Public Choice **96**: 271–294, 1998.

Rent-seeking in natural resource quota allocations*

JOHN R. BOYCE
Department of Economics, University of Auckland, Auckland, New Zealand

Accepted 16 February 1996

Abstract. This paper examines the incentives for rent-seeking in the allocation of natural resource quotas to competing user groups by political bodies. The political body has discretion in making the allocation, and competing user groups rent-seek to influence the allocation. We investigate ways in which the governmental body can affect the behavior of the players by setting the ground rules for the competition. A political body can affect an allocatively (Pareto) efficient outcome by choosing an appropriate default (pre rent-seeking) policy. Surprisingly, an allocatively efficient default policy is unlikely to minimize social costs. However, winner-take-all default policies are likely to maximize, not minimize, rent-seeking. A competitive post-allocation market reduces rent-seeking, but is not, either itself or in combination with an efficient default policy, capable of minimizing social costs. However, forcing winners in political redistributions to fully compensate losers both lowers the rent-seeking levels relative to a potential compensation criterion and, when used together with an efficient default policy, is capable of obtaining the first-best solution of an allocatively efficient allocation with zero rent-seeking.

1. Introduction

A number of institutions have been created to manage and allocate common property resources. Examples include regional fishery management councils, state boards of fish and game, and subsistence hunting and fishing boards. These governmental bodies are charged with managing biological stocks and allocating harvest quotas or access among competing user groups. While both tasks are complex, it is the allocation issue that leads to the most acrimonious debates. In part this is because the allocation of scarce resources necessarily excludes some individuals or groups. Thus all potential user groups have an incentive to compete for a larger share of the allocation through the political process.

One question that arises under this system of allocation of scarce resources is the extent to which competition for shares of the allocation creates wasteful expenditures. That is, have these institutions merely replaced one sort

* This paper has benefited from comments by Diane Bischak, Ron Johnson, and an anonymous referee. The usual disclaimer applies.

of unproductive competition (open access) with another (rent-seeking)? This paper develops a model of the allocation process in which the board or council has discretion in making the allocation, and which allows competing user groups to use rent-seeking to influence the allocation, say via direct political lobbying or legal recourse through the court system.[1] We investigate ways in which the governmental body can affect the behavior of the players by setting the ground rules for the competition. In particular, we are interested in determining whether rules exist that simultaneously minimize rent-seeking expenditures and allocate efficiently (in the Pareto sense). Furthermore, if such rules exist, have these rules been adopted?

Discretion in the allocation process can be exercised whenever a board or council has available to it characteristics that allow it to distinguish among the competing groups and thereby give it a criterion on which to discriminate. Discrimination on characteristics other than willingness-to-pay do not necessarily result in maximizing the return from the resource. One example of an allocation based on characteristics other than willingness-to-pay is the allocation of hunting permits between subsistence and sport hunters in Alaska. In this case, the distinction is based on location of the individual's residence (rural and urban, respectively). Currently, subsistence hunters have priority over sport hunters on all federal lands in Alaska (sixty percent of the total land base in the state).[2] Another example is the allocation of the groundfish (e.g., cod, pollock, and halibut) quotas in the Gulf of Alaska and the Bering Sea. Here, the two groups are *i*) the vertically integrated catcher-processors and *ii*) the non-integrated on shore processors and independent catchers who supply them. Currently, the allocation in this fishery is a sixty-forty percent split, with the larger share going to the on-shore processors.[3] A third example is the allocation among different gear groups in the commercial salmon fishery in Alaska. In the Cook Inlet salmon fishery, for example, five percent of the commercial catch has been allocated to the purse seine fleet, sixty percent to the drift gill-net fleet, and thirty-five percent to the set net fleet. Boyce (1993) found that the set net fleet has a higher net return per fish caught at the margin than either the drift net or purse seine fleets. Similarly, the allocation of salmon among the commercial, sport, personal use, and subsistence user groups has traditionally favored the commercial fishery (e.g., in Prince William Sound the commercial fleet gets over ninety percent of the total allowable catch). There is some evidence that at the margin the sport fishery gets a higher economic surplus per fish than does the commercial fleet (Layman, 1994). Another example is the spatial allocation along the migration path of the Yukon River salmon. The count of fish occurs while the lower Yukon fishery is active. As a result, fishermen on the upper Yukon River have been stopped from fishing in recent years when the lower

Yukon fishery took the entire allotment of fish the management agency later determined to be the maximum allowable catch (Criddle, 1994).[4]

All of these cases involve political allocations that can change. The North Pacific Management Council decides allocations in the groundfish fishery. The federal subsistence boards make some allocation decisions in the subsistence hunting case. The Alaska Board of Fish determines the allocations among gear types within the commercial fleets and among commercial, sport, personal use, and subsistence user groups in the salmon fishery. In the hunting and groundfish examples, the rights have been substantially changed in the past, with the decision made, ultimately, at the highest levels of government (the subsistence decision by the U.S. Congress, the transferable quotas decision by the U.S. Secretary of Commerce) but with input from the boards or councils responsible.[5] The rent-seeking activities take a number of forms. In the subsistence hunting conflict, the State of Alaska legislature has met in three special sessions since 1986 in an attempt to change the State Constitution. In addition, there are currently several lawsuits in federal courts over the subsistence issue. The controversy over sport versus commercial allocation of salmon harvests has resulted in sport-fish interests placing an inititative on the state ballot in 1996 to force the Board of Fish to increase the share going to sport fishing.

The paper is organized as follows. First, a political influence model is developed for the case in which a government body must allocate a fixed quantity of a good to society. We assume that the final political allocation to the different groups depends upon the default (or initial) allocation, which may either be based on historical use or on prior political allocations, and upon the lobbying effort by the groups to influence the political allocation. Social costs are defined as *policy costs* which increase as the allocation moves away from the Pareto efficient allocation, and *rent-seeking costs* which are the expenditures on lobbying effort, etc., to increase the share of the allocation.

With this political influence model, we first investigate how selection of the initial policy affects rent-seeking. Surprisingly, we show that the default allocation that (in a second-best framework) minimizes social costs is *not necessarily* the allocatively (Pareto) efficient allocation. This is in contrast to Becker's (1983) efficient redistribution hypothesis, which predicts efficient allocations will be chosen if the initial allocation is the only policy instrument that the government controls. We also show that winner-take-all allocations to either the group with the lowest net value of the allocation or to the group with the highest rent-seeking costs will maximize rent-seeking waste.

Second, we investigate the effect of post-allocation markets on the level of rent-seeking. Such markets exist in a number of cases. For example, in

Northwest Territories, Canada, polar bear hunts have been allocated exclusively to local Hunting and Trapping Associations, and the rights to the hunt are transferable (Stirling, 1991).[6] In the Alaska groundfish fishery, the government is moving from open access to an institution where fishermen own transferable quotas. Interestingly, however, transfers are only allowed *within* groups. Transfers are not allowed *between* groups. This is not the only case where this sort of restriction occurs: The limited entry program for the commercial salmon fishery prohibits transfers between different gear groups and between non-commercial groups and commercial groups.[7] Sometimes there is a prohibition on all transfers. In the allocation of hunting rights in Alaska, subsistence users have exclusive first priority, but the rights are not transferable.[8] In addition, indigenous peoples are the only ones who may hunt marine mammals such as polar bears in Alaska. Restrictions on market transfers lower the value of the good to the winner in the political allocation by restricting the use of the right. They also eliminate the possibility of obtaining the good via alternate means from the political process. In the case that a competitive post-allocation market is allowed, we show that the level of rent-seeking expenditures is reduced since the post-allocation market provides an alternative method of increasing one's share to rent-seeking. Thus restrictions on post-allocation markets increase rent-seeking expenditures.

