How To Avoid Awarding a Valuable Asset

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Abstract

Many mechanisms (such as auctions) efficiently allocate a good to the firm which most highly values it. But sometimes the owner of the asset or good may wish to transfer it only if it is not too valuable to potential buyers. The allocation problem becomes especially difficult when the potential buyers have private information about the asset's value. We describe several mechanisms which are efficient, or nearly so. We also show that rent seeking, and lobbying, rather than merely wasting resources, can lead to allocations which are close to efficient.

Keywords: Rent seeking; Lobbying; Auctions; Asymmetric information

JEL Classification: D44, D72, D82

1 Introduction

A standard economic problem is to allocate a good to the person or firm which most highly values it, where the seller does not know the buyers' valuations. In many examples of this sort of problem, simple auctions are mechanisms which allocate the good efficiently. But sometimes the allocator (say government) may prefer to keep the good if (and only if) it is valued highly by potential recipients.

For example, suppose government specifies an amount it will pay for a given quantity of a good from a private firm. If intense lobbying by firms suggests that the firms would earn obscene profits, government may choose to scuttle the deal.

Similarly, suppose government owns a facility that produces a good or service it needs. A private firm can operate the facility more efficiently than can government, but government is unsure about the monopoly power that would be exercised by a private owner (for example, the government may be unsure about the ease of entry into the industry). Government would therefore be more willing to sell the facility the less the firms value owning it.

As our last example, suppose the marginal cost of public funds exceeds 1, and that the government owns some income–producing asset. Government may prefer to retain the asset, and so retain the income stream generated, even if private firms could operate the asset more efficiently. Suppose as well that the private sector's cost advantage is unrelated to the value of the asset. Then the government may retain the asset if its value is high, but let the private sector operate it if its value is low.

The general idea here thus relates to the market for lemons—the more eager is a party to sell, the more cautious is the buyer. We turn this around, by supposing that the more eager are firms to obtain some prize or asset, the less willing should government be to give it.

2 Literature

We look at mechanisms which reveal private information. Other literature looks at the related issue of information provided by interest groups. The information can concern the importance of the problem a legislator is considering (Hansen (1991), Smith (1995)), the effectiveness of policy (Krehbiel

(1991), Smith (1984 and 1995), Lohmann (1995), Wright (1996)), and the electoral consequences of different policies (Kingdon (1984), Hansen (1991), Rasmusen (1993), Lohmann (1995 and 1998)).

Austen-Smith (1995) models how contributions signal policy preferences. In Lohmann (1995) interest groups pay a contribution to gain access and provide information to the policymaker. Glazer and Konrad (1995) consider a firm which lobbies for a tariff partly to signal to other firms that it has low costs, and thus to deter entry.

Konrad (2003) elegantly solves a problem related to ours. He considers an agent who wants to award the prize to the contestant who most highly values it, with each contestant knowing the value of the prize to itself and to other contestants, but with the awarding agent not knowing this. Konrad shows that a sequence of all-pay contests, with the prize awarded to the contestant who won m more contests than the others, will perfectly reveal which contestant most highly values the prize, while aggregate spending by the contestants approaches zero. This mechanism, however, leaves the prize-giver uninformed about the value of the prize (he only knows who values it most highly) and so does not apply to our problem.

The informational benefits of rent seeking are examined by Lagerlof (2005), who considers a lobby that has truth on its side and that can engage in a costly activity to prove it. Tirole and Dewatripont (1999) provide an informational rationale for advocacy, showing how competition among opposing parties can promote information revelation.

The informational problem we consider resembles that studied by Baron and Myerson (1982) on the regulation of a monopolist with unknown cost. We follow them in one of our mechanisms, with government offering a menu of contracts.

3 Assumptions

Each firm knows the common value of a prize. The value is either high (V_H) or low (V_L), with $V_H > V_L$. The principal, the "government," offers the prize to the firms; initially the government is ignorant about the prize's value, but may learn about it from the behavior of the firms. Government assesses a prior probability, π, that the value is high. If the asset's value to any firm is V_H, government values retaining it at G_H; government values retaining the asset at G_L if its value to any firm is V_L, with $G_H > V_H > V_L > G_L$.[1]We shall at first consider perfectly revealing mechanisms, mostly supposing that government aims to award the prize if it knows its value is V_L, but not if its value is V_H. Since these mechanisms are not used in practice, one of our tasks is to show the time-inconsistency problems inherent in perfectly revealing mechanisms. We shall also use these mechanisms as a benchmark for the performance of mechanisms we do see used, such as rent seeking and lobbying.

