

*Economics Department*  
*Economics Working Papers*

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*The University of Auckland*

*Year 1998*

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Ideology, Asymmetric Information, and  
Campaign Contributions to Politicians

John Boyce

## **Ideology, Asymmetric Information, and Campaign Contributions to Politicians<sup>#</sup>**

John R. Boyce  
Department of Economics  
University of Auckland  
Private Bag 92019  
Auckland, New Zealand

j.boyce@auckland.ac.nz  
64 9 373 7599, ext. 5254  
64 9 373 7000 (facsimile)

*March 23, 1998*

**ABSTRACT:** This paper considers a model of interest group competition to influence policy outcomes when politicians and some interest groups hold private information about the policy preferences (ideology) of politicians. Politicians cannot credibly reveal their ideology to others because all politician types prefer more campaign contributions to fewer. However, informed interest groups do convey some information about politician's type by their contributions. If an uninformed group is a friend (it prefers moving the given policy in the same direction as the informed group), the informed group will truthfully reveal whether or not the politician is receptive to contributions. However, if the uninformed group is an enemy (it prefers a policy movement in the opposite direction), with the same signal the informed group only partially reveals whether the politician is receptive to contributions from its enemies. Empirical evidence is presented that supports the hypothesis that political action committee contributions are informative as well as persuasive.

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<sup>#</sup> The author thanks Reiko Aoki, Diane Bischak, John Hillas, Matthew Ryan, John Small, and Rhema Vaithianaman for helpful comments. All remaining errors are my own.

# Ideology, Asymmetric Information, and Campaign Contributions to Politicians

**ABSTRACT:** This paper considers a model of interest group competition to influence policy outcomes when politicians and some interest groups hold private information about the policy preferences (ideology) of politicians. Politicians cannot credibly reveal their ideology to others because all politician types prefer more campaign contributions to fewer. However, informed interest groups do convey some information about politician's type by their contributions. If an uninformed group is a friend (it prefers moving the given policy in the same direction as the informed group), the informed group will truthfully reveal whether or not the politician is receptive to contributions. However, if the uninformed group is an enemy (it prefers a policy movement in the opposite direction), with the same signal the informed group only partially reveals whether the politician is receptive to contributions from its enemies. Empirical evidence is presented that supports the hypothesis that political action committee contributions are informative as well as persuasive.

## 1. Introduction

Politicians' preferences, broadly classified as their *ideology*, are known to be important in explaining voting in legislatures (Kau and Rubin 1979, 1993, Kalt and Zupan 1984, 1990).<sup>1</sup> However, the traditional view takes ideology to be a set of fixed preferences (e.g., Levitt 1996). Such a view, if correct, leaves little room for interest groups to affect policy outcomes (Borck 1996). In contrast, interest group competition models that ignore ideology (e.g., Becker 1983, Grossman and Helpman 1994) assume that politicians are responsive to contributions from those on *all* sides of an issue. The point of view taken in this paper is that ideology corresponds to a politician's willingness to respond to campaign contributions from one side or the other of an issue. This means that the politician's policy choice is affected by the actions of interest groups, but some politicians may not change their policy choice in response to contributions by certain interest groups.

Politicians may not have an incentive to correctly reveal their ideological preferences, because by doing so the politician foregoes campaign contributions from groups with which he disagrees. This is a problem for interest groups because they cannot easily purchase information about a politician's ideology. Even if an interest group has contributed to a politician in the past, votes occur so seldom on substantive issues that the group may still be uninformed as to the *effect* of the contributions.<sup>2</sup> Thus some interest groups may not have information about a politician's true ideological preferences. An interest group that does have private information about the politician's preferences would like to

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<sup>1</sup> See Lott and Davis (1992) and Bender and Lott (1996) for critical reviews of this literature.

<sup>2</sup> Kalt and Zupan (1990) assume that asymmetric information is one of the reasons politicians are able to shirk on their constituents. The present model simply extends the shirking to interest groups, who may or may not be

exploit this advantage, but their most obvious means of doing so—by contributing to the politician’s reelection fund—may itself reveal information to other groups.

The model considered here focuses on the role of ideology when there is an asymmetry of information between a politician and some interest groups regarding the politician’s preferences. The notion that there is an asymmetry in the information structures between politicians and interest groups has already received some attention.<sup>3</sup> However, this literature assumes that the politician is uninformed of the true costs of policies to the assorted interest groups. Here, the asymmetry is reversed: some interest groups have incomplete information about the politician’s ideology, so uninformed groups do not know whether the politician will respond to their campaign contributions.<sup>4</sup>

The model has three active participants: politicians, who make non-binding statements of their policy preferences prior to adoption of policy; informed interest groups who attempt to affect policy via campaign contributions; and uninformed interest groups who also attempt to affect policy via campaign contributions. Different ideological types of politicians respond differently to campaign contributions in selecting the policy. Thus the problem can be modeled as a signaling game, with the politician signaling preferences through “cheap talk” (the policy announcements do not enter the utility functions of any participant), and informed interest groups signaling via observable campaign contributions (which do enter the utility functions of some, perhaps all, participants).

The equilibrium in this model is shown to have the following characteristics. The politician is not able to credibly signal his ideological preferences, since the politician gets utility from campaign contributions, whether or not these actually influence his policy choice. Informed interest groups can, under some circumstances, credibly reveal information about the politician’s ideological preferences. In particular, when the informed interest group is signaling to a friend (a group on the same side of the issue), the information transmitted is sufficient for the friend to correctly infer the politician’s ideology or type, since the informed group would not contribute to an unresponsive politician.

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part of the politician’s voting constituency.

<sup>3</sup> See Austen-Smith and Wright (1992), Potters and van Winden (1992), Rasmusen (1993, 1997), Sloof (1997a, 1997b), Lohmann (1994, 1995a, 1995b), Austen-Smith (1995), and Lagerlof (1997).

<sup>4</sup> See also Harrington (1992), Coate and Morris (1995), Schultz (1995), Eichenberger and Serna (1996), and Davis and Ferrantino (1996) for models in which voters (not interest groups) are uninformed as to the politician’s type. Hersch and McDougall (1994) use a signaling model to explain the quality of challengers an

However, when the uninformed interest group is an enemy (i.e., is on the opposite side of the issue), the informed interest group signals only whether or not the politician is receptive to contributions from the informed group. So long as the politician might be willing to accept contributions from *both* sides of the issue, the uninformed enemy gains information, but not complete information.

The main empirical tests of the model derive from the relationship between contributions from an interest group and contributions of its informed friends or enemies. In non-ideological models politicians respond to all interest group contributions. Thus the reaction functions of friends are downward sloping, because each group attempts to free-ride on the contributions of its friend (e.g., Becker 1983). However, when contributions are informative as well as persuasive, the reaction functions of friends are positively sloped. A positive contribution by the informed group signals to the uninformed group that the politician is willing to respond to interest groups on that side of the issue. The reaction functions of enemies in non-ideological models are positively sloped, but when contributions are informative of ideology the reaction functions may or may not be positively sloped. When an uninformed group observes a positive contribution from its informed enemy, it can only rule out that the politician is responsive to neither side. Whether the politician is responsive to both sides or just to the opposition's side depends upon the (a priori) relative probabilities of each ideological type.

Support for these hypotheses is found using campaign contributions and voting data related to a recent decision by the U.S. Congress to lift a twenty-year-old ban on the export of Alaskan crude oil. The ban was put into place in 1973 as a compromise to allow the Trans-Alaska Pipeline to be built. The ban was opposed by the crude oil industry (which wanted to be able to sell its oil in Asian markets), but was supported by oil refineries (which benefited from lower domestic prices), the maritime industry (which had the exclusive right to transport oil sold domestically), and by environmentalist organizations (which wanted less oil production in Alaska).<sup>5</sup> Increased campaign contributions from the oil refinery industry, the maritime industry, and environmentalists are found to have a positive effect on one another's contribution levels. This result is consistent with the signaling

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incumbent faces as a function of aggregate campaign contributions.

<sup>5</sup> See Boyce, Splitstoser, and Bischak (1997) for a discussion of the legislative history of the oil export ban.

model where politicians respond differently to different interest groups, but not with a non-ideological model where politicians are responsive to all interest groups. Crude oil contributions are also found to decrease as contributions from environmental organizations increase. This result suggests that not only is ideology important, but so is asymmetric information. Crude oil companies apparently use positive contributions from environmental organizations as a signal to infer that the politician will not be receptive to contributions from the crude oil industry.

A second set of tests address how politicians respond to interest group campaign contributions. In the fixed preferences view of ideology, contributions have no effect on how members of Congress vote. This is strongly rejected by the data, as is the notion that politicians are equally responsive to all interest groups. Politicians who receive zero contributions from interest groups on one side of an issue are those who are less responsive to that side. This is inconsistent with the non-ideological view (where politicians respond to all sides) but is consistent with the asymmetric information model of ideology. Thus campaign contributions are informative as well as persuasive.

## 2. The Model

To illustrate the signaling aspects of interest group competition, it is assumed that there is a single legislator who is responsible for making policy. Thus, the issue of which members of the legislature should an interest group target its campaign contributions is ignored. This issue has already received much attention in literature discussed below in the empirical section.<sup>6</sup> It is also assumed that the policies are single dimensional.

The type of the politician, which we designate as their *ideology*, is one of four possible types  $t \in T \equiv \{N, L, R, B\}$ . Politicians of each type are willing to accept contributions from all interest groups, but politicians of different types will not necessarily respond to contributions from all groups. *N*-type politicians respond *neither* to contributions from the left nor the right; *R*- or *L*-type politicians respond only to contributions from the *right* or the *left*, respectively; and *B*-type politicians respond to contributions by *both* groups on the right and the left. Each type has probability  $\pi_t \geq 0$ , with  $\sum_t \pi_t = 1$ .