Finally, rules regarding the compensation of losers in political allocations can also affect the level of rent-seeking. Welfare economists have concluded that in government redistributions, winners need only be able to compensate losers (Scitovsky, 1941); no actual compensation has to occur.[9] We show that requiring actual compensation for losses in the political market-place reduces rent-seeking activities because it raises the cost of getting a larger share through the government. Thus, the potential compensation criterion encourages rent-seeking. Buchanan and Stubblebine (1962) have also argued for an actual compensation criterion based on efficiency grounds.

2. Rent-seeking model

The rent-seeking literature was initially developed by Tullock (1967), Krueger (1974), and Posner (1975). This literature is generally concerned with the level of waste due to the rent-seeking.[10] There are a number of variations on the way the rent-seeking occurs. In an imperfectly discriminating rent-seeking contest (Tullock, 1980), the winner (in a winner-take-all contest) is determined stochastically. Rent-seeking occurs because competitors can increase their chances of winning by increasing expenditures. In contrast, in a perfectly discriminating rent-seeking contest, the competitor making the largest outlay wins the contest (e.g., Hirschleifer and Riley, 1978; Hillman

and Samet, 1987; Hillman, 1989). The imperfectly discriminating model has been extended in several directions. Hillman and Katz (1984), Hillman and Samet (1987), and Van Long and Vousden (1987) have considered different variations where the competitors are risk averse. Hillman and Riley (1989) and Leninger (1993) have considered the case where the competitors have different valuations of the good. Van Long and Vousden (1987) have considered the case where the rents are divisible and rent-seekers are risk-averse. More recently, the attention has shifted to models where there exists a certain degree of public goodness to the rents, or where the competition is dynamic. Katz, Nitzan and Rosenberg (1990) and Ursprung (1990) consider the case with pure public goods. Nitzan (1991) has considered contests where the rent-seeking competition has a public good nature, but the allocation within the winning group may either be based on effort or upon an egalitarian rule. Linster (1993) has considered games where the public good is impure. Dynamic rent-seeking games have been analyzed by Cairns (1989), Leninger (1993), and Wirl (1994).

In a related set of literature (Stigler, 1971; Peltzman, 1976; and Becker, 1983), various interest groups compete for political influence (see also Wenders, 1987; Ellingsen, 1991).[11] This literature has mainly been occupied with the question of what types of groups are likely to win in political allocations, and whether or not the political allocations are efficient.[12] In general, this literature has used a perfectly discriminating model of competition (however, see Ellingsen, 1991), and has assumed that the allocation is divisible. In this paper, we consider a model of competition in which 1) there is perfect discrimination in the allocation,[13] 2) the allocation is divisible both between groups and within groups, and 3) the allocation within the group is efficient (e.g. based on effort, Nitzan, 1991). Our concern here is with various institutional frameworks and their effect upon the level of rent-seeking waste.

Suppose that a government has X units of a good that it plans to allocate. For example, let X be the number of animals a particular biological species is able to produce annually for hunting or fishing. Assume that there are two groups, left and right (L and R), who desire access to the resource. Let x denote the share to group R and X–x the share to group L. The marginal willingness to pay is $v_i(x_i)$, where $v_i' < 0$, for quantity x_i of the allocation, $i = L,R$. Total willingness to pay for the ith group is the integral of the area under the marginal willingness-to-pay (demand) function,

$$V_i = \int_0^{x_i} v_i(q)dq, \qquad i = L, R \tag{1}$$

V_i represents the maximum that group i is willing to pay to obtain x_i units of the good since this is the entire gross benefit received by the group if it gets

allocation x_i. Let X_i denote quantity of the resource that each interest group prefers R to get in the allocation. Assuming that each group has a positive marginal willingness to pay for the last unit if they get the full allocation implies $X_R = X$, and $X_L = 0$.

The final allocation that each group receives depends only upon two things: the initial allocation, which is selected by the government, and the change in the initial allocation resulting from political competition. The transfer contest is assumed to be perfectly discriminating and the allocation is divisible. Let the final allocation given to group R be

$$x = x_o + x_R - x_L, \tag{2}$$

and the final allocation to group L is X-x, with x_R and x_L the *effective* political pressure, measured as the gross change in share of the allocation from the initial political allocation x_o for groups L and R, respectively. As X is the total quantity available, the final allocation is bounded by $X_L = 0 \leq x \leq X_R = X$. It will be convenient to conduct the analysis in terms of minimizing costs for each group. Define the *policy costs* to group i as the cost of not getting the entire allocation. Thus,

$$c_R(X_R - x) = \int_x^{X_R} v_R(q)dq, \text{ and } \quad c_L(x - X_L) = \int_{X_L}^{x} -v_L(q)dq. \tag{3}$$

These are shown if Figure 1 for a given allocation x. Note that under this formulation, there are "policy costs" even if the allocation is efficient in the sense that $v_R = v_L$ (point x^* in Figure 1). However, such an allocation minimizes total policy costs. The properties of the policy cost functions are: *i*) $c_i(0) = 0$, *ii*) $c_i'(d_i) > 0$, and *iii*) $c_i''(d) > 0$ for a policy distance d_i from the group's preferred policy. Property *i* implies that a group incurs no policy costs if it gets the entire allocation ($d_i = 0$). Properties *ii* and *iii* imply that a groups' policy cost increases as the distance between what it prefers and what it gets increases, and that it increases at an increasing rate. Property *iii* thus is similar to Becker's (1983) assumption that deadweight loss triangles increase at an increasing rate as one moves away from the efficient allocation (Figure 1). Here, a policy which is efficient in the sense of Becker will be one which minimizes the sum of the policy costs, implying $c_R'(X_R\text{-}x^*) = c_L'(x^*\text{–}X_L)$ at an efficient policy x^*.

Assume that effective political pressure can be obtained at cost $w_i(x_i)$, where $w_i' > 0$ and $w_i'' > 0$.[14] The social cost of political pressure is thus the sum of the rent-seeking expenditures $w_R + w_L$ plus deadweight loss if the allocation is not Pareto efficient.[15] The cost functions may depend upon a number of factors such as group size (e.g., Olson 1965; Peltzman, 1976;

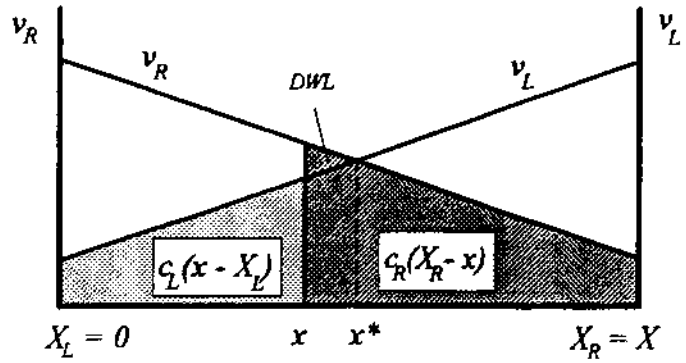

Figure 1. Policy costs of allocation x

Becker, 1983) and heterogeneity (e.g., Olson 1965; Johnson and Libecap, 1982; Libecap and Wiggins, 1985). These factors are ignored in what follows except so far as they affect the cost function w_i.