4 Efficient mechanisms

A mechanism is efficient if it reveals the private information of firms, while having government award the prize only when its value to a firm exceeds its value to government. We show that no mechanism with government using a pure strategy can induce the firm to reveal its private information. But when government is less constrained, we show that mechanisms can induce a firm to reveal its private information, with an infinitesimally small probability that government must award the prize when it should not.

4.1 Single firm

4.1.1 Pure strategies

Consider first a single firm, which knows whether the value of the prize is high or low. Consider equilibria with truthful revelation (which we know from Myerson's Revelation Principal is optimal). Let a type-L firm (a firm which knows the prize has value V_L) which announces it is of type-L be paid K_L, and win the prize with probability π_L. A type-H firm which announces it is of type-H is paid K_H, and wins the prize with probability π_H. The incentive compatibility constraint is that a type-H firm is indifferent about revealing its type, or that $K_L + \pi_L V_H = K_H + \pi_H V_H$. The participation constraint is that $K_L + \pi_L V_L \geq 0$.

With one firm, and a government which cannot commit, no mechanism can induce truthful revelation. For suppose a firm reports that the value of

[1] In the example about the "marginal cost of public funds" mentioned in the Introduction, suppose that $1 + m$ is the marginal cost of public funds, and that C is the cost advantage of the private sector. Then $G_H = (1+m)(V_H - C)$, and $G_L = (1+m)(V_L - C)$, so that if $mV_H(1 + m) > CmV_L$ the inequalities $G_H > V_H > V_L > G_L$ hold.

the prize is high, so that government will not award the prize. If the value of the prize is indeed high, and if $K_H > V_H - w_L$ the firm prefers doing so to reporting that the value of the prize is low. And if the value of the prize is low, and if $V_L - K_L > K_H$, the firm prefers reporting low. Combining these inequalities gives $V_L - K_L > w_H > V_H - K_L$. But since $V_L < V_H$, this is impossible.

Thus, since a firm which truthfully announced that the value is high would get nothing, no equilibrium can exist in pure strategies.

4.1.2 Nearly optimal mechanism

Though a perfectly revealing mechanism does not exist, a mechanism can be designed which induces truthful revelation with probability approaching 1.

Let a firm announce whether profits from the prize will be high (V_H) or low (V_L). If the firm announces V_L, it gets the asset; at the time it gets the asset, the firm knows whether its value will be V_H or V_L. The mechanism design has the consequences of announcing V_H come in three parts. First, the firm pays the government K. Second, government transfers the asset to the firm. Third, after government realizes the value of the asset, it makes a transfer (or imposes a tax) so that with probability $1/t$ the firm earns a profit of $(t + \lambda)V$ (with $V = V_H$ or $V = V_L$, whichever will be realized).

A firm which knows the value of the prize is V_L will be indifferent between the two choices if $(1/t)(t+\lambda)V_L - K = V_L$, or if $\lambda = Kt/V_L$. If this condition holds, then a firm which knows the prize is worth V_H will strictly prefer the lottery.

In short, when $\lambda = Kt/V_L$ an equilibrium has the firm truthfully reveal its private information. Government always awards the prize when its value is low. Government awards the prize when its value is high with probability $1/t$, which can be made infinitesimally small. The payment government makes, on average $(1/t)\lambda V_H$, is a transfer payment, not affecting social welfare.

The mechanism suffers from two weaknesses. First, it violates incentive compatibility for government—it would never want to award the prize when its value is high. Second, it requires government to condition the transfer on the realized value of V; commitment to such a transfer can be difficult if V is not verifiable. Absent these considerations, however, the mechanism can be made to deviate from the efficient solution by an arbitrarily small amount.

4.2 Two firms

Government can do better if it faces not one firm, but two firms with common knowledge of the value of the prize, and which compete to obtain it. In particular, government can set payments which do not depend on the realized values of the prize.