The minimum number of interest groups to illustrate our theory is three: an informed group

(group  $R$ ), a friend (group  $r$ ), and an enemy (group  $L$ ). All politician types are assumed to have preferences (absent contributions) for policy  $\hat{x}_p$ , and interest group  $g \in G \equiv \{L, r, R\}$  is assumed to prefer policy  $\hat{x}_g$ . Assume that groups  $L$ ,  $r$ , and  $R$  have preferences for policies ranked as

$$(1) \quad 0 \leq \hat{x}_L < \hat{x}_p < \hat{x}_r \leq \hat{x}_R \leq 1.$$

At most only one interest group is perfectly informed of the politician's type (although the politician also knows his type). Assuming that only group  $R$  has private information regarding the politician's type avoids the complications of simultaneous signaling (e.g., Mailath 1989, Aoki and Reitman 1992). However, the signaling equilibria may not be affected by more than one group being informed, since the equilibria are informative.<sup>7</sup>

The costs faced by an interest group depend upon two factors: the distance between the adopted policy  $x$  and their preferred policy  $\hat{x}_g$ , and the costs the group incurs in attempting to influence the policy. For group  $g$  these costs are assumed to take the following quadratic form:

$$(2) \quad V_g(x_g, x) = (\hat{x}_g - x)^2 + \phi_g x_g^2 \quad \text{for } g = L, r, R,$$

where  $\phi_g > 0$ . The first term is the "policy cost," measuring the cost to the interest group of not obtaining their preferred policy  $\hat{x}_g$ . The second term is the cost to the interest group of campaign contributions  $x_g$ . Thus the "transactions cost" to an interest group of producing campaign contributions  $x_g$  is the total cost to the group less the transfer to the politician ( $= \phi_g x_g^2 - x_g$ ), which has the property that marginal transactions costs may fall at first (i.e., for  $x_g < 1/2\phi_g$ ), but eventually rise.<sup>8</sup>

How the politician chooses the policy depends upon his type. Let the policy  $x$  chosen by the politician depend upon his type and campaign contributions  $\mathbf{x}_g \equiv \{x_L, x_r, x_R\}$  as follows:

$$(3) \quad \begin{aligned} x(\mathbf{x}_g, B) &= \hat{x}_p + x_r + x_R - x_L, & t = B, \\ x(\mathbf{x}_g, R) &= \hat{x}_p + x_r + x_R, & t = R, \end{aligned}$$

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<sup>6</sup> See Denzau and Munger (1986), Stratmann (1991, 1992), and Snyder (1991) for discussions of these issues.

<sup>7</sup> In the general case where there are  $P > 1$  politicians and each interest group  $g$  is informed over a subset of  $P_g$  legislators, each interest group has a check over the  $P_S \cap P_R$  members for which the 'receiver'  $R$  and the 'sender'  $S$  both hold private information. But if  $S$  is already truthfully informing  $R$ , then this check adds no new information to what  $R$  already knows. See Austen-Smith (1994) on this issue.

<sup>8</sup> The policy cost coefficient is normalized to one since it is rent-seeking costs relative to policy costs that matters.

$$\begin{aligned}
x(\mathbf{x}_g, L) &= \hat{x}_p - x_L, & t = L, \\
x(\mathbf{x}_g, N) &= \hat{x}_p, & t = N.
\end{aligned}$$

Equation (3) is a reduced form of a “political influence function” (Becker 1983) that differs by politician type. *B*-type politicians respond to contributions from both sides; *R*-type politicians respond only to groups on the right; *L*-type politicians respond only to groups on the left; and *N*-type politicians respond to neither the right nor the left. Below, we obtain (3) as the first-order condition from the politician’s optimization problem, given the contributions by the different interest groups.

### *The Non-ideological Case*

Before turning to the case where some interest groups are uninformed about the politician’s type, let us briefly examine the case where each politician is type *B*, and this is known to all groups. This is the standard assumption in models which ignore ideology (e.g., Becker 1983, Grossman and Helpman 1994).<sup>9</sup> Suppose group *R* moves first. In this case the first order conditions for the two Stackelberg followers are:

$$(4) \quad x_r = (\hat{x}_r - \hat{x}_p - x_R + x_L)/(1 + \phi_r),$$

$$(5) \quad x_L = (\hat{x}_p + x_R + x_r - \hat{x}_L)/(1 + \phi_L).$$

Thus group *R* chooses  $x_R$  to maximize (2) taking into account the actions of the followers as given by (4) and (5), i.e.,  $x_R^* = \operatorname{argmax} V_R(x_R, x_r(x_R), x_L(x_R))$ . From (4) and (5),  $x_r$  decreases and  $x_L$  increases as  $x_R$  increases. These constitute testable hypotheses in the non-ideological model. We shall see that the signaling model with asymmetric information about ideology provides an alternate set of hypotheses.

### *Signaling To Friends*

Now let the politician’s ideology take on the full range of possible types. Assume that there are only two *active* interest groups (*R* and *r*), both on the same side of the issue. Thus group *L* is inactive, meaning that  $x_L = 0$  for all types of politicians. In addition, suppose for now that the politician cannot

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<sup>9</sup> Clearly if the groups are fully informed and the politician’s type is either *L* or *N*, neither group *r* nor group *R* will contribute to the politician. Similarly, if the politician is type *R* or *N*, group *L* will not apply pressure. Below, we distinguish between the *full information ideological* model, where politicians may be different types but all groups know the type, from the *non-ideological* model, where all politicians are type *B*.

credibly signal his type but simply uses (3) to choose the policy. This assumption is examined below.

Assume that group  $R$  has (perfect) private information regarding the politician's type, and it is common knowledge that this is so. Group  $R$  may have private information because it has had previous, verifiable, evidence that the politician is of a certain type, say through previous contributions which were observed to have an effect on a vote. Group  $r$  is uninformed of the politician's type but observes the contribution given by group  $R$ . The *sender*,  $R$ , moves first, choosing a level of political pressure  $x_R(t)$ , and the *receiver*,  $r$ , after observing  $x_R$  but not  $t$ , chooses a level of political pressure  $x_r(x_R)$ . The game concludes by the politician choosing the policy according to (3), given his type. When group  $R$  observes the politician is type  $t \in T$ , group  $R$  is said to be a " $t$ -type  $R$ ."

In the event that the politician is of type  $L$  or type  $N$ , group  $R$  observes that the politician is unresponsive to contributions from groups on the right. Thus an  $L$ - or  $N$ -type group  $R$ 's costs are

$$(6) \quad V_{R/L}(x_R) = V_{R/N}(x_R) \equiv V_{R/L,N}(x_R) = (\hat{x}_R - \hat{x}_p)^2 + \phi_R x_R^2.$$

In this case group  $R$ 's optimal political pressure is  $x_R^* \equiv x_R^N = 0$  (where  $x_R^t$  denotes  $R$ 's optimal choice given the politician is type  $t \in T$ ), since  $R$ 's expenditures have no influence on the policy.

In the event that the politician is type  $R$  or type  $B$ ,  $R$ 's objective function is

$$(7) \quad V_{R/B}(x_R) = V_{R/R}(x_R) \equiv V_{R/R,B}(x_R) = (\hat{x}_R - \hat{x}_p - x_R - x_r)^2 + \phi_R x_R^2.$$

In this case actions by groups  $R$  and  $r$  do affect the policy chosen by the politician, and the policy chosen affects  $R$ 's and  $r$ 's policy costs.

In the second stage of the game, uninformed group  $r$  chooses  $x_r$  to minimize

$$EV_r(x_r | x_R) = \mu_r(R \text{ or } B | x_R)(\hat{x}_R - \hat{x}_p - x_R - x_r)^2 + \mu_r(L \text{ or } N | x_R)(\hat{x}_R - \hat{x}_p)^2 + \phi_r x_r^2,$$

where  $\mu_r(t | x_R)$  is group  $r$ 's *belief* about the probability that the politician is type  $t$ , given that  $x_R$  is observed, so that  $\sum_t \mu_r(t | x_R) = 1$  (e.g., Gibbons 1994). The solution to  $r$ 's minimization problem is thus

$$(8) \quad x_r^*(x_R) = \frac{\mu_r(R \text{ or } B | x_R)(\hat{x}_R - \hat{x}_p - x_R)}{\mu_r(R \text{ or } B | x_R) + \phi_r}.$$

The fact that  $R$ 's optimal contribution level is zero if a type  $N$  or type  $L$  politician is observed makes the equilibrium to this signaling game particularly simple. Group  $r$  knows that any contribution

greater than zero signals that the politician is receptive to contributions from groups on the right. Thus  $r$ 's beliefs are  $\mu_r(R \text{ or } B | x_R > 0) = 1$ ,  $\mu_r(N \text{ or } L | x_R > 0) = 0$ ,  $\mu_r(R \text{ or } B | x_R = 0) = 0$ , and  $\mu_r(N \text{ or } L | x_R = 0) = 1$ . From (8) we see that  $x_r^*(0) = 0$  and  $x_r^*(x_R) = (\hat{x}_R - \hat{x}_p - x_R)/(1 + \phi_r)$ , where the latter corresponds to the full-information best response given  $x_R > 0$ . Therefore group  $R$  selects  $x_R^* = x_R^N = x_R^L = 0$  if the type is  $N$  or  $L$ , respectively, and  $x_R^* = x_R^B = x_R^R \equiv \operatorname{argmax} V_{R|R,B}(x_R, x_r^*(x_R))$ , equal to the Stackelberg full-information equilibrium, if the type is  $R$  or  $B$ . This equilibrium is shown in Fig. 1.<sup>10</sup> When the game involves group  $R$  signaling only to group  $r$  (a friend), a *partial pooling equilibrium* occurs, although, as far as group  $r$  is concerned, all of the necessary information has been revealed.