The cost to group i given the final allocation x is the sum of policy and rent-seeking costs:

$$C_R(x_R) = c_R(X_R - x) + w_R(x_R), \tag{4a}$$

$$C_L(x_L) = c_L(x - X_L) + w_L(x_L), \tag{4b}$$

with x defined by (2) and c_i by (3). Social costs are thus $C_S = C_R + C_L$.

Following Becker (1983), the solution to the rent-seeking optimization problem given the initial allocation by the government is for each group to choose the level of political pressure that maximizes (4). Assuming Becker-Nash behavior, each group chooses rent-seeking expenditures to solve

$$\partial C_R/\partial x_R = -c'_R(X_R - x_o - x_R + x_L) + w'_R(x_R) = 0, \tag{5a}$$

$$\partial C_L/\partial x_L = -c'_L(x_o + x_R - x_L - X_L) + w'_L(x_L) = 0. \tag{5b}$$

Under Becker-Nash behavior, political pressure is applied to the point where the marginal value of the good "purchased" by the political pressure ($c'_i = v_i$) is equal to the marginal cost of implementing the political pressure. The slope of the reaction functions ϕ_R and ϕ_L for groups R and L in x_L-x_R space, defined implicitly by (5a) and (5b), respectively, are:

$$\partial x_R/\partial x_L \mid \phi_R = c''_R/(c''_R + w''_R), \tag{6a}$$

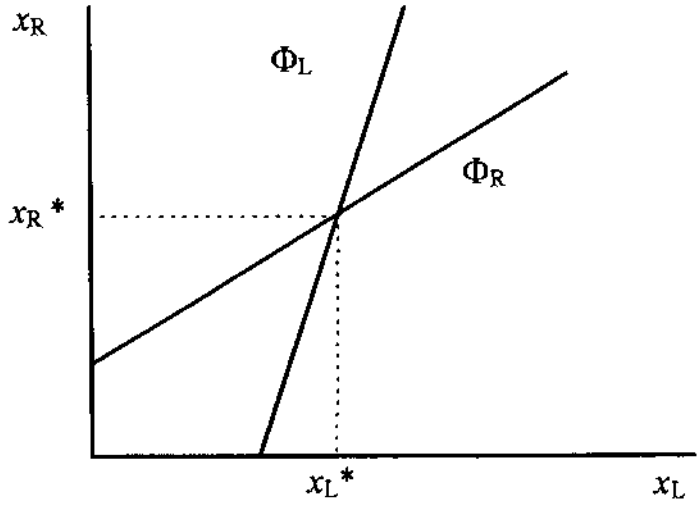

Figure 2. Optimal political pressure

$$\partial x_R/\partial x_L \mid \phi_L = (c_L'' + w_L'')/c_L''. \tag{6b}$$

Thus, both reaction functions are positive sloped, and the slope of the reaction function ϕ_L is less than unity for group L, and the slope of the reaction function ϕ_R is greater than unity for group R. As long as the intercept for group L is above the intercept for group R, there will be a unique and stable equilibrium to the rent-seeking competition. This is shown if Figure 2, and is qualitatively identical to Figure 1 in Becker (1983: 379).

It will be useful to examine the comparative statics of the Becker-Nash equilibrium with respect to the initial policy x_o:

Lemma: The level of effective political pressure applied by group L increases with an increase in the initial allocation x_o to group R and the level of effective political pressure applied by group R decreases with an increase in the initial allocation x_o.

Proof: Totally differentiate the pair of first order conditions (5) to obtain,

$$\begin{pmatrix} c_R'' + w_R'' & -c_L'' \\ -c_R'' & c_L'' + w_L'' \end{pmatrix} \begin{pmatrix} dx_R \\ dx_L \end{pmatrix} = \begin{pmatrix} -c_R'' \\ c_L'' \end{pmatrix} dx_o, \tag{7}$$

Assuming convexity of the c_i and w_i functions, the determinant of the matrix H on the left-hand-side of (7) is $|H| = (c_R'' + w_R'')(c_L'' + w_L'') - c_R''c_L'' > 0$.[16] The

expressions in the lemma follow by applying Cramer's rule. I.e., $\partial x_R/\partial x_o = -c''_R w''_L/|H| < 0$ and $\partial x_L/\partial x_o = -c''_L w''_R/|H| > 0$. •

The lemma says that rent-seeking by the each group will decrease if that group gets a larger initial share. It can also be shown that rent-seeking levels for both groups will increase if the either of the policy cost functions shift up (e.g., if the group demand for the good shifts out for either group) or if rent-seeking costs are lowered for either group (e.g., Tullock, 1980; Becker, 1983; Corcoran, 1984).

Empirical studies of rent-seeking expenditures such as Hazlett and Michaels (1993) and Dougan and Snyder (1993) have reported less than complete rent dissipation. Since we assume that political influence can only be purchased at an ever increasing cost, rent-seeking completely dissipates the rents at the margin, but not infra-marginally. This coincides with findings by Tullock (1980) which are predicated on there being imperfect discrimination for the rents (i.e., the winner is chosen stochastically). It also coincides with models where agents are risk averse (Hillman and Katz, 1984; Hillman and Samet, 1987; Van Long and Vousden, 1987), where the rent-seekers have asymmetric valuations of the good (Hillman and Riley, 1989; Van Long and Vousden, 1987), and where there is a public good characteristic associated with the good (Katz, Nitzan, and Rosenberg, 1990; Ursprung, 1990; Nitzan, 1991).

3. The initial allocation and the efficient redistribution hypothesis

One of the important conclusions reached by Becker in his analysis of (essentially) the preceding model is the "efficient redistribution hypothesis." Becker states:

> The cost of many programs, such as agricultural price supports or oil entitlements, has often seemed distressingly large. Yet this proposition implies that politically successful programs are "cheap" relative to the millions of programs that are too costly to muster political support, where "cheap" and "expensive" refer to marginal deadweight costs, not to the size of the taxes or subsidies (1983, p. 381).

Becker goes on to state an extreme form of the redistribution hypothesis where if groups are "the same size, ... equally efficient at producing pressure, ... and equally important in the 'influence function'" then allocations will be efficient in the sense that $c'_R = c'_L$ (*cf.* Becker's equation (18), p. 382, with lump sum taxes and subsidies). Becker, of course, recognized that this is an extreme form of the hypothesis, stating "the presumption must be that heavily subsidized groups, such as sugar growers and dairy farmers in the United States, not only can redistribute with relatively low deadweight cost, but also

overcome their intrinsic disadvantage with political appeal and efficiency" (p. 382). However, there has been a substantial amount of research directed at showing that redistributions are efficient in the sense that deadweight loss costs are minimized (e.g., Gardner, 1983, 1987, 1993; Antle and Johnson, 1991; Gisser, 1993; Constantine, Alston, and Smith, 1994). The purpose here is two-fold: first to show that the outcome of efficiency depends upon the initial policy or the status quo in addition to the factors Becker mentions, and second to show that an efficient outcome in terms of minimizing policy costs is not efficient in terms of minimizing social costs except under very strong assumptions.