Consider simple mechanisms, in which each firm announces a value for the prize, either V_H or V_L. We describe below mechanisms which make truth–telling a Nash equilibrium for the firms.

Suppose the government adopts the following policy. If both firms announce V_L it will award the prize to either firm, with probability $1/2$. If either firm announces V_H, government will keep the prize. Then truth–telling is a Nash equilibrium. If the true value is V_H, and one firm announces V_H, then the other firm gains nothing by lying.

This simple mechanism, however, suffers from several obvious defects. First, announcing V_H is a weakly dominated strategy for each firm, yet both firms are supposed to choose it when the true value is V_H. Second, the government's policy may be time inconsistent: the government will want to keep the prize when the announced values are (V_L, V_H) or (V_H, V_L) only if it believes it fairly likely that the prize has a high value when these announcements are made, or that the probability the value of the prize is high is $\bar{\pi}$ or greater, where

$$\bar{\pi}(G_H - V_H) = (1 - \bar{\pi})(V_L - G_L). \tag{1}$$

So the government's commitment to enforce its own rules depends on its own out–of–equilibrium conjectures. Third, under this mechanism the revealing Nash equilibrium is not the only Nash equilibrium: both firms *always* announcing V_H is another Nash equilibrium, again involving weakly dominated strategies. Both firms always announcing V_L is also a Nash equilibrium. The government will want to obey its own rules with these pooling equilibria if $\pi \geq \bar{\pi}$ in the first case, and if $\pi \leq \bar{\pi}$ in the second.

Not all the defects of the mechanism just presented can be avoided. That is, if the mechanism were to induce truth–telling as the unique Nash equilibrium for the bidders, then the government would want to renege some of the time on its own mechanism, once it learned the truth.

Proposition 1 *If some direct mechanism induces truth–telling as a Nash equilibrium, and if government keeps the prize whenever it believes that with* *probability $\bar{\pi}$ or higher the prize has high value, then a Nash equilibrium exists in which each firm always announces that the prize has high value.*

Proof: Let the parameters of the mechanism be γ_{ij} and K_{ij}, with γ_{ij} the probability that firm 1 gets the prize when the announcements are i and j, and with K_{ij} the payment made to firm 1 in this situation.

The time consistency requirement (government retains the prize when it believes it likely has high value) means that if truthful revelation is to be a Nash equilibrium, then $\gamma_{HH} = 0$.

If truthful revelation is a Nash equilibrium, then firm 1 must not gain from announcing L, if the true value is high, and if firm 2 announces H. Therefore, it must be that

$$(\gamma_{LH} - \gamma_{HH})V_H \leq K_{HH} - K_{LH}. \tag{2}$$

Since time consistency requires that $\gamma_{HH} = 0$, it follows that therefore $\gamma_{LH} \geq \gamma_{HH}$, which implies that

$$(\gamma_{LH} - \gamma_{HH})V_L \leq K_{HH} - K_{LH}. \tag{3}$$

Analogous conditions hold for firm 2, so that equations (2) and (3) imply that "always announce H" must also be a Nash equilibrium for the mechanism. QED.

The government, however, can get arbitrarily close to a mechanism in which the dominant strategies for the bidders are to tell the truth, and in which the government is willing to honor its own rules. The following mechanism requires the government to award the prize with some positive probability even when it has learned that its value is high. The probability, however, can be made arbitrarily small.

The rules of the mechanism are :

- If both firms announce low, then government awards the prize to each of them with probability 1/2. The firm which wins the prize pays $V_L - \epsilon$.
- If both firms announce high, then each firm wins the prize with probability ϵ. The firm winning the prize pays $V_L + \epsilon$.
- If one firm announces high and the other low then the firm which announced low does not get a chance at the prize. But the firm which announced high gets the prize with probability $1/2 + \epsilon$, and pays $V_L + \epsilon$ if it wins the prize.

With the above rules, a firm's dominant strategy is to tell the truth. Each firm gets a non–negative net payoff in equilibrium, whether the true value is high or low, so each is willing to participate. In equilibrium, firms will never give different answers. So the government's rules oblige it to award the prize for sure if its value is low, and to award it with probability 2ϵ if its value is high. Since ϵ can be made arbitrarily small, the government is required to behave contrary to its own interest with arbitrarily small probability.

