model. Person A chooses the level of usage (number of cars), $Q_1$, that will maximize her rent, given person B's choice of usage, $Q_2$. Potential

users are willing to pay the average product determined by equation (1), where $Q = Q_1 + Q_2$.

The rent to person A will be

$$\text{Max}_{Q_1} \quad P\,Q_1 = (a - bQ_1 - bQ_2)Q_1 \qquad (2)$$

where the first order condition for the rent maximization gives

$$0 = a - bQ_1 - bQ_2 - bQ_1$$

and we obtain a stable symmetric solution $Q_1 = Q_2 = (a/b)/3$. The usage by one person, $Q_1$ (or $Q_2$), will be one-third of the quantity, $Q_c$, that defines total dissipation of value. The rent obtained by each person is, $R_1 = P\,Q_1 = (a/3)(a/b)/3 = (a^2/b)/9 = R_2$, and the total rent is, $R(2) = (2/9)(a^2/b)$. For multiple (n) usage, the quantity for each person is $Q_n = Q_c/(n+1)$, and the total rent is, $R(n) = (na^2/b)/(n+1)^2$, which approaches zero as n increases.

(b) Exclusion rights. If each person is assigned a right to <u>exclude</u>, she can exercise this right by setting the price of her tickets, independently from the practice of the other owner. Let $P_1$ denote the price of a Green ticket, and $P_2$ the price of a Red ticket. Users are required to secure both a Green ticket and a Red ticket, but a user can get a refund on any ticket if the total price, $P_1 + P_2$, exceeds her reservation price. A user is willing to pay up to the average differential value of the convenient parking lot. Therefore, equation (1) can be interpreted as the demand schedule, where price of usage is, $P = P_1 + P_2$.

The quantity demanded, Q, will be determined by

$$P_1 + P_2 = a - bQ \qquad (3)$$

Nash equilibrium can be obtained by formulating a game in which each owner tries to maximize her rent by setting the ticket price. Note that this version of the price game is different from the Bertrand duopoly game.

Person A chooses $P_1$ so as to

$$\text{Maximize} \quad P_1 Q = P_1 (a - P_1 - P_2)/b \qquad (4)$$

The first-order condition for maximization is

$$(a - P_1 - P_2)/b - P_1/b = 0,$$

from which we can express $P_1$ as a response function of $P_2$;

$$P_1(P_2) = a/2 - P_2/2, \text{ and likewise } P_2(P_1) = a/2 - P_1/2$$

Solving the system of simultaneous equations gives a stable solution,

$$P_1^* = P_2^* = a/3.$$

The price a customer pays is $P^* = P_1^* + P_2^* = 2a/3$, and the total rent is $(P_1^* + P_2^*) Q = (2a/3)(a/b)/3 = (2/9)(a^2/b)$. For a setting with multiple excluders (n), the price of each separately designated colored ticket, $P_n$, quantity Q(n), and the total rent, TR(n), are

$$P_n^* = a/(n+1), \quad Q(n) = (a/b)/(n+1); \text{ and } TR(n) = n(a^2/b)/(n+1)^2.$$

The values, Q(n) and TR(n), approach zero as n becomes large. The common facility or resource tends toward total abandonment, with its potential value wasted in idleness.

The analysis demonstrates that the equilibrium in either the multiple users or the multiple excluder model is structurally analogous to that familiar in Cournot-Nash oligopoly settings of inter-firm competition. The efficiency implications, however, are diametrically different as between the commons setting and that of inter-firm rivalry. In the latter, efficiency is attained when net rents are zero, when firms are forced by competition to allow consumer-buyers to secure all potential surplus. In the commons

setting, by contrast, optimality is attained when net rents are maximized. Competition among users on the one hand or among excluders on the other tends to reduce rents, as in the inter-firm model, but, instead of reflecting transfers of value to consumer-buyers, such rent reduction represents destruction of value. Fully "competitive" equilibrium is, in either of the commons models, the pessimal rather than the optimal result.

## III. Membership Externality and Fiscal Commons

Constitutional solutions to the commons problem are: (1) the assignment of ownership rights or privatization and (2) the adoption of rules that limit usage. Our emphasis is on majority decision rules. When separate majority coalitions may authorize simultaneous usage of a common resource, total value is dissipated, but the interdependencies introduced by possible membership in differing coalitions to an extent reduce the incentives for exploitation.