The key empirical implication of this equilibrium can be seen by recalling how an increase in  $x_R$  affects  $x_r$  under the non-ideological case when all politicians are type  $B$ . In that case the reaction function (4) is downward sloping because group  $r$  free-rides on the contributions of group  $R$ . This is reversed when politician's are ideological. In the signaling equilibrium, if  $x_R = 0$ , group  $r$  correctly infers that the politician is not receptive to contributions from groups on the right. Thus group  $r$  optimally chooses  $x_r^*(0) = 0$ . In contrast, when  $x_R > 0$  group  $r$  correctly infers that the politician is receptive to contributions from the right and chooses  $x_r^*(x_R) > 0$ . Thus to the econometrician it will appear as if the reaction function is positively sloped, not negatively sloped as would occur if politicians respond to contributions from all interest groups.<sup>11</sup>

<sup>10</sup> The isocost curves  $V_{R|R,B}$  have slopes

$$dx_R/dx_r|_{dV_{R|R,B}=0} = \frac{\hat{x}_R - \hat{x}_p - x_R - x_r}{(1 + \phi_R)x_R + x_r - (\hat{x}_R - \hat{x}_p)}.$$

The denominator is  $R$ 's best response function  $B_{R|R,B}$  given that it observes the politician is of type  $R$  or type  $B$  ( $R$ 's best response function when it observes the politician is of type  $L$  or  $N$  is the  $x_R = 0$  locus). This vanishes when the  $V_{R|R,B}$  locus intersects the  $B_{R|R,B}$  locus, so the slope of the isocost curve is vertical at that point. Above the  $B_{R|R,B}$  locus the denominator is positive. The locus of points where the numerator vanishes,  $N_{R|R,B}$ , is given by  $x_R = \hat{x}_R - \hat{x}_p - x_r$ . Above the  $N_{R|R,B}$  locus the numerator is negative. The  $B_{R|R,B}$  locus is given by  $x_R = (\hat{x}_R - \hat{x}_p - x_r)/(1 + \phi_R)$ . These two loci intersect where  $x_r = \hat{x}_R - \hat{x}_p$ , or  $x_R = 0$ . Thus the locus of points where the numerator vanishes lies everywhere above the locus of points where the denominator vanishes. Below the locus of points where the numerator vanishes, the numerator is positive. Thus the isocost loci  $V_{R|R,B}$  is positively sloped above the locus  $B_{R|R,B}$  and below the  $N_{R|R,B}$  locus, and negatively sloped both below the  $B_{R|R,B}$  locus and above the  $N_{R|R,B}$  locus.

<sup>11</sup> This is in contrast to the case where all politicians are non-ideological (i.e.,  $T \equiv \{B\}$  so all interest groups know the type), but not necessarily in contrast to the case where politicians are ideological (i.e.,  $T \equiv \{N, L, R, B\}$ ) and where all interest groups have *full information*. In the latter case, for politicians of types  $R$  and  $B$ ,  $x_R > 0$  and  $x_r > 0$ , and for politicians of types  $L$  and  $N$ ,  $x_R = x_r = 0$ . Thus a sample of many politicians would appear to have positively sloped reaction functions.

## Signaling To Enemies

Consider next the case where there are only two active interest groups, as before, but now group  $R$  faces an enemy (group  $L$ ) instead of a friend. (Group  $r$  is inactive.) Group  $R$ 's preferences are thus:

$$(9) \quad \begin{aligned} V_{R/B}(x_R, x_L) &= (\hat{x}_R - \hat{x}_p + x_R - x_L)^2 + \phi_R x_R^2, & t = B, \\ V_{R/L}(x_R, x_L) &= (\hat{x}_R - \hat{x}_p + x_L)^2 + \phi_R x_R^2, & t = L, \\ V_{R/R}(x_R, x_L) &= (\hat{x}_R - \hat{x}_p - x_R)^2 + \phi_R x_R^2, & t = R, \\ V_{R/N}(x_R, x_L) &= (\hat{x}_R - \hat{x}_p)^2 + \phi_R x_R^2, & t = N. \end{aligned}$$

$R$  is indifferent to what  $L$  does if the politician is type  $N$  (in which case  $x_R^* \equiv x_R^N = 0$ ) or the type is  $R$  (in which case  $x_R^* \equiv x_R^R = (\hat{x}_R - \hat{x}_p)/(1 + \phi_R)$ ).<sup>12</sup> Thus  $L$  must place zero probability on these types following other strategies, i.e.,  $\mu_L(N | x_R \neq 0) = 0$  and  $\mu_L(R | x_R \neq x_R^R) = 0$ . Thus, when group  $R$  signals only to group  $L$  (an enemy), the equilibrium cannot involve all types pooling on the same contribution level. Since an  $L$ - or  $B$ -type  $R$  cannot pass himself off as an  $N$ - or  $R$ -type  $R$  by choosing any strategy other than  $x_R = 0$  or  $x_R = x_R^R$ , respectively, if there is pooling in equilibrium, it must either be a partial pooling equilibrium, with sets of different types pooling on the same contribution level, or a hybrid partial pooling equilibrium with  $B$ - or  $L$ -type  $R$ 's randomizing between different contribution levels. Each of these is possible under certain parametric assumptions.

Given his beliefs after observing  $x_R$ ,  $L$ 's expected costs are:

$$\begin{aligned} E(V_L | x_R) &= \mu_L(R | x_R)(\hat{x}_p + x_R - \hat{x}_L)^2 + \mu_L(B | x_R)(\hat{x}_p + x_R - x_L - \hat{x}_L)^2 \\ &\quad + \mu_L(L | x_R)(\hat{x}_p - x_L - \hat{x}_L)^2 + \mu_L(N | x_R)(\hat{x}_p - \hat{x}_L)^2 + \phi_L x_R^2. \end{aligned}$$

$L$ 's optimal contribution level, given his beliefs after observing message  $x_R$ , is:

$$(10) \quad x_L^*(x_R) = \frac{[\mu_L(B | x_R) + \mu_L(L | x_R)](\hat{x}_R - \hat{x}_p) + \mu_L(B | x_R)x_R}{\mu_L(L | x_R) + \mu_L(B | x_R) + \phi_L}.$$

To characterize the equilibria, we need to know the shapes of the indifference (isocost) curves for group  $R$  when  $R$  is an  $L$ - or  $B$ -type. (An  $N$ - or  $R$ -type group  $R$  always chooses  $x_R^* = x_R^N = 0$  or  $x_R^* = x_R^R$ ,

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<sup>12</sup> While the value  $x_R^R$  depends on which other groups are active, the outcome that an  $R$ -type  $R$  always chooses  $x_R^R$  is invariant to which groups are active.

respectively, so their indifference curves are irrelevant.) An  $L$ -type  $R$ 's isocost curves have slope

$$\frac{dx_R}{dx_L} \Big|_{dV_{R/L}=0} = -\frac{\hat{x}_R - \hat{x}_p + x_L}{\phi_R x_R} < 0.$$

Thus an  $L$ -type  $R$  has negatively sloped indifference curves which become perfectly vertical as they cross the  $x_L$  axis. An  $L$ -type  $R$ 's costs decline as one moves towards the origin.

A  $B$ -type  $R$  has indifference curves with slopes

$$\frac{dx_R}{dx_L} \Big|_{dV_{R/B}=0} = \frac{\hat{x}_R - \hat{x}_p - x_R + x_L}{\hat{x}_R - \hat{x}_p - x_R + x_L - \phi_R x_R} \equiv \frac{\hat{x}_R - \hat{x}_p - x_R + x_L}{B_{R/B}} \geq 0,$$

where the denominator  $B_{R/B}$  is group  $R$ 's (Nash) best response function given  $x_L$  in the full-information model when the politician is of type  $B$ . The best response loci  $B_{R/B}$  has a positive intercept and a slope that is positive but less than unity. Near the best response curve the numerator is positive since it equals  $\phi_R x_R > 0$  along the best response curve. In addition  $dB_{R/B}/dx_R = -(1 + \phi_R)$ , so above the best response loci a  $B$ -type  $R$ 's indifference curves are negatively sloped, and below they are positively sloped. A  $B$ -type  $R$ 's costs decline as one moves towards the  $x_R$  axis.

Let us first characterize a *partial pooling* equilibrium with  $B$ - and  $R$ -type  $R$ 's pooling on  $x_R^* = x_R^R$  and  $L$ - and  $N$ -type  $R$ 's pooling on  $x_R^* = 0$ . By Bayes' rule group  $L$ 's beliefs must satisfy:  $\mu_L(L | x_R^R) = \mu(N | x_R^R) = \mu_L(B | 0) = \mu_L(R | 0) = 0$ ,  $\mu_L(L | 0) = \pi_L/(\pi_L + \pi_N)$ ,  $\mu_L(N | 0) = \pi_N/(\pi_L + \pi_N)$ ,  $\mu_L(R | x_R^R) = \pi_R/(\pi_R + \pi_B)$ , and  $\mu_L(B | x_R^R) = \pi_B/(\pi_R + \pi_B)$ . From (10), we see that

$$(11) \quad x_L^*(0) = \frac{\pi_L(\hat{x}_p - \hat{x}_L)}{\pi_L + \phi_L(\pi_L + \pi_N)} \quad \text{and} \quad x_L^*(x_R^R) = \frac{\pi_B(\hat{x}_p - \hat{x}_L + x_R^R)}{\pi_B + \phi_L(\pi_B + \pi_R)}$$

(Even though  $x_R^R$  appears in  $x_L^*(x_R^R)$  and not in  $x_L^*(0)$ , it cannot be determined which is larger without knowing the magnitudes of the  $\pi_i$  and  $\phi_i$ .) For this equilibrium to hold, it must be that no type  $R$  wishes to deviate by trying to pass himself off as another type. This is clearly satisfied for an  $R$ -type  $R$  and for an  $N$ -type  $R$ , because each of these types gets its preferred outcome. However, it does not necessarily hold for either the  $L$ - or the  $B$ -type  $R$ . In Fig. 2, neither an  $L$ - or a  $B$ -type  $R$  wish to deviate

from the equilibrium.<sup>13</sup> An  $L$ -type  $R$  increases his costs if he tries to pass himself off as an  $R$ - or a  $B$ -type by contributing  $x_R^R$  instead of 0. Similarly, a  $B$ -type  $R$  increases his costs if he tries to pass himself off as an  $N$ - or  $L$ -type.