Proposition 1 above holds as well if there are more than 2 bidders. And the mechanism can be generalized to more than 2 bidders: with $n > 2$ firms, each firm wins the prize with probability $1/n$ if all n firms announce a low value, and each firm announcing a high value wins the prize with probability $1/n + \epsilon$ if m firms announce a high value, with $m < n$.

5 Rent-seeking

The mechanisms described above are not commonly seen, and therefore appear to contribute little to a positive analysis of government behavior. Perhaps they are not used because other mechanisms can do as well, or almost as well. We accordingly examine a model of rent seeking, which is widely studied in the literature, and appears to give the spirit of how special interest politics works. In the standard rent-seeking model, if firm i spends x_i on rent seeking, it wins the prize with probability $x_i/(\sum_j x_j)$. We modify the standard rent-seeking game, in one way: if the government believes that the value of the prize is high, it awards it to some firm only with probability $z < 1$.[2]

5.1 Two firms

As before, let each of the two firms value the prize at either V_H or V_L. When the prize is V_L, the equilibrium is for each firm to spend $V_L/4$, and a firm's expected profits are $V_L/4$. When the prize of value V_H is awarded with probability z, the standard rent-seeking has each firm spend $zV_H/4$, and earn expected profits of $zV_H/4$.

Consider the state of nature where the firms value the prize at V_H. If each firm spent $V_L/4$ on lobbying, the government would learn nothing about the

[2]For the seminal papers on rent seeking, see Tullock (1967), Krueger (1974), Posner (1975), and Bhagwati (1982).

value of the prize, and, by assumption, would award the prize. A firm's expected profits would be $V_H/2 - V_L/4$. But this is not the equilibrium. For suppose one firm spent $x > V_L/4$. Government would then know that the prize is worth V_H, and by assumption would award the prize only with probability $z < 1$. We suppose that which firm gets the prize follows the standard rent-seeking model. A firm spending x wins the prize with probability $z\frac{x}{x+V_L/4}$. Its expected profits are

$$zV_H \frac{x}{x + V_L/4} - x. \tag{4}$$

The first-order condition for the firm's optimal x is that

$$x = \frac{2\sqrt{zV_H V_L} - V_L}{4}. \tag{5}$$

If $\sqrt{zV_H V_L} > V_L$ this exceeds $V_L/4$. Substituting this x into the firm's profit function yields

$$\Pi = zV_H - \sqrt{zV_H V_L} + V_L/4. \tag{6}$$

This can exceed $V_H/2 - V_L/4$, the profits were the firm to spend $V_L/4$. For sufficiently large V_H, a firm will prefer to spend $x > V_L/4$ if $z > 1/2$. Thus if the government can be trusted not to renege, rent-seeking among two firms can reveal information, but at a high cost of efficiency.

5.2 More than 2 firms

The previous section considered two firms which rent seek. Here we extend the model to consider $n > 2$ firms. We are particularly interested in behavior when n is large. Extending the analysis given above, with n firms, and a prize of value V_L, in equilibrium each firm spends $V_L\frac{n}{(n-1)^2}$. Each firm's expected profits are V_L/n^2.

Now suppose one firm spent $x > V_L\frac{n}{(n-1)^2}$. Government would then know that the prize is worth V_H, and by assumption would award the prize only with probability $z < 1$. We suppose that which firm gets the prize follows the standard rent-seeking model. The firm that spends x wins the prize with probability $z\frac{x}{x+(n-1)nV_L/(n-1)^2}$. Its expected profits are

$$zV_H \frac{x}{x + (n-1)V_L\frac{n}{(n-1)^2}} - x. \tag{7}$$

The first-order condition is that

$$x = \sqrt{V_H V_L z}(n-1)/n - V_L(n-1)^2/n^2. \tag{8}$$

Substituting this x into the firm's profit function yields

$$\Pi = 2(1-n)\sqrt{V_H V_L z}/n + V_H z + V_L(n-1)^2/n^2. \tag{9}$$

If, instead, the firm spent $V_L \frac{n}{(n-1)^2}$ when it valued the prize at V_H, the firm's profits would be

$$V_H/n - V_L \frac{n}{(n-1)^2}. \tag{10}$$

For large n, the difference between these two approaches

$$-2\sqrt{V_H V_L z} + V_H z + V_L. \tag{11}$$

This is positive if $V_H^2 z^2 - 2V_H V_L z > -V_L^2$, which for any given z will hold for sufficiently small V_L and sufficiently large V_H. Under these conditions, rent seeking is efficient. That is, when many firms rent seek, the private information held by firms is perfectly revealed, government will alway award the prize when it should (that is, when its value is V_L), and government will rarely award the prize when it shouldn't (that is, when its value is V_H).