Standard analyses of fiscal politics embody an implicit presumption that taxing-spending results emerge from a monolithic collective. A natural consequence of such assumption is the theory of optimal taxation. Papers in our project are grounded on the different presumption that fiscal outcomes emerge from a set of interdependent choices made by separately organized coalitions.

But central to the notion of democracy and democratic process is the authority of electoral and legislative majorities both to impose taxes on all members of the polity even if not always generally, and to finance direct transfers which are almost always

differentially targeted. The models examined here are explicitly constructed for the purpose of facilitating understanding of the majoritarian models.

(1) . Single Majority

We examine, first, the behavior of persons who successfully secure membership in the single majority coalition that is authorized to levy general taxes, applied uniformly to all incomes, to finance direct transfers which are restricted to members of the coalition.

Members of the single majority coalition will not impose the revenue-maximizing rate, even on the assumption that no leakage is present. They will recognize that they, too, are internal to the taxpaying group and will thereby suffer excess burdens from their own parametric responses to tax rates. The postulated relationship between tax rate (t) and base (x) for each of the income generators is, $t = a - bx$.

An emergent majority coalition becomes the sole tax authority that chooses the tax rate and transfers. We assume transfers are distributed equally among coalition members. Let the coalition consist of M members in the polity of N taxpayers. A reference person of the majority coalition will choose tax rate t so as to maximize her utility

$$U = (a - t)\, x/2 + (1/M)\, t\, y$$

which includes two components, the surplus that arises from the generation of income that is retained post-tax, and one M-th of the revenue collected; y is the aggregate income or tax base in accordance with the relationships: $t = a - (b/N)y$. To obtain the first-order condition, substitute x and y and differentiate U with respect to t,

$$0 = (t - a)/b + (N/M)(a - 2t)/b$$

Solving for t, we obtain

$$t^* = a(N - M)/(2N - M) \qquad (5)$$

As the inclusive membership becomes large, the ratio N/M converges to 2 and the tax rate converges to $t^* = a/3$. The minimal majority coalition will impose a tax rate that is always below the revenue-maximizing rate, a/2, which is the limit value when the taxing power is assigned to a single agent. Note the necessary relationship between the size of the minimal majority and the total membership of the polity.

## (2). Two Majorities: Membership Externality

Consider, now, a setting in which each of two prospective majority coalitions is authorized to impose taxes separately and simultaneously. The question at issue concerns the utility-maximizing behavior of the individual who faces the prospect of being a member of either one or both of the majority coalitions that, when formed, are authorized to impose taxes to finance transfers for the benefit of coalition members.

To model the simultaneity involved here, and to avoid slippage into sequential coalition strategy, we may think of an individual who sends two agents, with proxies, to two separated meetings of agents who represent the whole polity's membership. In each of these meetings the total membership (N) is divided into a minimal majority coalition and the residual minority. Each agent is provided with instructions as to how to act if membership in a majority coalition is secured.

One such instruction might be, upon observation of the tax rate, $t_2$, chosen by the other coalition, to choose $t_1$ and maximize,

$$U = (a - t_1 - t_2)^2/(2b) + (1/M)\, t_1\, (a - t_1 - t_2)/(b/N)$$

Note, however, that the maximand does not include any recognition of the prospect that the person's other agent will also secure membership in the other majority that is organized.

This "membership externality", which emerges within the calculus of a single person, will temper the maximizing strategy in the instructions indicated above. The behavior of an agent in one majority coalition will "externally" affect the principal as a prospective member, through the second agent, of the alternative majority. These membership externalities should be clearly distinguished from the basic or "excess burden externalities" that are the source of the differential efficiency shortfalls between the operations of a single majority and those of multiple majorities. The latter set of externalities will be internalized only if members of separate majorities act as if a value-maximizing collusive agreement has been reached among all majorities. Membership externalities and excess burden externalities work in opposite directions.