Becker's *influence function* is essentially what we are calling the policy cost functions. Assume that $c_R(d) = c_L(d) \equiv c(d)$ for some function c such that $c' > 0$ and $c'' > 0$ for a given distance $d \geq 0$. This implies that each interest group is "equally important in the influence function." Second assume that the rent-seeking cost functions are also identical so that $w_R(z) = w_L(z) \equiv w(z)$, with $w' > 0$ and $w'' > 0$ for effective political pressure levels z. We may now state:

Proposition One: If interest groups have equal policy costs [$c_R(d) = c_L(d) \equiv c(d)$ for $d \geq 0$] and equal rent-seeking costs [$w_R(z) = w_L(z) \equiv w(z)$ for $z \geq 0$], the outcome of the Becker-Nash political competition will be allocatively efficient ($c'_R = c'_L$) if and only if the initial policy x_o is allocatively efficient.

Proof: Suppose the initial allocation is not allocatively efficient, i.e., $c'(X_R - x_o) \neq c'(x_o - X_L)$. Allocative efficiency of the final policy implies:

$$c'(X_R - x_o - x_R + x_L) = c'(x_o - x_R + x_L - X_L). \tag{8}$$

However, if the final allocation is allocatively efficient, the Becker-Nash first-order conditions imply:

$$w'(x_R) = c'(X_R - x_o - x_R + x_L) = c'(x_o - x_R + x_L - X_L) = w'(x_L). \tag{9}$$

Since $w_R(z) = w_L(z)$ for all $z \geq 0$, $x_R = x_L$. This contradicts the premise that $c'(X_R - x_o) \neq c'(x_o - X_L)$. •

The point is that history matters. It is not enough that groups are identical in rent-seeking costs and in policy costs to obtain allocatively efficient political outcomes. It also requires that the status quo policy be efficient. Note also that $c_R(d) = c_L(d)$ for all $d \geq 0$ is not necessary to obtain the result that if the initial allocation is allocatively efficient then the final allocation will also be allocatively efficient.

Next, consider how selection of the initial policy affects social costs. Suppose that the initial policy is chosen such that the final outcome will be efficient. That is, given the Becker-Nash competition, suppose x_o^* is chosen such that

$$c_R'[X_R - x_o^* - x_R(x_o^*) + x_L(x_o^*)] = c_L'[x_o - x_R(x_o^*) + x_L(x_o^*) - X_L], \quad (8')$$

where $x_i(x_o^*)$ are the Becker-Nash equilibrium levels of rent-seeking behavior satisfying (5).

Proposition Two: Choosing x_o^* such that an efficient allocation ($c_R' = c_L'$) results does not minimize total social costs unless policy costs and rent-seeking costs are identical for each group.

Proof: The value x_o^{**} that minimizes $C_s = C_R + C_L$, given x_R and x_L must satisfy (5), is given by:

$$\partial C_s/\partial x_o = -[1 - \partial x_L/\partial x_o]c_R' + [1 + \partial x_R/\partial x_o]c_L' = 0. \quad (10)$$

From the lemma, the final outcome can be allocatively efficient if and only if

$$\partial x_L/\partial x_o = c_L'' w_R''/|H| = c_R'' w_L''/|H| = -\partial x_R \partial x_o.$$

which occurs only if both policy costs are identical, $c_R(d) = c_L(d) \equiv c(d)$, and rent-seeking costs are identical, $w_R(z) = w_L(z) \equiv w(z)$. •

The point is that whether or not the efficient redistribution hypothesis is supported empirically is irrelevant for judging whether policies are selected in such a way as to minimize total costs, including rent-seeking costs. The efficient redistribution hypothesis focuses only on policy costs, not on policy plus rent-seeking costs. Note also that if policy costs and rent-seeking costs are identical, choosing the efficient allocation is trivial: simply divide the quota equally between the two groups.

4. The initial allocation and winner-take-all allocations

Some political allocations are "winner-take-all" in nature, even though the resource being allocated is divisible. An example of this sort of allocation is the Marine Mammals Act (1972) which specified that marine mammals could only be hunted for "subsistence" purposes. Prior to this act, marine mammals such as polar bears could be hunted either for subsistence or sport purposes. Thus the act had the effect of making a winner-take-all allocation to

subsistence hunters. Similarly, a number of environmental laws in the United States are winner-take-all. For example, the Wilderness Act (1964) created land management specifications where some types of usage (development) were forbidden on lands with those specifications. Similarly, the Endangered Species Act (1973) prohibits use of endangered species habitat for economic use. Indeed, some of the most bitterly contested environmental issues – the spotted owl, old-growth forest, the snail darter – have all developed over a winner-take-all allocations.

In this section, we consider winner-take-all allocations in the context of the choice of the initial policy selection x_o.[17] We have seen in (10) how x_o may be selected to minimize social costs. It is unlikely that this results in a corner solution. Indeed, for the case where rent-seeking and policy costs are identical for both groups, the social cost minimizing initial allocation (second-best) is to choose $x_o = X/2$, which is the efficient allocation. Now consider a Niskanen-like (1971) government wishing to *maximize* rent-seeking costs. Such an objective might be conceivable if the government is the recipient of a portion of the rent-seeking costs either through an expanded budget (more commissions, hearings, etc.) or as campaign contributions, lobbying favors, etc. Let $W = w_R + w_L$ be total rent-seeking costs. The first-order condition for maximizing W with respect to choice of x_o is:

$$\partial W/\partial x_o = [\partial x_R/\partial x_o]w'_R(x_R) + [\partial x_L/\partial x_o]w'_L(x_L) = 0. \tag{11}$$

Consider, however, the second-order condition:

$$\begin{aligned}\partial^2 W/\partial x_o^2 = {} & [\partial x_R/\partial x_o]^2 w''_R + [\partial x_L/\partial x_o]^2 w''_L + [\partial^2 x_R/\partial x_o^2]w'_R \\ & + [\partial^2 x_L/\partial x_o^2]w'_L.\end{aligned} \tag{12}$$

For a maximization, the second order condition must be negative. The first two terms on the right-hand-side of (12) are positive, while the third and fourth terms are ambiguous in sign (depending upon third derivatives of c_i and w_i). While in general it is possible for the second-order conditions to be satisfied, it is possible that they are not. For example, in the case where c_i and w_i are quadratic functions, the $\partial^2 x_i/\partial x_o^2$ terms are zero, implying second-order conditions are violated. This indicates that maximization of rent-seeking will occur at a corner solution. The question is which one? Unfortunately, this does not involve a simple comparison in general functional forms. However, some intuition can be gained by examining a simple example that is quadratic in each of the cost functions c_i and w_i, e.g., $c_i(d_i) = \gamma_i[d_i]^2$ for $d_i \geq 0$, and $w_i(z_i) = \omega_i[z_i]^2$ for $z_i \geq 0$, for $\gamma_i > 0$ and $\omega_i > 0$. In this event, the following can be shown:

Proposition Three: With quadratic cost functions, rent-seeking is maximized if the initial allocation involves the corner solution where *i*) the full allocation goes to the group with the *smallest* policy cost if $w_R(z) = w_L(z)$ for all $z \geq 0$, and *ii*) the full allocation goes to the group with the *largest* rent-seeking costs if $c_R(d) = c_L(d)$ for all $d \geq 0$.