6 Lobbying

As our last mechanism, which is also observed in practice, we consider lobbying. We take lobbying as similar to rent seeking, but with the difference that lobbying is a binary choice (a firm either lobbies or not), and that the cost of lobbying is fixed at F. We also consider here only subgame-perfect solutions, with government awarding the prize only if it is in its own interest to do so

Thus, each firm, knowing the value of the prize, must decide whether to lobby. After observing lobbying by the firms, the government decides whether to award the prize. The lobbying enables the government to update its estimate of the probability that the asset has value V_H, to some posterior belief $\tilde{\pi}$. It will award the prize if and only if $\tilde{\pi} \leq \bar{\pi}$, where the threshold probability $\bar{\pi}$ was defined above by equation (1). If government does award the prize, it does not care which firm gets the prize, since the value is common. Hence the government can commit credibly to the following rule:

If the government awards the prize after only one firm lobbied, then the firm which lobbied wins the prize.

Firms know the government's prior belief, π, and its valuations G_H and G_L of the prize in the two different states of nature. Therefore, they know that government will award the prize only when it benefits from doing so.

If the government awards the prize after neither firm had lobbied, then each wins it with probability 1/2.

Lobbying here involves no transfer to the government, with F representing a real social cost. A firm which lobbies incurs this cost F whether or not it gets the prize. The firms make their lobbying decisions simultaneously, each aiming to maximize its expected profits. (Profits are the value of the prize, times the probability of winning the prize, minus any lobbying costs the firm incurred.)

6.1 Firms' behavior

Suppose firms anticipate that the government will retain the prize if they both lobby, but that it will award the prize if one firm lobbies, or if neither firm does. We will examine below whether this behavior is rational for the government; we first consider a firms' lobbying activity, given that each anticipates this behavior by the government.

It is not obvious that more firms will lobby when the prize has high value. For a firm which lobbies improves its chance of winning the prize if the other firm did not lobby, but will lose the prize if the other firm did lobby. We consider the possibility of each firm adopting the identical mixed strategy, choosing to lobby with probability λ_i ($i = H$ or L) when the value of the prize is V_i.

These mixed strategies can maximize a firm's profits only if a firm is indifferent about lobbying. If firm 1 does not lobby, it wins the prize only if neither did firm 2 lobby: government chooses firm 1 with probability 1/2. The firm's expected profit is $(1-\lambda_i)V_i/2$, where V_i is the value of the prize in state i ($i \in \{L, H\}$). If firm 1 does lobby then it wins the prize if firm 2 did not lobby. (Recall that we are looking at a possible equilibrium in which the government awards no prize if both firms lobby). The firm's expected profit is $(1-\lambda_i)V_i - F$. So the firm is indifferent between lobbying and not, or a Nash equilibrium in mixed strategies can exist, if $(1-\lambda_i)V_i/2 = (1-\lambda_i)V_i - F$, or if

$$\lambda_i = 1 - 2F/V_i, \tag{12}$$

which can hold when $0 < F < V_i/2$. Thus, a necessary condition for the existence of a Nash equilibrium of this type is that

$$0 < F < \frac{V_L}{2}. \tag{13}$$

Equation (12) implies that λ_i increases with V_i: the firms will more likely lobby when the value of the prize is high than when it is low. Thus, the number of firms that lobbied signals the value of the prize to the firms. It can be rational for the government to deny the prize if both firms lobbied.

The expected joint profits of the firms if they play their equilibrium strategies, and if the government awards the prize unless they both lobby, is

$$-2\lambda_i F + V_i(1 - \lambda_i^2). \tag{14}$$

Substituting for λ_i gives expected profits as $2F$.