The empirical implication of the partial pooling equilibrium with signaling to enemies can be observed by recalling that when the politician is non-ideological (i.e.,  $T = \{B\}$ ), the reaction functions are positively sloped. This may or may not hold when there are multiple ideological types and asymmetric information. In particular, when  $x_L^*(x_R^R) < x_L^*(0)$ , the observed reaction function may be negatively sloped. However, unlike the signaling to friends case, it is the asymmetric information that causes the reversal in the reaction function slopes, not the fact that there are multiple ideological types.<sup>14</sup> This allows us to distinguish between alternative hypotheses regarding information and ideological types.

The partial-pooling signaling equilibrium depends upon the *shape* of the indifference curves for  $R$ -type and  $B$ -type  $R$ 's as well as the relative locations of  $x_L^*(x_R^R)$  and  $x_L^*(0)$ . Thus there are several ways in which the partial pooling equilibrium may fail. However, in each case it can be shown that there does exist a hybrid partial-pooling equilibrium in which the  $L$ - or  $B$ -types randomize between playing  $x_R = x_R^R$  and  $x_R = 0$  or the  $B$ -types randomize between  $x_R = x_R^B$  and  $x_R = x_R^R$ .

In Fig. 3 the partial pooling equilibrium fails because the  $B$ -type  $R$  has lower costs if he can pass himself off as an  $L$ - or  $N$ -type. Suppose, however, that the  $B$ -type  $R$  randomizes by contributing  $x_R = x_R^R$  with probability  $p$  and  $x_R = 0$  with probability  $1-p$ . Group  $L$ 's beliefs must be  $\mu_L(B | x_R^R) = p\pi_B / (p\pi_B + \pi_R)$ ,  $\mu_L(R | x_R^R) = \pi_R / (p\pi_B + \pi_R)$ ,  $\mu_L(L \text{ or } N | x_R^R) = 0$ ,  $\mu_L(B | 0) = (1-p)\pi_B / [(1-p)\pi_B + \pi_L + \pi_N]$ ,  $\mu_L(L | 0) = \pi_L / [(1-p)\pi_B + \pi_L + \pi_N]$ ,  $\mu_L(N | 0) = \pi_N / [(1-p)\pi_B + \pi_L + \pi_N]$ , and  $\mu_L(R | 0) = 0$ . Using (10), we obtain

$$(12) \quad x_L^*(0, p) = \frac{[(1-p)\pi_B + \pi_L](\hat{x}_p - \hat{x}_L)}{(1-p)\pi_B + \pi_L + \phi_L[(1-p)\pi_B + \pi_L + \pi_N]} \quad \text{and} \quad x_L^*(x_R^R, p) = \frac{p\pi_B(\hat{x}_p - \hat{x}_L + x_R^R)}{p\pi_B + \phi_L(p\pi_B + \pi_R)}$$

The notation  $x_L^*(x_R, p)$  is used to differentiate  $L$ 's contributions in (12) from the case where there is no

<sup>13</sup> Fig. 2 also shows why no separating equilibrium exists. A  $B$ -type  $R$ 's will want to pass himself off as an  $R$ -type  $R$  since a  $B$ -type  $R$ 's costs are minimized at  $(0, x_R^R)$ .

<sup>14</sup> Suppose that each interest group is fully informed, but that all four politician types are represented in the sample. The estimated reaction functions will fit through the  $(x_L, x_R)$  points  $\{(0, 0), (0, x_R^R), (x_L^L, 0), (x_L^B, x_R^B)\}$ , so will have a positive slope so long as the  $B$ -type  $R$  and  $L$ 's (Nash) best response functions are positively sloped.

randomization by the  $B$ -type  $R$  as in (11). Taking the limit as  $p \rightarrow 1$  yields  $x_L^*(0, 1) = x_L^*(0)$  and  $x_L^*(x_R^R, 1) = x_L^*(x_R^R)$ . Thus the equilibrium fails for  $p = 1$ . However, taking the limit as  $p \rightarrow 0$  yields:

$$\lim_{p \rightarrow 0} x_L^*(0, p) = \frac{(\pi_B + \pi_L)(\hat{x}_p - \hat{x}_L)}{\pi_B + \pi_L + \phi_L(\pi_B + \pi_L + \pi_N)} > 0 \quad \text{and} \quad \lim_{p \rightarrow 0} x_L^*(x_R^R, p) = 0.$$

As the  $B$ -type  $R$  increases the chances that he contributes 0 rather than  $x_R^R$  (i.e., as  $p$  decreases),  $x_L^*(x_R^R, p)$  approaches zero and  $x_L^*(0, p)$  approaches some positive level. Thus there exists a  $p^* \geq 0$  such that the  $B$ -type is indifferent between the two outcomes. Therefore, if the partial pooling equilibrium does not exist because a  $B$ -type  $R$  to wants to deviate by playing 0 rather than  $x_R^R$ , a hybrid-partial pooling equilibrium does exist, with the  $B$ -type  $R$  randomizing between  $x_R^R$  and 0.

Two other examples where the partial pooling equilibrium in Fig. 2 fails are examined in the Appendix. In each case, the result is a hybrid partial pooling equilibrium.

### *Cheap Talk By Politicians*

So far it has simply been assumed that the politician cannot credibly signal his type. Here we show that the reduced form influence function (3) is associated with a politician's utility function for which this is true. Politicians have different preferences for policy outcomes depending upon their type, but all politicians are assumed to prefer more campaign contributions to fewer (e.g., Snyder 1991, Grossman and Helpman 1994, Groseclose and Snyder 1996, Dixit, Grossman and Helpman 1997). Let  $G$  be the set of all active interest groups and  $\Gamma$  be the set of all potential interest groups (i.e.,  $G \subseteq \Gamma$ ). The *net costs* to a politician of type  $t$  for policy  $x$ , given contributions  $\mathbf{x}_g$ , are

$$(13) \quad \begin{aligned} V_p(x, \mathbf{x}_g | B) &= \sum_{g \in \Gamma} (\hat{x}_g + x_R + x_r - x_L - x)^2 - \sum_{g \in G} x_g, & t = B, \\ V_p(x, \mathbf{x}_g | R) &= \sum_{g \in \Gamma} (\hat{x}_g + x_R + x_r - x)^2 - \sum_{g \in G} x_g, & t = R, \\ V_p(x, \mathbf{x}_g | L) &= \sum_{g \in \Gamma} (\hat{x}_g - x_L - x)^2 - \sum_{g \in G} x_g, & t = L, \\ V_p(x, \mathbf{x}_g | N) &= \sum_{g \in \Gamma} (\hat{x}_g - x)^2 - \sum_{g \in G} x_g, & t = N. \end{aligned}$$

The policy  $x$  that minimizes (13) is given by (3), with  $\hat{x}_p = \sum_{g \in \Gamma} \hat{x}_g / n_G$ , where  $n_G$  is the number of active

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Thus negatively sloped reaction functions occur with enemies only if there is asymmetric information.

interest groups.<sup>15</sup> The first term in the politician's utility function is almost, but not quite, a social welfare function in the policy costs of the interest groups. The second term implies that the politician's costs are lowered by increased campaign contributions.<sup>16</sup> When the type is  $N$ , the first term in (13) is the sum of policy costs to the interest groups. Thus an  $N$ -type politician minimizes social policy costs by his choice of the policy  $x$ . An  $L$ -type politician chooses the policy to minimize  $\sum_g (\hat{x}_g - x_L - x)^2$ , which minimizes social costs with the preferred policy of each group shifted to the left by  $x_L$  units. An  $R$ -type politician in essence shifts the preferred policy of each group to the right by  $x_r + x_R$  units, and a  $B$ -type politician shifts them in net by  $x_r + x_R - x_L$  units. Thus the effect of ideology is to make the politician more sympathetic to the views of groups on one side or the other of the issue (type- $L$  or type- $R$ ) or to all interest groups (type- $B$ ). A type- $N$  politician is unpersuaded by any interest group. Each type of politician chooses the policy such that, from his perspective, social costs are minimized. Each ideological position reflects an assumption about how the world works, and each politician type seeks to minimize social costs, given his world-view.

An important consequence of (3) is that the net utility of the politician depends only upon the contribution levels. Substitution of (3) into (13) yields

$$(14) \quad V_p(\mathbf{x}_g | t) = \sum_{g \in \Gamma_P} (\hat{x}_g - \hat{x}_p)^2 - \sum_{g \in \Gamma_G} x_g, \text{ for all } t \in T.$$

Thus politicians of all types will prefer to maximize aggregate contributions. For example, suppose that with full information aggregate contributions are maximized when the politician is type  $B$ . This means that no separating equilibrium is possible in a "cheap talk" game where the politician announces his type in the form of a message such as " $t = L$ ," because any non- $B$ -type politician will always wish to pass himself off as a  $B$ -type politician. Thus politicians cannot credibly reveal their type by talk alone (*cf.* Harrington 1992), because the politician desires more campaign contributions and because by (14) the actions of the interest groups affect the politician only through the transfer of campaign contributions. However, as we saw above, in spite of this the politician's type is (partially)

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<sup>15</sup> Thus in the event that  $G \equiv \Gamma$ ,  $\hat{x}_p = \sum_{g \in \Gamma} \hat{x}_g / n_\Gamma$ , which is the average policy preference of society, and is the value that minimizes the sum of policy costs to all interest groups (*cf.*, Dixit, Grossman, and Helpman 1997).

<sup>16</sup> Campaign contributions are assumed to be valuable to the politician because he is able to provide (dis)information to voters that helps him get reelected (e.g., Chappell 1994, Schultz 1995, Eichenberger and Serna 1996). See also Coate and Morris (1995) for an alternate view on this issue.

revealed—although not by the politician.

### 3. Testing Among Alternative Models

There are two ways to test among the various possible models: by estimating the slopes of the reaction functions for campaign contributions of competing interest groups, and by examining how campaign contributions affect the way politicians vote.