Proof: i) Assume $V_L = [x - X_L]^2 + \omega[x_L]^2$ and $V_R = \gamma_R[X_R - x]^2 + \omega[x_R]^2$, where $\gamma_R > 1 = \gamma_L$ and $\omega_R = \omega_L = \omega > 0$. In this case, the Becker-Nash equilibrium values of x_R and x_L can be shown to equal:

$$x_R = \frac{\gamma_R[X_R - X_L + \omega(X_R - x_o)]}{\omega + \omega\gamma_R + \omega^2}, \quad x_L \frac{\gamma_R(X_R - X_L) + \omega(x_o - X_L)}{\omega + \omega\gamma_R + \omega^2}.$$

Define $W(X_R)$ and $W(X_L)$ to be the values of the rent-seeking expenditures $W = w_R + w_L$ when $x_o = X_R$ and $x_o = X_L$, respectively. Then it can be shown that:

$$W(X_R) - W(X_L) = \frac{(1 - \gamma_R)(2\gamma_R + \omega + \omega\gamma_R)(X_R - X_L)^2}{(1 + \omega + \gamma_R)^2} < 0,$$

since $\gamma_R > 1$. Thus proving *i*.

ii) Now assume $V_L = \gamma[x - X_L]^2 + [x_L]^2$ and $V_R = \gamma[X_R - x]^2 + \omega_R[x_R]^2$, where $\omega_R > 1 = \omega_L$ and $\gamma_R = \gamma_L = \gamma > 0$. In this case, the Becker-Nash equilibrium values of X_R and X_L can be shown to equal:

$$x_R = \frac{\gamma[X_R - x_o + \gamma(X_R - X_L)]}{\gamma + \omega_R + \gamma\omega_R}, \quad x_L = \frac{\gamma[\omega_R(x_o - X_L) + \gamma(X_R - X_L)]}{\gamma + \omega_R + \gamma\omega_R}.$$

Let $W(X_R)$ and $W(X_L)$ be defined as above. Then, it can be shown that:

$$W(X_R) - W(X_L) = \frac{\gamma^2\omega_R(\omega_R - 1)(X_R - X_L)^2}{(\gamma + \omega_R\gamma\omega_R)^2} > 0,$$

since $\omega_R > 1$. Thus proving *ii*. •

The intuition of the first result can be seen in Figure 3. When R values the good higher than L, it incurs the largest policy costs of having zero allocation. Thus the *gains from trade* are larger if L gets the entire initial allocation than if R gets it. The gains from trade measure the difference in policy costs between R and L of the allocation X_L. It is these gains from trade which constitute the source of the rent-seeking. Thus, in a winner-take-all allocation, giving the entire allocation to the group which places the least value on the resource maximizes the rent-seeking activity. The second result is slightly more subtle. In this case, the policy costs are identical, but R has higher costs

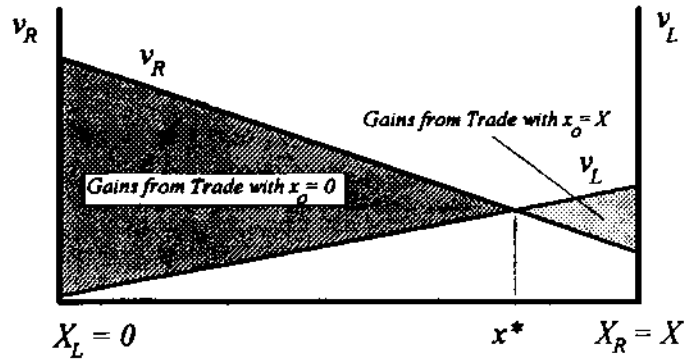

Figure 3. Gains from trade from winner-take-all allocation

of applying political pressure than does L. In this case, rent-seeking is largest with R getting the entire allocation since L is more likely to rent-seek than is R.

Whether or not the winner-take-all allocations mentioned above fit either of these cases is an empirical question. It is likely that environmentalists have higher rent-seeking costs than do developers since the environmentalists face higher free-rider problems and since developers have higher benefits per member. Thus winner-take-all allocations such as wilderness designation of areas would, in the case where each side has equal value on the alternative uses, maximize rent-seeking activities by allocating such that the group with lowest rent-seeking costs gets zero initial allocation.

5. Post-allocation markets and rent-seeking

Some political allocations of natural resource quotas have prohibitions on the resale of the quota by the winning group. For example, in North America arctic polar bears are hunted for both sport and subsistence purposes. In the U.S., the Marine Mammal Protection Act (1972) prohibits sport hunting, but does allow indigenous Alaskans to engage in subsistence hunting of polar bears (e.g., Bean, 1983). In Northwest Territories, Canada, similar legislation has given local Hunter's and Trapper's Associations (HTAs) the full quotas for polar bear hunts.[18] However, in Canada, the HTAs are allowed to sell their quota of hunts to sport hunters.[19] The U.S. law clearly creates extremely high transactions costs (Coase, 1960) since selling the permit to a sport hunter is illegal. The question we wish to address is what effect does prohibiting post-allocation markets have on rent-seeking expenditures?

We assume that the goods granted are of the private good sort (such as hunting permits). Thus, once the political allocation has been made, it is individuals who may buy or sell the goods.[20] In this case, it is plausible to assume that the post-allocation market is competitive, even thought the rent-seeking market is imperfectly competitive. If the post-allocation market is competitive, then the ultimate allocation is efficient so long as there are no externalities or public goods problems excluded from the analysis. The market price will be such that[21]

$$p = c'_R(X_R - x_m) = c'_L(x_m - X_L), \tag{13}$$

where the market clearing quota allocation to group R, x_m, is given by:

$$x_m = x_o + x_R - x_L + y_R, \tag{14}$$

where x_R and x_L are defined as before and y_R is the quantity of quotas purchased ($y_R > 0$) or sold ($y_R < 0$) at market price p by group R. Market clearing implies

$$y_R = -y_L, \tag{15}$$

In addition, if R is buying then $y_R \leq X\text{-}x$ and if R is selling, $y_L \leq x$. Indeed, (13) only holds under the assumption that each inequality is strict. However, these restrictions will be ignored in what follows. The objective function for each group is to minimize

$$\tilde{C}_R = c_R(X_R - x_m) + w_R(x_R) + py_R, \tag{16a}$$

$$\tilde{C}_L = c_L(x_m - X_L) + w_L(x_L) + py_L, \tag{16b}$$

The system of first-order conditions in the choice variables x_i and y_i are:

$$\partial\tilde{C}_R/\partial x_R = -c'_R + w'_R = 0, \quad \partial\tilde{C}_R/\partial y_R = -c'_R + p = 0, \tag{17a}$$

$$\partial\tilde{C}_L/\partial x_L = -c'_L + w'_L = 0, \quad \partial\tilde{C}_L/\partial y_L = -c'_L + p = 0, \tag{17b}$$

Thus,

$$w'_R(x_R) = p = w'_L(x_L), \tag{18}$$

which implies that rent-seeking is bounded from above by the market price. This, of course, makes sense. There are two methods by which a group might

obtain an increase in the allocation: by rent-seeking or by purchasing it in the post-allocation market. Thus, at the margin, each group is indifferent between purchasing additional shares by rent-seeking or by the market. In the case where no post-allocation market exists, rent-seeking expenditures are not bounded from above by the market price. Thus it is likely that rent-seeking expenditures will be larger without a post-allocation market.