The agent ($A_1$) will be instructed more or less as follows: If you succeed in securing membership for me in the majority coalition organized in Meeting One, proceed to maximize,

$$U = (a - t_1 - t_2)^2/(2b) + (1/M)\, t_1\, (a - t_1 - t_2)/(b/N) + p\, (yt_2)/M. \qquad (6)$$

Precisely the same instructions are given to the other agent ($A_2$). These instructions direct the agents how to act if majority membership for the principal is achieved in one setting. As equation (6) indicates, the behavior dictated depends critically on the value assigned to p, which measures the probability that the principal's second agent will secure membership in the alternative majority coalition.

The first-order condition of the maximization in (6) is

$$0 = (t_1 + t_2 - a) + (N/M)(a - 2t_1 - t_2) - p\,(N/M)\,t_2$$

The reaction function obtains by solving the first-order condition above:

$$t_1\,(t_2) = \{(N - M)a - (N - M)\,t_2 - (p\,N)\,t_2\}/(2N - M)$$

And the symmetric solution is,

$$t^* = t_1 = t_2 = a\,(N - M)/(3N + p\,N - 2M)$$

When N is large, and we assume a majority coalition of minimal size, we may equate N with 2M and obtain the combined tax rate,

$$T = 2t^* = 2a/(4 + 2p) \qquad (7)$$

If we assign a value of .5 for p, the tax rate is 2a/5. Note, first, that this combined rate is higher than the rate imposed by the single majority coalition (2a/5 > a/3). Each majority coalition's action in imposing a tax generates an "excess burden" externality on the other coalition. But note, secondly, that the combined rate is smaller than the combined rate 2a/3 that emerges in the case of two independent taxing authorities. See Section II. The "membership externality" reduces the rate of tax exploitation, in this case, from 2a/3 to 2a/5 or by 4a/15. Note, further, that while the combined rate under two assigned authorities exceeds the revenue-maximizing rate (2a/3 > a/2), the combined rate under the setting with two majority coalitions falls below the revenue-maximizing rate (2a/3 > a/2 > 2a/5).

(3). Multiple Majorities

Suppose, now, that there are L majority coalitions authorized to tax the general base. Each member of the polity entertains some positive probability, p > 0, of belonging to

each of the L simultaneous coalitions. We continue to restrict the formal analysis to the model in which p = .5.

A reference member of a current coalition chooses a tax rate, $t_1$, given rate decisions of other coalitions, and maximizes her utility from the current coalition as well as her expected revenue share from membership in other coalitions. Her surplus from income generation will depend only on the total tax rate T, while her transfers come from the current and expected coalitions.

She maximizes the following utility function,

$$U = (a - T)\, x/2 + (t_1\, y)/M + p\,\{(t_2\, y)/M + \ldots + (t_L\, y)/M\}$$

$$= (a - t_1 - T_1)^2/(2b) + (t_1/M)(a - t_1 - T_1)/(b/N)$$

$$+ p\{(t_2 + \ldots + t_L)/M\}(a - t_1 - T_1)/(b/N),$$

where x is the income of the reference member, y is the aggregate income, and the combined tax rate is $T = t_1 + \ldots + t_L$. As before, the incomes x and y satisfy the linear relationship: $T = a - b\,x$ and $T = a - (b/N)\,y$.

We demonstrate that, in the limit, the outcome involves a combined tax rate that is revenue-maximizing.

The first-condition of the maximization is:

$$0 = 2(t_1 + T_1 - a)/(2b) + (N/M)(a - T_1 - 2t_1) - p\,(t_2 + \ldots + t_L)(N/M)/b$$

where $T_1 = T - t_1$. The necessary condition above can be solved for $t_1$:

$$t_1 = \{(N - M)a - (N - M)\,T_1 - pNT_1\}/(2N - M)$$

Symmetric Nash solution obtains:

$$t^* = (N\text{-}M)\,a/[(2N\text{-}M) + (N\text{-}M)(L\text{-}1) + p\,N\,(L - 1)] \qquad (8)$$

For a simple majority, we assume N = 2M and obtain a simpler expression:

$$t^* = a/[2p(L-1) + L + 2]$$

The combined tax rate will be

$$T = Lt^* = aL/[2p(L-1) + L + 2] \qquad (9)$$

Since we assume that p = 0.5, in the limit, the combined tax rate, $T = a\,L/(2L + 1)$, converges to a/2, the revenue maximizing rate. This result may be contrasted with that emergent when there are many independent taxing authorities, where the aggregate rate is always higher than a/2.