Consider first the reaction function slopes. Let the preferred level of campaign contributions by group  $g$  take the following form:

$$(15) \quad x_g^* = \alpha_g y + \beta_g z_g + \sum_{h \neq g} \gamma_{gh} x_h + \varepsilon_g, \quad g \in G,$$

where  $x_g$  is a  $P \times 1$  vector with  $P$  the number of politicians in the sample,  $y$  ( $P \times K$ ) is a set of characteristics affecting the politician's reservation price (generic to each equation),  $z_g$  ( $P \times 1$ ) is a variable that identifies the  $g$ th contribution equation (discussed below),  $\varepsilon_g$  ( $P \times 1$ ) is the econometric error, and  $\alpha_g$ ,  $\beta_g$ , and  $\gamma_{gh}$  are parameters to be estimated. Note that  $x_g = x_g^*$  if  $x_g^* > 0$  and  $x_g = 0$  otherwise, thus censoring occurs because the econometrician observes only  $x_g$ . However, interest group  $g$  observes  $x_h$ , not  $x_h^*$ , so it is  $x_h$  that appears on the right-hand-side of (15).

The parameter  $\gamma_g$  is the  $[(n_G - 1) \times 1]$  vector of reaction function slopes. The null hypothesis is that  $\gamma_g = 0$ , but there are three possible alternative hypotheses. Let  $\gamma_{gh}$  be the  $h^{\text{th}}$  element of this vector. In the non-ideological model (i.e.,  $T \equiv \{B\}$ ), the reaction functions are negatively sloped for  $g$  and  $h$  friends ( $\gamma_{gh} < 0$ ) and positively sloped for  $g$  and  $h$  enemies ( $\gamma_{gh} > 0$ ). In either the signaling model or the full-information model when politicians are ideological (i.e.,  $T \equiv \{N, L, R, B\}$ ), zero (positive) contributions from a friend will result in zero (positive) contributions, so  $\gamma_{gh} > 0$ . Thus it is possible to distinguish only between ideological and non-ideological models when groups  $g$  and  $h$  are friends. For  $g$  and  $h$  enemies, if the groups have full information the reaction functions are positively sloped ( $\gamma_{gh} > 0$ ), whether politicians are ideological or not.<sup>17</sup> But in the signaling model the slope may be positive or negative, depending upon whether  $x_g(0) \gtrless x_g(x_h)$ , either of which is possible.<sup>18</sup> Thus a negatively

<sup>17</sup> See footnote 14 above.

<sup>18</sup> A necessary condition for  $x_L^*(0) > x_L^*(x_R^R)$  is that  $\pi_L \pi_R > \pi_B \pi_L$ . Roughly speaking, this occurs so long as the

sloped reaction function for enemies is consistent only with the signaling model.

The model also provides testable hypotheses regarding how a member of Congress's preferred policy  $x$  changes in response to campaign contributions. Equation (3) describes which policy will be chosen by the politician given his preferences and the contributions of the interest groups. In the non-ideological model all politicians are type  $B$ , so increased contributions from the left should move the policy to the left (right) should move the policy to the left (right). When politicians have different ideologies the problem is more complicated, since the econometrician does not observe the politician's type.<sup>19</sup> However, if interest group  $R$  observes that the politician is type  $N$  or  $L$ , then  $x_R^* = 0$ , otherwise  $x_R^* = x_R^R > 0$ . A zero contribution indicates that the politician is not responsive to the interest group, i.e.,  $\Pr(t = L \text{ or } N) \approx \Pr(x_R = 0)$ .<sup>20</sup> Thus the predicted value of  $\Pr(t = B \text{ or } R) = 1 - \Pr(t = L \text{ or } N) \approx 1 - \Pr(x_R = 0)$  can be used as an indicator of the probability that the type is  $B$  or  $R$ . Similarly,  $\Pr(t = R \text{ or } N) \approx \Pr(x_L = 0)$  for group  $L$ . The politician's preferred policy choice given in (3) may be then written as (ignoring group  $r$ ):

$$(3') \quad x = \hat{x}_p + [1 - \Pr(x_R = 0)]x_R - [1 - \Pr(x_L = 0)]x_L.$$

Let  $v_j^*$  denote the utility a legislator obtains from supporting an amendment that changes the policy from  $x_0$  to  $x_j$ . An econometric specification of (3') is:

$$(16) \quad v_j^* = \theta_j y + \delta_{Rj} x_R + \delta_{Lj} x_L + \phi_{Rj} x_{Rj} I_R + \phi_{Lj} x_{Lj} I_L + \kappa(x_j - x_0) + \upsilon_j, \quad j = 1, \dots, J,$$

where  $v_j = 1$  if  $v_j^* > 0$  and  $v_j = 0$  otherwise,  $I_g = 1$  if  $x_g^* < 0$  and  $I_g = 0$  otherwise,  $\upsilon_j$  is the econometric error, and  $\theta_j, \delta_{gj}, \phi_{gj}$ , and  $\kappa_j$  are parameters to be estimated.<sup>21</sup> If ideology is a fixed set of preferences (e.g., Levitt 1996), then  $\delta_g = \phi_g = 0$  for all  $g \in G$ . Suppose that vote  $v_j$  moves the policy to the right if adopted. In the non-ideological model, this implies  $\delta_R > 0$  and  $\delta_L < 0$ , but it also implies  $\phi_R = \phi_L = 0$

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chance of being an ideologue on one side or the other is greater than not being an ideologue. Thus, for example, if  $\pi_L = \pi_R = 1/3$  and  $\pi_B = \pi_N = 1/6$ , the necessary condition is satisfied, but would not be if  $\pi_L = \pi_R = 1/6$  and  $\pi_B = \pi_N = 1/3$ . However, note that the condition cannot hold in the event that  $\pi_i = 1/4$  for all  $i$ .

<sup>19</sup> This is further complicated by the fact that we do not know which interest group (if any) is informed.

<sup>20</sup> If  $R$  is informed, then  $\Pr(x_R = 0 \mid t = N \text{ or } L) = 1$ . Suppose that  $\Pr(x_R = 0 \mid t = B \text{ or } R) = w \geq 0$  (majority rule can cause  $w > 0$ , e.g., Stratmann 1991, 1992). Then by Bayes' rule,  $\Pr(t = L \text{ or } N \mid x_R = 0) = (\pi_L + \pi_N)/[\pi_L + \pi_N + w(\pi_R + \pi_B)]$ , which approaches 1 as  $w$  approaches 0.

<sup>21</sup> Since  $x_j - x_0$  is a constant (it is the same for every legislator) it is subsumed into the intercept.

since  $I_g$  will be white noise. When ideology is important,  $\delta_R > 0$  and  $\delta_L < 0$  as with the non-ideological model, but  $\phi_R < 0$  and  $\phi_L > 0$ , since the groups' contribution decisions depend upon their beliefs about the politician's ideology. Similar results hold if vote  $v_j$  moves the policy to the left.

### *Estimation Methodology*

The equations (15) and (16) form a system of equations which are estimated using instrumental variables. Since there are a large proportion of zero contributions, the contribution equations (15) are estimated by tobit. The vote equations (16) are estimated by probit. Econometric models in which a single contribution equation is jointly estimated with a single voting equation have been estimated using full information maximum likelihood methods by Chappell (1981, 1982) and Stratmann (1991, 1992). However, with multiple contributions equations (four in this case) and multiple vote equations (up to seven) this is not feasible.<sup>22</sup> Thus, a two-stage estimation procedure suggested by Nelson and Olson (1978) for large simultaneous probit-tobit models is used. This method is computationally simple to use and provides consistent estimators.<sup>23</sup> First, the reduced form contribution equations are estimated using tobit. The reduced form predicted contributions,  $\hat{x}_g$ , are used as instruments to estimate the structural equations (15), and the predicted structural equations contributions,  $\hat{x}_g$ , are used as instruments in the vote equations (16).<sup>24</sup> Instrumental variables for the indicator variables  $I_g$  are obtained using the same two-stage method applied to (15) using probit estimation. The vote equations (16) are estimated using probit with  $\hat{x}_g$  and  $\hat{I}_g$  used as instruments for  $x_g$  and  $I_g$ .<sup>25</sup>

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<sup>22</sup> Nelson and Olson (1978, p. 698) state that "maximization is computationally feasible [for the likelihood function of a two equation probit-tobit model] ... but as other limited dependent variables are added the occurrence of multiple integrals in the likelihood function will make the computational costs prohibitive, so FIML is not a viable estimation procedure for the general model." Maddala (1983, p. 198), speaking of the Nelson and Olson model, adds "[w]ith more truncated and censored variables, the maximum likelihood estimation method becomes more cumbersome, because each truncated or censored variable introduces an integral sign in the likelihood function." Maddala (Section 8.8, Model 5) recommends estimating the model as follows: "The reduced forms are estimated by the tobit and probit methods, respectively; the structural equations are estimated by the second-stage tobit and the two-stage probit methods, respectively."

<sup>23</sup> Amemiya (1979) and Lee, Maddala, and Trost (1980) consider the asymptotic properties of these models.

<sup>24</sup> The predicted  $x_g$  variables, not the predicted  $x_g^*$  variables, are used as instruments in both the contributions equations and the vote equations. This is consistent with the information that is available to the interest groups.

<sup>25</sup> One issue that arises in the contribution equation is that of identification. To resolve the identification problem, the structure used by Stratmann (1992) is adopted. This assumes that PACs concentrate their contributions in the center of the ideology distribution since the Congress operates on a majority-rule basis (Denzau and Munger 1986). Specifically, the  $y$  variables in (15) include a linear term for each of the interest group's employment share (or percent of adults who are members in environmental organizations) in the state from which the Congressman serves. The  $z_g$  variable is the squared value of the interest group's employment (or

#### 4. Empirical Results

The empirical tests of the contribution equation model (15) were conducted using political action committee (PAC) contribution data for four interest groups affected by the Alaska oil export ban, using the U.S. House and Senate as separate data sets.<sup>26</sup> When Congress approved construction of the Trans-Alaska pipeline in 1973, it required that oil transported over the pipeline not be exported. The ban was lifted in 1995 after the Republican Party gained control of both the House and the Senate with the 104<sup>th</sup> Congress.