Notice that if the fixed costs of lobbying are very low, then both λ_L and λ_H approach 1: lobbying activity would convey little information. Nonetheless, the government may learn enough from observing lobbying behavior, even when F is very small, to benefit from the proposed strategy of awarding the prize only if at least one firm refrained from lobbying.

6.2 Government's estimate of the value of the prize

We now consider the government's optimal actions, given the behavior of the firms. Our first task is to determine the expected payoff to the government when it awards the prize only if the probability that its value to a firm is V_H lies below some $\bar{\pi}$. Government uses the (common) prior belief π and its observation of the number of firms that lobbied to generate a posterior estimate of the probability that the value of the prize is high. Suppose then that with probability λ_i either firm lobbies when it values the prize at V_i. Then the posterior probability that the prize has high value when n firms lobbied is π_n, with

$$\pi_2 = \frac{\pi\lambda_H^2}{\pi\lambda_H^2 + (1-\pi)\lambda_L^2} \tag{15}$$

and

$$\pi_1 = \frac{\pi\lambda_H(1-\lambda_H)}{\pi\lambda_H(1-\lambda_H) + (1-\pi)\lambda_L(1-\lambda_L)}. \tag{16}$$

If the firms use their equilibrium mixed strategies, equation (12) implies (15) and (16) can be written as

$$\pi_2 = \frac{\pi(V_H - 2F)^2 V_H^2}{\pi(V_H - 2F)^2 V_H^2 + (1-\pi)(L - 2F)^2 V_H^2} \tag{17}$$

and

$$\pi_1 = \frac{\pi V_L^2 (V_H - 2F)}{\pi L^2 (V_H - 2F) + (1-\pi) V_H^2 (V_L - 2F)}. \tag{18}$$

Equations (17) and (18) imply that both π_1 and π_2 increase with F. At the maximum value of F consistent with condition (13), $\pi_1 = \pi_2 = 1$. For lower values of F, π_2 always exceeds π_1. When $F = 0$, $\pi_2 = \pi$ and $\pi_1 = (\pi V_L)/(\pi V_L + [1-\pi]V_H)$. Figure 1 depicts π_1 and π_2 as functions of F when $V_H = 2$, $V_L = 1$, and $\pi = 1/2$.

The previous section assumed that each firm expects government to award the prize unless they both lobbied. The government will choose this strategy if and only if

$$\pi_2 > \bar{\pi} > \pi_1. \tag{19}$$

The inequality $\pi_0 \leq \pi_1$ always holds. Therefore, precisely when condition (19) holds will an equilibrium exist in which the government awards the prize unless both firms lobby.

6.3 Existence of an equilibrium

The previous two sub–sections give necessary and sufficient conditions for the existence of a Nash equilibrium in which lobbying signals the value of the prize, and in which the government retains the prize if (and only if) both firms lobby.

Given the government's posited behavior, firms will lobby with probability λ_i when the prize has value i, with $0 < \lambda_L < \lambda_H < 1$, only if condition (13) holds. The government will be willing to obey the rule "award the prize if and only if fewer than two firms lobby" if and only if $\pi_1 < \bar{\pi} < \pi_2$, where π_2 and π_1 are defined by equations (17) and (18).

If the lobbying cost F is small, so that both λ_L and λ_H approach 1, then $\pi_2 \to \pi$, and $\pi_1 \to \pi V_L/(\pi V_L + (1-\pi)V_H)$.

At $F = 0$, the requirement that $\bar{\pi} < \pi_2$ is simply that $\bar{\pi} < \pi$: the government would retain the asset (or not award the prize) based on prior information. Not surprisingly, if the lobbying cost F is very low, a government which sees both firms lobby will change little from its prior beliefs. The requirement that $\bar{\pi} > \pi_1$ at $F = 0$ must also hold, so that for low values of F the equilibrium exists whenever

$$\frac{V_L}{V_H} < \frac{\bar{\pi}}{(1-\bar{\pi})} \frac{(1-\pi)}{\pi} < 1. \tag{20}$$

Moreover, whenever the left inequality in (20) holds, then for some range of F this equilibrium will exist.