A more interesting result has to do with comparing the instrument of post-allocation markets with the instrument of choosing x_o. In each case, it is possible to obtain an allocatively efficient outcome. In the case of the post-allocation market, this occurs as a result of the competitiveness of the market. In the selection of x_o, it has to do with setting the initial allocation in such a way as to obtain an allocatively efficient outcome given the Becker-Nash political pressure competition. Let us state:

Proposition Four: Rent-seeking costs are identical with a post-allocation market as in the case where the government chooses x_o such that the political competition results in an allocatively efficient outcome.

Proof: In each case, the final outcome is allocatively efficient, implying that $c'_R(X_R - x^*) = c'_L(x^* - X_L)$. However, the Becker-Nash first-order conditions under each case imply:

$$w'_R(x_R) = c'_R(X_R - x*) = p = c'_L(x^* - X_L) = w'_L(x_L). \qquad (19)$$

Inspection of (9) reveals that it is identical to (19). •

Knowing which initial policy results in an allocatively efficient allocation, of course, requires a tremendous amount of information. In this sense, a post-allocation market appears to be a superior instrument for reducing rent-seeking activities relative to the much more expensive (extra-model) instrument of choosing x_o to affect the allocatively efficient outcome.

However, it should be noted that while rent-seeking costs are identical under the two instruments, this does not mean that a post-allocation market, by itself, is capable of minimizing total social costs $\tilde{C}_S = \tilde{C}_R + \tilde{C}_L$. It can be shown that the value of x_o which minimizes C_S is identical to the value of x_o which minimizes C_S. That solution was given in (10). As in (10), the only case where x_o* happens to also be allocatively efficient is the trivial case where $w_R(z) = w_L(z)$ for all z, and $c_R(d) = c_L(d)$ for all d. As before, if these extreme conditions hold, choosing the initial allocation is as trivial as simply giving each group equal shares.

6. The compensation criterion and rent-seeking

The government could also alter the rent-seeking rules by allowing groups to impose pressure to change the initial political allocation, but requiring that the winners compensate the losers for changes from the initial allocation. In this section, we investigate the effect on rent-seeking of such a set of rules. Such a criterion exists, for example, in the "takings" clause of the U.S. Constitution. It is fair to say that most economists would argue that actual compensation of losers by winners in a political redistribution is *not* necessary on purely efficiency grounds. Indeed, modern welfare economics has adopted the "potential compensation criterion" as the appropriate measure of welfare. However, the potential compensation criterion measure does not take into account rent-seeking expenditures. Recall from (7) that even if the government chose an efficient initial allocation, there will still exist rent-seeking expenditures if no compensation is required. Will the rent-seeking vanish if compensation is required for changes in the initial political allocation if the initial allocation were efficient? If the initial allocation is not efficient, will rent-seeking move the allocation to the efficient point? In this section, we examine these questions in the narrow context where the compensation requirement is applicable to changes from the initial allocation, i.e., for the difference $-x-x_0-$.

Let us suppose that losers in the political reallocation are just compensated for their losses. This is the minimum compensation possible to leave the losing group as well off as with the initial allocation. Thus it will give the greatest incentive to rent-seek among possible compensation schemes in which the losers are at least fully compensated for their losses. Suppose also that the initial allocation favors one group, but that the political allocation favors the other (since this is where the gains from trade lead the rent-seeking). By construction, let the winning group in the political reallocation be group R and the losing group be group L. Consider the problem faced by the winning group (R) when the government allows rent-seeking to change the initial allocation, but requires the losers be just compensated. Assume also that post-allocation markets are prohibited. It is easy to show that the rent-seeking under an actual compensation scheme moves the allocation towards the efficient allocation. If the political competition were to move the allocation away from the efficient allocation, the winners could not compensate the losers. (For the same reason, if the initial allocation is allocatively efficient, then no rent-seeking will occur since neither group can afford to compensate the other.) Thus the group with a smaller share than is allocatively efficient in the initial allocation ultimately will be the one which gains quote shares in the political allocation.

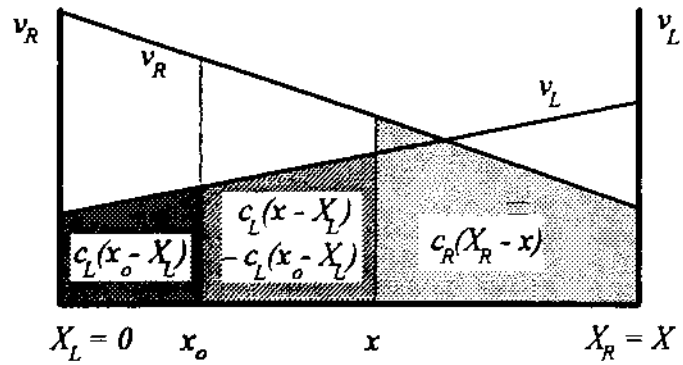

Figure 4. Rent-seeking and the compensation criterion

Figure 4 shows the policy costs plus compensation costs to each group after the final allocation. Group R faces two types of costs. The net returns to group R can are given by (see Figure 4),

$$\hat{C}_R = c_R(X_R - x) + w_R(x_R) + c_L(x - X_L) - c_L(x_o - x_L), \qquad (20)$$

where the first two terms are the policy plus rent-seeking costs and the third and fourth terms comprise net compensation costs, and x is given by (2). The losing group, group L in this case, faces the following costs:

$$\hat{C}_L = c_L(x_o - X_L) + w_L(x_L). \qquad (21)$$

Note that optimization of (21) by L results in a particularly simple solution: an increase in x_L does not reduce policy costs, it only increases rent-seeking costs. Therefore, the optimal policy is $\hat{x}_L* = 0$.

Now, consider R's optimization problem. The optimal x_R must satisfy:

$$\partial \hat{C}_R / \partial x_R = -c'_R(X_R - x) + w'_R(x_R) + c'_L(x - X_L) = 0, \qquad (22)$$

which states that marginal policy costs, c'_R, equal the sum of marginal rent-seeking costs plus marginal compensation costs. Thus we conclude:

Proposition Five: Social rent-seeking costs are reduced if an 'actual compensation criteria' is adopted rather than a 'potential compensation criteria'.

Proof: Since $\hat{x}_L* = 0$ with an actual compensation criteria and $x_L* > 0$ with a potential compensation criteria, it only remains to be shown that $\hat{x}_R* < x_R*$. This is shown by noting that there are two effects. First, since the reaction

function ϕ_R is positive sloped, a reduction in x_L causes $\hat{x}_R*$ to be smaller than x_R*. Second, from (22), $\hat{x}_R* < x_R*$ since for any given $\hat{x}_L$, the reduction in policy costs obtained by an additional amount of rent-seeking are equated with not just rent-seeking costs at the margin, but with rent-seeking plus compensation costs. Both effects thus cause $\hat{x}_R$ to be reduced. •

Note that rent-seeking is not, in general, eliminated by imposing an actual compensation criteria rather than a potential compensation criteria. However, in the case where the initial allocation is chosen to be allocatively efficient, this plus an actual compensation criteria results in zero rent-seeking *and* in an allocatively efficient allocation. Thus, when used in conjunction with an efficient initial distribution, the actual compensation criteria results in a first-best solution to minimizing social costs. It is not surprising that it takes two instruments to obtain the first-best solution since there are two sources of social costs. However, no other combination of policy instruments appears capable of simulteneously resulting in Pareto efficiency and eliminating rent-seeking expenditures.