The U.S. Department of Energy estimated the net gains from relaxing the ban on the order of \$500 million (Department of Energy 1994). The crude oil producers in Alaska were expected to become suppliers in the lucrative Asian markets; if this occurred the domestic price would rise, benefiting all domestic crude oil producers. However, the rise in prices would hurt oil refineries (the downstream part of the industry). The existing ban also required that oil shipped between Alaska and other U.S. ports be transported on U.S. flagged vessels. This requirement did not apply to goods shipped to a foreign port, so without the ban the U.S. maritime industry would face competition in its formerly protected market. The oil export ban was also supported by environmentalists, since the ban reduced the price crude oil companies received and thereby reduced oil production. Thus three of the groups (oil refineries, the maritime industry, and environmentalists) are on the same side of the issue, and the crude oil companies are on the other side.

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membership) share. Identification occurs because  $z_g$  appears only in the  $g$ th equation.

Also included in  $y$  are variables to control for differences in the politician's constituency and the politician herself. Constituency variables include the 1992 Clinton presidential vote (to measure liberal constituency), the percent urban (because rural and suburban dwellers have a more inelastic demand for oil), the per capita oil BTU consumption (to measure demand for oil), and median family income (because the environment is a normal good). Data describing the Congressman or Senators include the vote received in the most recent election (to measure security of the seat), the number of years served in office (to measure the member's power), the party with Republican = 1 and Democrat = 0 (to measure national constituency differences), the League of Conservation Voters score (to measure pro-environment voting tendencies), and the American Security Council's National Security Index (to measure pro-national security voting tendencies), and whether or not she is a member of the Resources or International Affairs Committees (since these committees dealt with the legislation). Stratmann (1996) suggests that contributions by PACs may be targeted to members who face hostile constituencies. We control for this using a pair of instrumental variables derived from the magnitudes of the residuals of a probit regression using constituency variables to predict party. The full regression results are available from the author.

<sup>26</sup> Boyce, Splitstoser, and Bischak (1997) estimated a non-ideological model using these data. They discuss the legislative history of the Alaska oil export ban in more detail.

## Results for the Contributions Equations

For each interest group, contributions are measured as the sum of contributions each politician received from all members of the interest group during the 103<sup>rd</sup> Congress (1993-1994) election cycle. The analysis is restricted to incumbents who were reelected to the Congress in the 104<sup>th</sup> Congress.<sup>27</sup>

Tables 1 and 2 present the second-stage tobit estimation results for slopes of the reaction functions from the contributions equations (15) for the House and Senate, respectively. Looking first at the House votes in Table 1, we see that crude oil contributions (column 1) are positively related to both maritime and oil refinery contributions and negatively related to contributions from green organizations. In the maritime equations (column 2), increased crude oil contributions result in increased maritime contributions. The positive signs on maritime and oil refinery contributions in the crude oil equation and on crude oil contributions in the maritime contributions equation are consistent with both the ideological and non-ideological models. The negative sign on contributions from environmental organizations in the crude oil equation, however, is consistent only with the signaling model, since both the non-ideological model and the ideological model with full information imply that the reaction functions for enemies will be positively sloped. The crude oil industry takes the signal of positive contributions by environmental groups as an indication that the congressman's type is "pro-export ban."<sup>28</sup> Oil refinery contributions (column 3) are not affected by contributions from the other groups. Contributions by environmental organizations (column 4) are positively related to oil refinery contributions. This result cannot occur in the non-ideological model but may occur whether or not there is asymmetric information in the ideological model.

The Senate contributions equations results are in Table 2. There are five instances in which

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<sup>27</sup> This excludes members who would retire or be defeated in the 1994 elections. However, none of these members would be voting on the legislation. It also excludes newly elected members of the 104<sup>th</sup> Congress. However, these members do not have established voting records, and as these are used as instruments in the regressions below, they could not be included. The data source is the *Almanac of American Politics 1994* (Barone 1995), which reports lagged values of voting index scores.

<sup>28</sup> The result in Table 1 that crude oil contributions respond differently to environmentalist contributions than to maritime contributions when both are "enemies" may need to be studied further. Using a two-receiver version of (11) it is possible to show that circumstances exist where  $x_L^*(0) - x_L^*(x_R^R) > 0$  and where  $x_I^*(0) - x_I^*(x_R^R) < 0$ , for two enemies  $L$  and  $I$  receiving a signal from  $R$ . (This holds, for example, under the following values:  $\pi_L = \pi_V = 1/3$ ,  $\pi_R = \pi_B = 1/6$ ,  $\hat{x}_L = 0$ ,  $\hat{x}_I = 1/10$ ,  $\hat{x}_R = 1$ ,  $\hat{x}_P = 3/11$ ,  $\phi_R$  large enough such that  $x_R^R < 1/7$ , and  $\phi_L$  and  $\phi_I$  both positive). But whether a *single* receiver facing two informed enemies would react differently to their respective signals is unclear from the present model.

contributions from one group affect the level of contributions from another. Of these results only the positive sign on oil refinery contributions in the crude oil contributions equation (column 1) is consistent with the non-ideological full information model. However, it is also consistent with either of the ideological models. The other four significant results are all examples of positively sloped reaction functions among friends, which is consistent with either ideological model (full or asymmetric information) but not with the non-ideological model.

Note that the contributions equations results for both houses strongly reject the null hypothesis that ideology is a fixed set of preferences. Also strongly rejected is the alternative hypothesis that politicians are equally receptive to contributions from groups on both sides of the issue (the non-ideological model). All of the statistically significant coefficients support the hypothesis that politicians are ideological in the manner predicted by the asymmetric information model, and the finding in the House that environmentalist contributions have a negative effect on crude oil contributions rejects the hypothesis that interest groups have symmetric information (the effect would be positive in this case). Not only does ideology appear to be important in explaining the pattern of interest group campaign contributions, but there is also support for the asymmetric information hypothesis.

### *Results for Vote Equations*

Table 3 presents the second-stage probit estimation results for the vote equations (16) for a selection of House and Senate votes.<sup>29</sup> There were a total of seven roll-call votes in the House and

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<sup>29</sup> The House votes include a binding resolution to forward the Resource Committee bill (HR 70) to the floor for consideration by the full House (passed 361-54), the vote on the House version of the bill (which passed 324-77 on July 24, 1995), an amendment by Gejdensen (D-Connecticut) to require U. S. flagged vessels to carry all oil exported (the existing bill required U. S. flagged vessels only when one was available—the amendment failed 117-278 on July 25, 1995), an amendment by Miller (D-California) to allow exports only when there was excess supply on the west coast (the existing bill had no such restriction—the amendment failed 95-310 on July 25, 1995), a non-binding resolution sponsored by Miller to instruct the House conference committee members to insist on removing the royalty exemption from the conference bill (the royalty exemption was in the Senate version but not the House version—the resolution was passed 261-161 on July 25, 1995), an amendment by Miller to remove the royalty exemption from the conference committee bill (the amendment failed 160-261 on July 25 1995), and the vote to adopt the conference committee version of the bill (passed 289-134 on November 13, 1995). The reason the House version of the bill passed prior to its amendments is that the House passed its version of the bill on July 24, 1995. Then on July 25, by voice vote, it substituted the text of HR 70 for the Senate passed bill (S. 395). The July 25<sup>th</sup> amendments are all to S. 395, which then contained the language of the House bill.

The Senate votes include a motion by Murkowski (R-Alaska) to table the substitute to S. 395 authored by

three in the Senate, of which Table 3 presents results for five House and two Senate votes.<sup>30</sup>

In Table 3, columns 1-3 contain results from votes where a ‘Yes’ (‘Yes’ = 1, ‘No’ = 0) is in opposition to lifting the Alaska oil export ban, while columns 4-7 contain results from votes where a ‘Yes’ is in support of lifting the export ban. Expected signs under the signaling model are indicated to the left of each set of votes. Crude oil, maritime, and oil refinery contributions are significant with the expected signs in two or more votes each. Environmentalist contributions are only significant in one vote (the non-binding House resolution to remove the royalty exemption), and have the “wrong” sign.<sup>31</sup> With this exception, the results are supportive of either the non-ideological or the signaling model. The null hypothesis of static ideological preferences is strongly rejected.

The difference in the non-ideological and the ideological model is in the “informed against” variables at the bottom of the table, which are the instrumental variables for the probability of a zero contribution from each group times the contribution instrumental variable. The non-ideological model predicts that these coefficients will be zero. The ideological models predict that these coefficients will have the opposite sign of the contribution variables. There are six statistically significant results in this set of variables across three votes (all in the House). In each case the sign of each statistically significant result is the sign predicted in the ideological model. Thus the non-ideological model is strongly rejected by the vote data.

## 5. Discussion and Conclusions

This paper has developed and tested an economic model of interest group competition to influence policy when some interest groups are uncertain about the ideology of the politician. In this model a politician’s ideology is treated as a willingness to respond to campaign contributions (relative

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Murray (D-Washington) (adopted 80-6 on May 15, 1995). The effect of Murkowski’s motion was to kill the substitute (the Administration was supportive of S. 395, but not the substitute). The Senate approved its version of S. 395 74-25 on May 16, 1995. The conference committee bill (titled S. 395) was adopted by the Senate on November 14, 1995 with a 69-29 vote. President Clinton signed the bill into law on November 28, 1995. The first exports began in June of 1996.

<sup>30</sup> Excluded are the Miller amendment in the House to allow exports only if in excess of west coast demand (which did not have any variables of interest that were statistically significant), the House vote on the House version of the bill (which was immediately voided by a voice vote adopting the Senate version as a substitute), and the Senate vote on the motion to table the Murray substitute (which only had six ‘No’ votes).

<sup>31</sup> Representative Young (R-Alaska) argued in the conference committee that the House members were “confused” as to what they were voting for on this vote, and for this reason the Conference Committee rejected the non-binding House Resolution.

to some default position) from one, neither, or both sides of an issue. The politician's response "type" is not public information. Although both the politician and an informed interest group learn the type at the beginning of the game, some interest groups are uninformed. The politician signals uninformed groups of his type by stating his (possibly truthful) policy preferences. The informed interest group then signals uninformed groups of the politician's type by making an observable campaign contribution to the politician with the intent of influencing the politician's policy choice. Uninformed interest groups observe the politician's stated preferences and the informed group's contributions, but not the politician's true ideology. Based on this information, they choose the campaign contribution to give to the politician. In the final stage of the game, the politician chooses the policy. Politicians of different types choose different policies given the same levels of campaign contributions.