Analysis in this paper is limited to strict majority rule as the central feature of political decision-making. If the effective coalition is between N (unanimity) and (N/2) + 1 (majority), there will be less exploitation than under majority rule. Example: If decisions must be made by 2/3 members of the polity, and all possible coalitions of this size may be formed, then a representative person may expect to be a member of 2/3 of the coalitions, that is, p = 2/3. Each member of polity will internalize more membership externality than in the simple majority model. This result can be obtained by substituting M = 2N/3 and p = 2/3 in equation (8). The aggregate tax rate is $T = aL/[3p(L - 1) + L + 3]$, which is less than the combined tax rate in equation (9).

As the models examined to this point have suggested, the aggregate tax rate will remain below or at the revenue-maximizing rate in all cases where the value for p is set at .5. And we can offer a reasoned argument for the .5 value here. This value will be assigned to p if members of the inclusive polity are risk neutral and consider themselves to have equal chances to become members of any majority that may be formed, whether or not membership is secured in another majority. Such a general attitude might suggest

that participants think of the whole majoritarian process as being “fair” in one meaningful sense.

The “anti-commons” is a useful metaphor for understanding how and why potential economic value may disappear into the “black hole” of resource utilization, a wastage that may be quantitatively comparable to the over-utilization wastage employed in the conventional commons logic. We extend the discussion to several applications. We suggest that our construction is helpful in understanding the sources of major value wastage in modern regulatory bureaucracy, in federal tax system, and in monetary union.

## IV. Fiscal Commons and Regulations

Our specific objective in Buchanan and Yoon [2000d] is to describe the properties of the equilibrium solutions that emerge in settings where different majority coalitions may operate simultaneously to place transfer charges on the fisc. These charges are residually financed from the general taxable capacity of the whole polity. A central finding of the analysis is that the presence of membership externality acts to limit fiscal exploitation in a majoritarian democracy.

We extend our analysis to a setting in which general taxes are used to finance goods and services, either partitionable or nonpartitionable. We assume that each dollar’s worth of public goods is implemented from general tax revenues, upon the approval of some (any) majority coalition of citizens. It is useful to think of a whole set of collective decisions being made simultaneously by separate majority coalitions for each public

goods provision. As the tax rate increases to finance public goods spending, the marginal cost rises because of the deadweight loss caused by reduced work effort.

Basic elements of the analysis in Buchanan and Yoon [2000b, d] seem applicable to modern administrative governance. An anti-commons problem arises when there exist multiple rights to exclude usage of the common property. The anti-commons problem in which resources are inefficiently underutilized suggests that our construction is helpful in understanding modern regulatory bureaucracy. Majorities in the legislature may authorize separately acting agencies to impose regulations on the economic activities that impose costs on the whole economy. This is akin to the more direct exploitation of the productive income base through taxation. To the extent that such agencies act separately, and do not recognize the interdependency involving usage of "the commons" that is the whole productive capacity of the economy, the thrust of our analysis seems applicable.

## V. Pico-economics and Budget

A person possesses a multidimensional capacity that may be used in different ways. In "Rationality as Prudence: Another Reason for Rules" [Buchanan and Yoon, 1999], this capacity is modeled as "the commons", where open access results in value dissipation. As applied to personal choice, rationality as maximization is a "learned behavior" rather than a "natural" behavior attribute. This analysis of rationality is readily extended from individual to collective choice and budget rules. The classic commons tragedy involves the demonstration of a failure in "collective" rationality. The rules that dictate internalization of the fiscal margins are necessary to allow collective decision-makers to choose rationally so as to maximize the objective function that describes their action.

The final results of the project will be summarized in a separate paper, which incorporates the ideas expressed in “Why Constitutions matter?” [Buchanan, 1999], “The Efficacy of Arbitrary Rules” [Buchanan and Yoon, 2000e], and “Rationality as Prudence” [Buchanan and Yoon, 1999]. From the history of ideas’ perspective, we will discuss the generalized increasing returns expounded by Adam Smith and the Malthusian decreasing returns. We conjecture that economy has the tendency of increasing returns, while polity has the commons problem.

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