7. Discussion and conclusions

By virtue of its role as a rules maker, the government is in a perfect position to design rules that affect the nature of competition between groups. Becker (1983) predicts that the government will offer "efficient" institutions through the competition to become the governing party (see also Gardner, 1983, 1987, 1993; Antle and Johnson, 1991; Gisser, 1993; Constantine, Alston, and Smith, 1994). The model in this paper is similar to Becker's model, both in terms of the competition between pressure groups and in our search for an efficient institution. However, we find that the allocation that is allocatively efficient in the Pareto sense is *not* the one that minimizes social costs except under exceedingly restrictive assumptions.

The institutions studied in this paper do not appear to minimize rent-seeking. A number of the institutions we studied allow a market to function after the political allocation has been made. Examples include subsistence and sport hunting permits. Exceptions include the polar bear hunting permits in Canada's Northwest Territories, commercial transferable quotas, and transferable limited entry permits. Not surprisingly, this has given the owners of the permanent quotas an incentive to manage the biological populations with more care than is observed elsewhere (e.g., Stirling, 1991). The restrictions on trading in the other examples force the competing groups to expend resources competing in the political market. Conversely, if a market is allowed, it becomes an alternative to the political process, and more substitutes gener-

ally lowers economic rents. The same is true of rent-seeking expenditures. If there is a market alternative, then rent-seeking is reduced.

Our model also sheds some light on the effect of the "potential compensation criterion." In a rent-seeking society, forcing winners in political allocations to compensate the losers increases the cost of rent-seeking and thereby decreases the level of rent-seeking expenditures by both potential winners and potential losers in the political competition. Interestingly, under this interpretation the "takings" clause in the U.S. Constitution appears an attempt by the Founding Fathers to decrease rent-seeking behavior. However, in the institutions we have studied, we have found no other case of actual compensation of the losers by the winners. It appears that the institutions are not designed to minimize rent-seeking expenditures.

If we accept these findings as indications that the institutions actually promote rent-seeking activities (e.g., Niskanen, 1971; Romer and Rosenthal, 1979), then we are led to the conclusion that the government's propensity to side with underdogs (e.g., the smaller operators in the groundfish fishery or the indigenous people in the subsistence hunting example) can be explained by recourse to factors other than ideology (e.g., Kalt and Zupan, 1984). In particular, giving a larger share to the underdogs promotes rent-seeking, especially if accompanied by limitations on post-allocation trading and on compensation of losers in the political process.

In short, it appears that the institutions we have studied have replaced the rent-dissipation from open access with an institution that allows rent-dissipation through rent-seeking. The advantage of the rent-seeking institution over the open access institution is that it is more difficult to dissipate fully the rents in the rent-seeking model than in the open access model. Nevertheless, there appears to be room for improvement in the economic efficiency of these institutions.

Notes

1 Throughout the paper, we ignore the potential rent-dissipation that might be caused by not fully defining the property rights after the allocation has been made. For example, the limited entry program in Alaska's commerical salmon fisheries changed the property system from one of open access to one of common property. In both cases there exists an incentive to race for fish. However, we are concerned with the rent-dissipation due to competition at the political level for access or quota shares.

2 The Alaska Statehood Act of 1958 gave the state management over fish and game on both federal and state lands (except in national parks). The "common use" clause of the Alaska State Constitution (Article III, Section 3) prohibits granting exclusive rights for use of natural resources. (Thus the limited entry program in the salmon fisheries required a constitutional amendment when implemented in 1973.) However, the Alaska National Interest Land Conservation Act of 1980 (Title XIII) required the "rural preference" on

federal lands to ensure a subsistence priority. (This law was opposed by the Alaska congressional delegation. "Rural preference" was the compromise they forced.) Since this was in violation of the state constitution, the state lost management over fish and game on federal lands in 1990. On the forty percent of land owned by the State of Alaska, private individuals, municipalities, and Native corporations (created under the Alaska Native Claims Settlement Act (1971)), there is no rural preference.

3 The management authority for groundfish is the North Pacific Management Council, which was created by the Magnuson Act of 1977. The council serves in an advisory role to the Secretary of Commerce. The membership of the council is composed of industry and government officials. State of Alaska interests have a majority on the council (which the Alaskan congressional delegation has defended vigorously). This, in part, accounts for the sixty-forty percent split in favor of the onshore processors.

4 The examples used in this paper are all from the same geographic region (the North American Pacific Northwest), but the institutions and problems are prevalent in most political quota allocations.

5 All of these boards and councils are restricted by statutes in the latitude of their allocation decisions. But each group has the power to restrict access to some groups or individuals. These allocations are also contestable. The most contested appears to have been the subsistence allocation. The State of Alaska is involved in two legal cases with the federal government over the issue. Both cases are now at the first appeal level (after the state lost the first round in each).

6 Even this case has some restrictions imposed upon it. The Hunting and Trapping Association member holding the quota may sell the hunt, but the sport hunter must be accompanied by the permit holder, and the hunt must be conducted by traditional means (e.g., dog teams rather than snowmachines; rifles are considered to be traditional).

7 The limited entry permit is specific to the type of gear that can be allowed as well as to the areas where the permit is valid. Furthermore, the limited entry permit is an access permit, not a fishing quota. This reduces its value as property, as divorced spouses and the Internal Revenue Service have discovered.

8 In addition to the subsistence preference (which is stated as a "rural" preference) for hunting big game, the federal government also gives Natives exclusive rights to harvest marine mammals (e.g., fur seals, walrus, and polar bears) under the Marine Mammals Act of 1972 (Bean, Chapter 11, 1983). The rights are restricted, however. The right to hunt the species cannot be transferred, and even Natives can only use the animal for traditional purposes in the U.S.

9 Varian (1984, pp. 269–70) states "[t]he usual argument in defense of the compensation principle is that the question of whether the compensation is carried out is really a question about income distribution, and the basic welfare theorems show that the question of income distribution can be separated from the question of allocative efficiency."

10 Two recent surveys of this literature are Hillman (Chapter 6, 1989) and Nitzan (1994).

11 In the Stigler (1971) model, industries are viewed as having political power but voters are not. This is based largely in the rational ignorance problem with voters. In the Peltzman (1976) model, voters are not entirely viewed as powerless. Peltzman notes that voters still must support the politicians who vote for industry protection, and that swaying that vote costs money. Thus voters are still protected, but not due to having any strategic power in the political competition. Becker (1983) explicitly formulates the competition between interest groups in an imperfect competition model.

12 See Gardner (1983, 1987, 1993); Antle and Johnson (1991); Gisser (1993).

13 Since there is perfect discrimination, concerns about risk aversion are irrelevant.

14 We are assuming that the cost does not depend upon the initial allocation. This rules out any "moral higher ground" that some groups may have in regards to the initial allocation.

15 We are assuming that the different groups allocate within the group according to the rule that those with the highest value obtain the goods. This avoids a number of complexities regarding "easy riding" problems (e.g., Nitzan 1991).