In our example discussing the "marginal cost of public funds," the condition $\bar{\pi} < \pi$ is simply that $m[EV] > (1+m)C$, or that the value of keeping expected rents from the prize in the public sector exceeds the cost disadvantage. The condition $\bar{\pi} > (\pi L)/(\pi L + [1-\pi]V_H)$, necessary for $\bar{\pi}$ to exceed π_1, becomes

$$mV_H V_L < (1+m)C[\pi V_L + (1-\pi)V_H]. \tag{21}$$

When $V_L = V_H = EV$, condition (21) becomes $m[EV] < (1+m)C$ which cannot be consistent with $\bar{\pi} < \pi$. But whenever $V_H > V_L$, for some range of values of C and m inequality (21) holds, and $\bar{\pi}$ is still less than π. For example, if V_L/V_H is sufficiently small, then condition (21) must hold.

The threshold probability $\bar{\pi}$ does not depend on the fixed costs F: it is determined by the relation among V_L, V_H, G_L, and G_H. So the signaling equilibrium proposed here will exist whenever this threshold $\bar{\pi}$ lies between the two curves in Figure 1.

In general, then, if under government's prior beliefs it would retain the asset, if the variation in the asset's possible value is large, and if lobbying costs are small, then lobbying is informative. In such circumstances, seeing exactly one firm lobby signals that the prize likely has a low value. This enables the government to transfer the asset to the private sector precisely when the government would most benefit from the transfer.

The informational benefits we discuss would disappear if firms colluded. Since the equilibrium we described had government retain the prize if both firms lobbied, the firms may agree that in any period in which they value the prize highly, none of them will bid, thereby reducing their costs and apparently ensuring that government will award the prize. Such collusion may be unstable, because then if one firm did lobby while the other firm did not, the lobbying firm would win the prize for sure. More sophisticated collusion would have only one of the two firms lobby in each period. Indeed, such collusion might be self-enforcing: if one firm is expected to lobby in a given period, the other firm has no incentive to lobby, because if it did, government would retain the prize.

Such collusion could be effective for a limited number of periods. But note that if government recognizes that the firms collude, then it will recognize that it learns nothing about the value of the prize. For some parameter values, this means that government will not wish to award the prize at all.

6.4 More than two firms

When more than to firms can lobby, each perfectly informed about the common value of the prize, the government could, potentially, observe a wider variety of lobbying activity. A natural candidate for an equilibrium has each firm lobby with the same probability λ_i, with $0 < \lambda_L < \lambda_H < 1$ when a firm values the prize at V_i. This behavior by firms would be consistent with equilibrium if each firm correctly believed that the government would withhold the prize if and only if at least $m + 1$ firms lobbied, where $\pi_m < \bar{\pi} < \pi_{m+1}$. Here π_i is the government's posterior belief that the value is V_H, given that i firms lobbied. Since $\pi_i > \pi_{i-1}$, as long as $\lambda_H > \lambda_L$ and $\pi_0 < \bar{\pi} < \pi_N$ (with N the total number of firms) such a threshold cutoff m will exist.

Of course the λ_i's chosen by firms depend on their expectations about the government's threshold number m of firms which determines whether government will award the prize. A higher threshold makes lobbying more attractive. In turn, higher λ_i's will lower the government's threshold. So there will typically be a unique threshold level m of lobbying which is consistent with equilibrium.

But other equilibria with mixed strategies are possible. A simple possibility has only two of the N firms lobby. If firm 1 and firm 2 each lobbies with probability

$$\lambda_i = 1 - \frac{N}{N-1}\frac{F}{V_i} \tag{22}$$

when it believes the prize has value V_i, then each of the two firms will be indifferent between lobbying and not lobbying: the expected payoff from lobbying,

$$(1 - \lambda_i)V_i - F \tag{23}$$

equals the expected payoff from not lobbying,

$$(1 - \lambda_i)\frac{V_i}{N}. \tag{24}$$

In this case, none of the other $N-2$ firms will lobby. The expected profit of any firm other than firm 1 or firm 2 when it lobbies is

$$(1-\lambda_i)^2 V_i - F; \tag{25}$$

its expected profit when it does not lobby is

$$(1-\lambda_i)^2 \frac{V_i}{N}. \tag{26}$$

Since the second expression is $(1-\lambda_i)$ times firm 1's expected payoff from not lobbying, and the first expression is less than $(1-\lambda_i)$ times firm 1's expected payoff from lobbying, firms $3, 4, \ldots, N$ would strictly prefer not to lobby.