Although politicians are not able to credibly signal their ideological preferences, an informed interest group can do so. While neither friends nor enemies can infer the exact type of the politician from the informed interest group's contribution, to friends of the informed interest group the informed group's contributions give all the necessary information. This is not the case with enemies, even though enemies gain some information by observing the informed interest group's contributions. Because interest groups with private information are able to completely inform their friends and only partially inform their enemies, they have an advantage over uninformed groups in their attempt to influence policy.

Since groups who are friends are able to credibly reveal information to one another, the slopes of the reaction functions will be positive rather than negative, as occurs if there is no information content to contributions. Support for this hypothesis was found using data from campaign contributions from three groups who attempted to keep the Alaska oil export ban in place. Campaign contributions from oil refineries, the maritime industry, and environmentalist organizations are found to have a positive effect on one another's contribution levels. This result is consistent with the signaling model developed in the paper, but not with a non-ideological model where politicians respond to campaign contributions from all groups. A second hypothesis that comes out of the signaling model is that the reaction functions for enemies may be negatively sloped, rather than positively sloped as occurs either in the non-ideological model or in an ideological model where all interest groups are fully informed.

Contributions from crude oil producers decrease as contributions from environmental organizations increase, a result that is only consistent with the signaling model.

A third hypothesis involves how politicians respond to campaign contributions. Non-ideological politicians are responsive to campaign contributions from either side of the issue, but the ideological model predicts that members are more likely to receive no contribution if the interest group knows that the politician will not respond to the contribution. Thus, as the probability of a zero contribution increases, it becomes more likely that the interest group knows the politician is not responsive to their side. Support for this hypothesis is found in looking at the effect of campaign contributions on votes to lift the Alaska oil export ban.

The theory developed in this paper suggests that ideology is properly viewed as a willingness by politicians to respond differently to interest groups of different persuasions. This is in contrast both to the view that ideology means policy preferences are fixed, and to the view that politicians respond equally to contributions from both sides of an issue. The evidence both from contribution patterns and from voting by members of Congress supports the hypothesis that campaign contributions are informative as well as persuasive, and rejects each of these alternative views.

#### APPENDIX: OTHER HYBRID PARTIAL-POOLING EQUILIBRIA

The equilibrium in Fig. 2 can fail if  $x_L^*(0)$  is sufficiently greater than  $x_L^*(x_R^R)$  so that the  $L$ -type  $R$  wants to pass himself off as an  $R$ - or  $B$ -type. Suppose the  $L$ -type contributes 0 with probability  $q$  and  $x_R^R$  with probability  $1-q$ . Group  $L$ 's beliefs now must be  $\mu_L(L | x_R^R) = (1-q)\pi_L / [(1-q)\pi_L + \pi_B + \pi_R]$ ,  $\mu_L(R | x_R^R) = \pi_R / [(1-q)\pi_L + \pi_B + \pi_R]$ ,  $\mu_L(B | x_R^R) = \pi_B / [(1-q)\pi_L + \pi_B + \pi_R]$ ,  $\mu_L(N | x_R^R) = 0$ , and  $\mu_L(L | 0) = q\pi_L / (q\pi_L + \pi_N)$ ,  $\mu_L(N | 0) = \pi_N / (q\pi_L + \pi_N)$ , and  $\mu_L(R | 0) = \mu_L(B | 0) = 0$ . Using (10), we obtain

$$x_L^*(0, q) = \frac{q\pi_L(\hat{x}_p - \hat{x}_L)}{q\pi_L + \phi_L(q\pi_L + \pi_N)}, \quad \text{and} \quad x_L^*(x_R^R, q) = \frac{[\pi_B + (1-q)\pi_L](\hat{x}_p - \hat{x}_L) + \pi_B x_R^R}{\pi_B + (1-q)\pi_L + \phi_L[\pi_B + \pi_R + (1-q)\pi_L]}.$$

Thus  $x_L^*(0, 1) = x_L^*(0)$  and  $x_L^*(x_R^R, 1) = x_L^*(x_R^R)$ . Taking the limit as  $q \rightarrow 0$  yields:

$$(A.1) \quad \lim_{q \rightarrow 0} x_L^*(0, q) = 0, \quad \text{and} \quad \lim_{q \rightarrow 0} x_L^*(x_R^R, q) = \frac{(\pi_B + \pi_L)(\hat{x}_p - \hat{x}_L) + \pi_B x_R^R}{\pi_B + \pi_L + \phi_L(\pi_B + \pi_R + \pi_L)} > 0.$$

As was the case with the  $B$ -type  $R$  hybrid equilibrium, we see that the larger of the two values (here,  $x_L^*(0) >$

$x_L^*(x_R^R)$  converges to zero while the smaller converges to a positive value as  $q$  approaches zero. Thus if group  $R$  signals only to group  $L$  (an enemy), and if the partial pooling equilibrium does not exist because an  $L$ -type  $R$  want to deviate by contributing  $x_R^R$  rather than 0, then a hybrid-partial pooling equilibrium exists with the  $L$ -type  $R$  randomizing between  $x_R^R$  and 0.

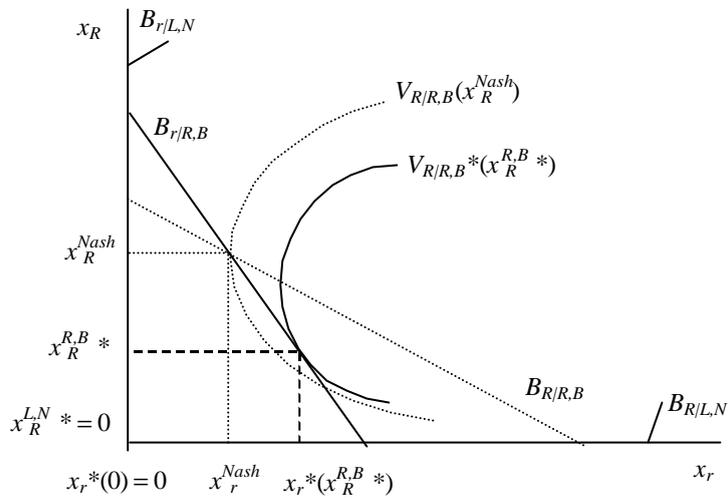
In Fig. 4, the partial pooling equilibrium fails for a different reason than the two previous cases. Here, both the  $B$ -type and  $L$ -type  $R$ 's do not wish to deviate by contributing the other partial pooling equilibrium value, but rather, the  $B$ -type  $R$  would prefer to contribute  $x_R^B$ , the Stackelberg full information value, rather than  $x_R^R$ . But if  $L$  observes  $x_R^B$ , which is off the equilibrium path,  $L$  infers (correctly) that the type is  $B$ . Suppose that the  $B$ -type  $R$  randomizes between  $x_R^B$  and  $x_R^R$ , contributing  $x_R^R$   $s$  percent of the time and  $x_R^B$  the remaining  $1-s$  percent of the time. As before, assume that  $L$ - and  $N$ -type  $R$ 's pool on 0 and  $R$ -type  $R$ 's play  $x_R^R$ . Fig. 4 shows the case where  $x_R^B > x_R^R$ . Note that a necessary condition is that  $x_R^R$  lie to the right of the  $B$ -type  $R$ 's indifference curve passing through the point  $x_R^B$ , since otherwise the  $B$ -type  $R$  prefers the partial pooling equilibrium at  $x_R^R$ .  $L$ 's beliefs under this equilibrium are  $\mu_L(B | x_R^B) = 1$ ,  $\mu_L(N \text{ or } L \text{ or } R | x_R^B) = 0$ ,  $\mu_L(B | x_R^R) = s\pi_B/(s\pi_B + \pi_R)$ ,  $\mu_L(R | x_R^R) = \pi_R/(s\pi_B + \pi_R)$ ,  $\mu_L(N \text{ or } L | x_R^R) = 0$ ,  $\mu_L(R \text{ or } B | 0) = 0$ ,  $\mu_L(N | 0) = \pi_N/(\pi_L + \pi_N)$ , and  $\mu_L(L | 0) = \pi_L/(\pi_L + \pi_N)$ . Thus  $x_L^*(0)$  satisfies (11),  $x_L^*(x_R^B) = (\hat{x}_p - \hat{x}_L + x_R^B)/(1 + \phi_L)$ , and  $x_L^*(x_R^R, s) = s\pi_L(\hat{x}_p - \hat{x}_L)/[s\pi_L + \phi_L(s\pi_L + \pi_N)]$ , which is identical to the expression for  $x_L^*(x_R^R, q)$  in (A.1) above, with  $s$  and  $q$  switched. Thus, as  $s \rightarrow 0$ ,  $x_L^*(x_R^R, s) \rightarrow 0$ . Since  $x_R^B$  remains fixed as  $s$  changes, when signaling to enemies, if the  $B$ -type  $R$ 's prefer to play the full-information Stackelberg level  $x_R^B$  to playing the partial pooling level  $x_R^R$ , then a hybrid equilibrium exists with  $B$ -type  $R$ 's randomizing between  $x_R^B$  and  $x_R^R$ , playing the latter a non-zero proportion of the time.