16 Note that if $w_i'' = 0$ for both groups, $|H| = 0$, so no solution exists.
17 We consider winner-take-all allocations in the context of the initial policy because such allocations are possible final allocations only under fairly extreme conditions.
18 Interestingly, U.S. law also prohibits U.S. citizens from bringing a polar bear pelt into the U.S. Thus, Canadians involved in the polar bear hunts have suggested to me that they would be happy to have the U.S. allow its citizens to keep the furs, because that would shift out the demand curve, raising the price HTAs receive.
19 The exclusive and transferable property rights granted to the HTAs have resulted in two instances where this has affected management of the populations (Stirling, 1991). In one case, the HTAs near the U.S. border, after expressing concern that the U.S. side was not properly managing the shared population, offered to enter into a joint management of the population. In Churchill, Manitoba, the local HTA has elected to not take its full quota (even though sport hunters pay about $5,000–15,000 per hunt). The reason is that the community makes more money in non-consumptive tourism than it could from the hunts themselves.
20 For example, in the polar bear case, the HTAs allocate the permits to individual members who may then choose to use the hunt themselves or sell it to a sport hunter. The other example discussed in the introduction had to do with transferable fishing quotas. Like the polar bear permits, it is individuals who buy or sell their shares of transferable fishing quotas. In both cases, there as some limits placed on who the permits can be sold to. For example, United States citizens cannot bring a polar bear hides into the country, greatly inhibiting the value of a polar bear hunt to them. More importantly, in the transferable fishery quotas examples, there are generally restrictions on sales across gear types. Similar restrictions exist for limited entry commercial salmon permits also.
21 This assumes that neither group would want to purchase the entire quantity in the post-allocation market.

References

Antle, J.M. and Johnson, R.N. (1991). Efficient redistribution reconsidered. Working Paper No. 91/10, Bozeman, Montana State University.

Bean, M.J. (1983). The evolution of national wildlife law. Praeger Publishers, New York.

Becker, G.S. (1983). A theory of competition among pressure groups for political influence. *Quarterly Journal of Economics* 98: 371–400.

Boyce, J.R. (1993). Using participation data to estimate fishing costs for commercial salmon fisheries in Alaska. *Marine Resource Economics* 8: 367–394.

Buchanan, J.M. and Stubblebine, W.C. (1962). Externality. *Economica* 29(November): 371–384.

Cairns, R.D. (1989). Dynamic rent-seeking. *Journal of Public Economics* 39: 315–334.

Coase, R.H. (1960). The problem of social cost. *Journal of Law and Economics* 3(October): 1–44.

Constantine, J.H., Alston, J.M. and Smith, V.H. (1994). Economic impacts of the California one-variety cotton law. *Journal of Political Economy* 102: 951–974.

Corcoran, W.J. (1984). Long-run equilibrium and total expenditures in rent-seeking. *Public Choice* 43: 89–94.

Criddle, K.R. (1994). Predicting the consequences of alternative harvest regulations in a sequential fishery. Unpublished manuscript. Department of Economics, University of Alaska Fairbanks.

Dougan, W.R. and Snyder, J.M. (1993). Are rents fully dissipated? *Public Choice* 77: 793–813.

Ellingsen, T. (1991). Strategic buyers and the social cost of monopoly. *American Economic Review* 81(3): 648–657.

Gardner, B.L. (1983). Efficient redistribution through commodity markets. *American Journal of Agricultural Economics* 65: 225–34.

Gardner, B.L. (1987). Causes of U.S. farm commodity programs. *Journal of Political Economy* 95: 290–310.

Gardner, B.L. (1993). Changing economic perspectives on the farm problem. *Journal of Economic Literature* 30(1): 62–101.

Gisser, M. (1993). Price support, acreage controls, and efficient redistribution. *Journal of Political Economy* 101(4): 584–611.

Hazlett, T.W. and Michaels, R.J. (1993). The cost of rent-seeking: Evidence from cellular telephone license lotteries. *Southern Economic Journal* 59(January): 425–435.

Hirshleifer, J. and Riley, J.G. (1978). Auctions and contests. UCLA Working Paper No. 118B.

Hillman, A.L. (1989). The political economy of protection. Fundamentals of pure and applied economics. Harwood Academic Publishers, Chur.

Hillman, A.L. and Riley, J. (1989). Politically transferable rents and transfers. *Economics and Politics* 1(1): 17–39.

Hillman, A.L. and Katz, E. (1984). Hierarchical structure and the social cost of bribes and transfers. *Journal of Public Economics* 94: 104–110.

Hillman, A.L. and Samet, D. (1987). Dissipation of rents and revenues in small number contests. *Public Choice* 54: 63–82.

Johnson, R.N. and Gary Libecap D. (1982). Contracting problems and regulations: The case of the fishery. *American Economic Review* 72: 1005–1022.

Kalt, J.H. and Zupan, M.A. (1984). Capture and ideology in economic theory of representative government. *American Economic Review* 74(June): 350–367.

Katz, E., Nitzan, S. and Rosenberg, J. (1990). Rent-seeking for pure public goods. *Public Choice* 65: 49–60.

Krueger, A.O. (1974). The political economy of the rent-seeking society. *American Economic Review* 64: 291–303.

Layman, C. (1994). The economic value of the recreational King Salmon Fisheries on the Gulkana and Klutina Rivers, Alaska. Unpublished manuscript. Thesis, Department of Economics, University of Alaska, Fairbanks.

Leninger, W. (1993). More efficient rent-seeking – A Munchhausen Solution. *Public Choice* 75: 43–62.

Libecap, G.D. and Wiggins, S.N. (1984). Contractual responses to the common pool: Prorationing of crude oil production. *American Economic Review* 74(1): 87–98.

Linster, B.G. (1993). A generalized model of rent-seeking behavior. *Public Choice* 77: 421–435.

Niskanen, W.A. (1971). Bureaucracy and representative government. Chicago: Aldine-Atherton.

Nitzan, S. (1991). Collective rent dissipation. *Economic Journal* 101(November): 1522–1534.

Nitzan, S. (1994). Modeling rent-seeking contests. *European Journal of Political Economy* 10: 41–60.

Olson, M., Jr. (1965). The logic of collective action. Cambridge, MA: Harvard University Press.

Peltzman, S. (1976). Toward a more general theory of regulation. *Journal of Law and Economics* 19(2): 211–240.

Posner, R.A. (1975). The social costs of monopoly regulation. *Journal of Political Economy* 83(4): 807–827.

Romer, T. and Rosenthal, H. (1979). On the political economy of resource allocation by direct democracy. *Quarterly Journal of Economics* 93(November): 563–587.

Scitovsky, T. (1941). A note on welfare propositions in economics. *Review of Economic Studies* 9: 77–88.

Stigler, G.J. (1971). The economic theory of regulation. *Bell Journal of Economics and Management Science* 3: 3–21.

Stirling, I. (1991). Management of shared populations of polar bears. Paper presented at the 56th North American Wildlife and Natural Resources Conference, Edmonton, Alberta, Canada, March 26, 1991.

Tullock, G. (1967). The welfare costs of tariffs, monopolies, and theft. *Western Journal of Economics* 5: 224–32.

Tullock, G. (1980). Efficient rent-seeking. In J.M. Buchanan, R.D. Tollison and G. Tullock (Eds.), Towards a theory of the rent-seeking society. College Station, Texas A&M University Press.

Ursprung, H.W. (1990). Public goods, rent dissipation, and candidate competition. *Economics and Politics* 2(July): 115–132.

Varian, H.R. (1984). Microeconomic analysis. (Second Edition). New York, W.W. Norton and Co.

Wenders, J.T. (1987). On perfect rent dissipation. *American Economic Review* 77(June): 457–459.

Wirl, F. (1994). The dynamics of lobbying: A differential game. *Public Choice* 80(September): 307–323.