So with N firms a Nash equilibrium exists with each of two firms lobbying with probability λ_i defined by equation (22), provided that this strategy implies $\pi_1 < \bar{\pi} < \pi_2$ when the government does its Bayesian updating. But equation (22) is just equation (12), with the fixed cost scaled up by $N/(N-1)$ instead of 2. Figure 1 shows that effectively lowering the fixed cost of lobbying leads to the existence of a signaling equilibrium, if the government's threshold probability $\bar{\pi}$ is close to, but less than, its prior expectation π.

Of course, when the number of firms exceeds two, many other mixed-strategy equilibria are possible, such as equilibria in which each of $n < N$ firms lobbies with some positive probability λ_i, and in which the other $N-n$ firms never lobby.

6.5 Examples of excessive lobbying

Finding examples where projects were cancelled because of excessive lobbying is more difficult than finding examples where projects were completed—the cancelled ones do not exist, have no officials responsible for them, and are not subject to continuing media coverage or political debate. It is like the dog in the Sherlock Holmes story which did not bark. Yet some examples come to mind. In 2001 NextWave, Verizon Wireless, and AT&T Wireless intensely lobbied Congress, but it refused to approve an agreement that would have paid NextWave to transfer spectrum rights to the other firms.[3]Our view is that the heavy lobbying signaled that the agreement would excessively benefit the firms, thereby reducing congressional support for the agreement.

[3]See http://www.wirelessweek.com/index.asp?layout=article&articleid=CA 188950. The NextWave example illustrates, incidentally, the grave problems that can arise with auctions.

A similar history may apply to the SuperConducting Super Collider.[4] Initial estimates of the costs were \$2 billion, including the construction of an oval, underground tunnel some 54 miles in circumference. States lobbied heavily to be selected as the site of the project, with many offering large financial contributions. After a presidential decision in 1987 to proceed with the project, 26 states submitted proposals, of which seven were selected for further review, resulting in the selection of Texas as the site for the project. But then support for the project declined, leading to its cancellation in 1993. The standard story for the decline in support is that congressmen viewed the project as a pork barrel, with states engaged in rent seeking to obtain the project. Once it became clear that only Texas would get the project, congressmen from other states, the story goes, withdrew their support. We would add an additional element. The intensive efforts by states to get the project suggested to other congressmen (including those from states which had not even submitted a proposal) that the benefits of the project would be largely local, so that states other than Texas might benefit little. That is, in our view support for the project declined because some states devoted so much effort to getting the project.

7 Conclusion

We considered several mechanisms which would allow government to learn from firms their private information about the value of a prize, while not requiring government to grant the prize when its value is high. The problem differs from that addressed in auctions—the conventional problem has a firm which reveals that it highly values the asset as increasing the probability that it will receive it; in the problem we address we would want the firm's chances of getting the asset to decline with its valuation of it.

We saw that some mechanisms can approach the efficient allocation arbitrarily closely. Perhaps the most interesting of these mechanisms is a rent-seeking game. It can perfectly reveal the information, yet under some conditions would require government to inefficiently grant the prize only with very small probability.

We also showed how lobbying can generate informational benefits. This contrasts with the standard approach, which views lobbying as effective in getting firms what they want: newspapers often report following the failure

[4]See Jeffreys (1992).

of a special interest that "despite intense lobbying" government adopted or failed to adopt some policy. We show how the intense lobbying can cause the special interest to fail.

We thus interpreted rent seeking, and more generally lobbying, in a novel way. Rather than assume that government passively responds to political pressures, we explain how rent seeking can benefit government by providing information about the value of the prize it allocates. Even when extensive rent seeking causes government to refrain from awarding the prize, each firm engages in rent seeking because it thereby increases the chance that it rather than the competing firm will win whatever prize is awarded.

8 Notation

F Cost of lobbying

G_i Value of asset to government when its value to a firm is V_i

V_i Value of prize to firm, with $i = H$ or $i = L$

z Probability government awards prize when it believes its value to firm is V_H.

λ_i Probability firm lobbies when value of prize is i

π Prior probability that value of prize is high

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