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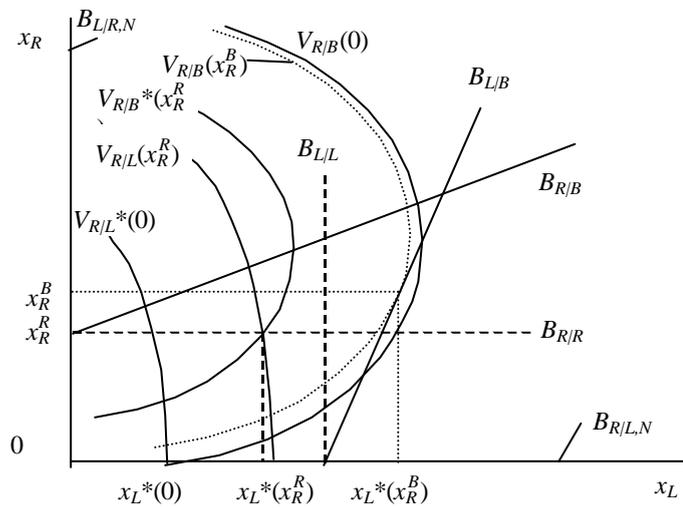
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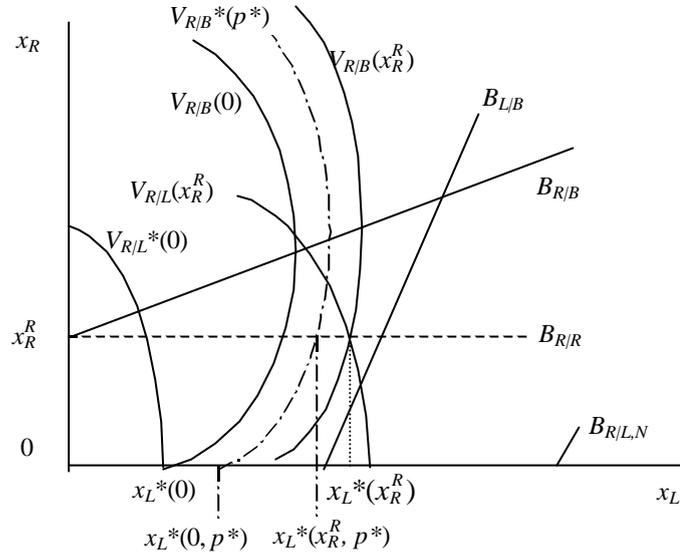
**Fig. 1: Signaling to Friends: A Pure Strategy Partial Pooling Equilibrium**



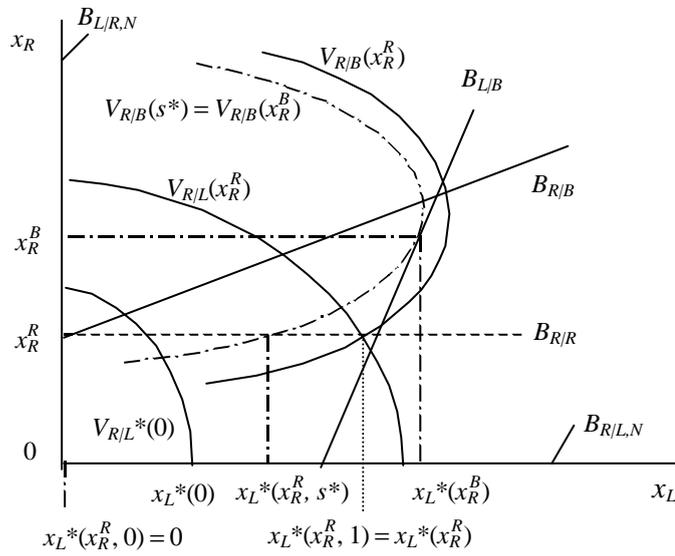
**Fig. 2: Signaling to Enemies: A Partial Pooling Equilibrium**



**Fig. 3: Signaling to Enemies: A Hybrid-Partial Pooling Equilibria with  $B$ -type  $R$ 's Randomizing on 0 and  $x_R^R$ .**



**Fig. 4: Signaling to Enemies: A Hybrid-Partial Pooling Equilibria with  $B$ -type  $R$ 's Randomizing Between  $x_R^B$  and  $x_R^R$ .**



**Table 1: House Contributions from Alaska Oil Export Ban Interest Groups**

Contribution Equation	(1)	(2)	(3)	(4)
Variable	Crude Oil Contributions	Maritime Contributions	Oil Refinery Contributions	Environmental Contributions
Crude Oil Contributions	—	2.01 ***(4.65)	0.04 (0.43)	0.10 (0.40)
Maritime Contributions	0.74 *** (3.60)	—	0.10 (0.80)	-0.29 (-0.72)
Oil Refinery Contributions	3.06 (1.49)	-1.85 (-0.59)	—	4.16 ** (2.00)
Environmental Contributions	-1.33 * (-1.89)	1.04 (1.09)	0.14 (0.69)	—
Log Likelihood Ratio Test	***65.51	***143.63	***63.59	***89.85

Notes:—Dependent variable is the PAC contributions to each member from each interest group during the 1993-1994 election cycle ( $n=344$ ). The coefficients are the regression coefficients (not normalized) from a two-stage tobit estimation procedure (see text). Asymptotic  $t$ -ratios in parentheses. Significance at the 99% (\*\*\*), 95% (\*\*) and 90% (\*) is indicated. See text at n. 25 for a description of other variables not reported that were included in the regression and for a discussion of how the equations were identified. The Log-likelihood ratio tests are for the full model. Average contributions (and percentage of members receiving zero contributions) are: Crude oil \$3,882 (19.1%), Maritime \$4,046 (26.2%), Oil Refinery \$339 (64%), Green \$295 (80.5%).

**Table 2: Senate Contributions from Alaska Oil Export Ban Interest Groups**

Contribution Equation	(1)	(2)	(3)	(4)
Variable	Crude Oil Contributions	Maritime Contributions	Oil Refinery Contributions	Environmental Contributions
Crude Oil Contributions	—	-0.04 (-0.09)	0.21 (1.51)	0.17 (0.49)
Maritime Contributions	0.14 (0.23)	—	0.28 * (1.72)	0.51 *** (2.60)
Oil Refinery Contributions	6.83 * (1.71)	5.20 * (1.82)	—	-4.84 (-1.63)
Environmental Contributions	1.26 (0.82)	3.88 *** (4.24)	-1.26 (-0.94)	—
Log Likelihood Ratio Test	16.10	***38.33	16.28	***33.94

Notes:—Dependent variable is the PAC contributions to each member from each interest group during the 1993-1994 election cycle ( $n=88$ ). Asymptotic  $t$ -ratios in parentheses. Significance at the 99% (\*\*\*), 95% (\*\*) and 90% (\*) is indicated. The coefficients are the regression coefficients (not normalized) from a two-stage tobit estimation procedure (see text). See text at n. 25 for a description of other variables not reported that were included in the regression and for a discussion of how the equations were identified. The Log-likelihood ratio tests are for the full model. Average contributions (and percentage of members receiving zero contributions) are: Crude oil \$5,780 (45.4%), Maritime \$3,882 (53.4%), Oil Refinery \$591 (75.0%), Green \$319 (87.5%).

**Table 3: Votes on the Alaska Oil Export Ban**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)		
Vote (Outcome) <sup>a,b</sup>	House Amend. to Require U.S. Vessels (108-210)	House Resolution to Remove Roy- alty Exemption (210-122)	House Amend. to Remove Royalty Exemption (140-193)	<i>Exp. Sign Cols 1-3</i>	House Resolut- ion to Advance Bill to Floor (274-51)	House Vote on Final Version of Bill (217-118)	Senate vote on Senate Final Version of Bill (62-25)	Senate vote on Senate Final Version of Bill (57-29)	<i>Exp. Sign Cols 4-7</i>
Crude Oil Contributions	-0.05 (-0.70)	-0.41 ***(-4.41)	-0.14 (-1.63)	(-)	0.24 **(1.97)	0.17 *(1.89)	0.00 (-0.02)	0.01 (0.04)	(+)
Maritime Contributions	0.05 (0.63)	0.30 *** (3.76)	0.14 *(1.79)	(+)	-0.04 (-0.38)	-0.14 *(-1.84)	0.14 (1.50)	0.06 (0.58)	(-)
Oil Refinery Contributions	-0.23 (-0.13)	0.28 (0.19)	-2.07 (-1.25)	(+)	-4.78 **(-1.99)	-1.12 (-0.67)	-2.33 *(-1.82)	-2.03 (-1.52)	(-)
Environmental Contributions	-0.03 (-0.11)	-0.76 *(-1.73)	0.24 (0.54)	(+)	-0.16 (-0.58)	-0.86 (-1.25)	-0.03 (-0.04)	-0.21 (-0.25)	(-)
Crude Oil Informed Against <sup>c</sup>	0.09 (0.17)	-0.22 (-0.42)	0.91 *(1.78)	(+)	0.88 (1.21)	-0.02 (-0.03)	0.02 (0.09)	-0.03 (-0.10)	(-)
Maritime Informed Against <sup>c</sup>	-0.16 (-0.58)	-0.84 **(-2.52)	-0.84 ***(-2.64)	(-)	0.48 (1.28)	0.62 ** (2.02)	-0.15 (-0.44)	0.01 (0.02)	(+)
Oil Refinery Informed Against <sup>c</sup>	5.59 (1.40)	-8.15 **(-2.12)	-3.78 (-0.90)	(-)	5.42 (0.99)	5.32 (1.23)	1.87 (0.71)	1.57 (0.53)	(+)
Environmental Informed Against <sup>c</sup>	-0.13 (-0.15)	-0.02 (-0.02)	-1.59 (-1.38)	(-)	0.09 (0.09)	2.73 *(1.70)	-3.06 (-1.57)	-0.43 (-0.20)	(+)
LLR Test <sup>d</sup>	***191.77	***219.94	***250.93		***128.46	***238.94	***45.20	***59.40	

Notes:—Probit coefficients  $\times 10^3$  (asymptotic *t*-values in parentheses). Statistical significance at the 99% (\*\*\*), 95% (\*\*), and 90% (\*) confidence levels. Dependent Variable is the Congressman's vote ('Yes'=1, 'No'=0). See text at n. 29 for a more complete description of the votes. <sup>a</sup> Variables included in the regression but not reported are: Party, the 1992 Clinton presidential vote, the League of Conservation Voters score, the National Security Index score, median family income, the Congressman's seniority (years in office), the Congressman's 1992 election vote, and a constant. <sup>b</sup> The numbers of yes and no votes used in the regression analysis. Votes made by newly elected members are excluded. <sup>c</sup> A interest group is "informed against" if they are predicted to give zero contributions to the Congressman. <sup>d</sup> Log-likelihood ratio test of significance of entire regression versus constant only model (15 degrees of freedom).