Do Interest Groups Compete?

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Abstract

This paper conducts a test of the hypothesis that interest groups compete strategically for influence with a policy-making agency. It adapts econometric methodology from the empirical industrial organization literature that was designed to work with discrete game-theoretic models, and uses data on whether or not supporting and opposing interest groups submitted comments to the Fish and Wildlife Service about each of 173 proposals to add new species to the endangered species list. The results imply that groups do respond to variations in the expected costs and benefits of a listing when deciding whether to pressure the agency. There is no support, however, for the hypothesis that the levels of pressure exerted by the groups emerge from the Nash equilibrium of games with simultaneous moves and perfect information.

Keywords: interest groups, strategic competition, empirical game theory, endangered species

JEL Codes: C25, C72, D72, Q28

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Amy Whritenour Ando[1]

1 Introduction

Pressure from interest groups has long been known to influence the process of forming policy and carrying out regulatory activities.[2] Becker's 1983 theory of interest-group competition took that recognition one step further. His model yielded a number of provocative conclusions, including the well-known hypothesis that political competition causes transfers between interest groups to be accomplished with the most efficient instrument available. Because Becker's work has been intellectually influential, some empirical work has tried to test elements of his conclusions by analyzing patterns in observed policy choice.[3] However, no studies have tested the basic proposition that interest groups compete strategically for influence.

That test is worth conducting for two main reasons. The first reason is intellectual curiosity; it would be satisfying to verify whether interest groups generally behave in the rational manner attributed to them by the assumptions of Becker's work. If interest-group lobbying varies rationally with the costs and benefits of proposed policies and with the intensity of pressure from other interest groups, then that lobbying may well steer decision makers toward policies and policy instruments with relatively high net benefits. The second reason is more practical. Scholars can use data on interest-group activities (e.g. reactions to policy proposals, expenditures on direct conservation actions) to

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[1] Fellow, Quality of the Environment Division, Resources for the Future.

[2] Examples of empirical papers that confirm that influence are Magat, Krupnick, and Harrington (1986), Cropper et al. (1992), and Ando (1997a).

[3] See Gardner (1987) and Bullock (1995).

shed light on matters such as the demand for public goods and the expected costs of the policies in question.[4] The correct interpretation of (and proper methodology for) such analyses may depend on whether observed levels of interest-group pressure come from political Nash equilibria. For example, if environmental groups lobby hard to save the spotted owl, that may be because they have a relatively high willingness-to-pay to save the owl, or because the timber industry is fighting hard to keep it from being added to the endangered species list. Thus, it would be useful to develop a sense of how common strategic interest-group competition is. To that end, scholars must have an empirical methodology available to test for strategic behavior when their data are not well suited to traditional econometric techniques.

This paper presents a test of the hypothesis that opposing interest groups pressure a regulatory agency in a manner that is consistent with the Nash equilibrium of a struggle for influence with simultaneous moves and perfect information. It uses data on interest-group responses to proposals made by the Fish and Wildlife Service (FWS) to add new species to the list of those protected under the Endangered Species Act of 1973 (ESA). Many such proposals attract no comments from one or both sides of the issue. Hence, this case study uses discrete dependent variables that record merely the presence or absence of pressure from each of the two sides.

Classic econometric approaches to simultaneous equations break down in the face of a model of discrete strategic behavior. Bresnahan and Reiss (1990, 1991) develop econometric methodology to work with discrete game-theoretic models of firms deciding whether to enter new markets; this paper adapts their techniques to a model of interest groups choosing whether or not to exert pressure on the agency. The results of the analysis indicate that while the interest groups in this regulatory

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[4] For examples of analyses that analyze data on interest-group activities, see Ando (1997b), Bellido (1997), Crone and Tshirart (1997), and Cropper et al. (1989).

arena do seem to respond reasonably to costs and benefits, there is no support for the hypothesis that their behavior is strategic.

2 Model

This section develops a simple illustrative model of competing interest groups, and examines the interface between that model and the econometric methodology designed by Bresnahan and Reiss (henceforth B&R). The model is consistent with some of the basic features of Becker's theory: there are two interest groups; they compete in a Cournot-style model for influence by exerting pressure on an agency; and their reaction functions may have positive slopes. However, since the ultimate goal of this paper is an econometric analysis, the model is flexible in some important ways. First, it imposes no restrictions on the mechanism through which pressure is translated into regulatory outcomes. In contrast to Becker's work, where assumptions[5] yield reaction functions that are upward-sloping, my model allows them to slope either up or down.[6] Second, it incorporates non-participation as a strategy, since interest groups often choose not to exert any pressure at all with regard to a particular policy proposal. Third, it accommodates the possibility that interest groups behave non-strategically, each side deciding how much pressure to exert without consideration of the other's actions.

The two interest groups are on opposite sides of a policy debate (here, a proposal to add a species to the endangered species list). One stands to gain from the proposal and thus is for it (F); the other will be harmed by the proposal if it is carried out, and thus is against it (A). They decide simultaneously how much to pressure the relevant policy maker about the proposal. A group's

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[5] The key assumption is about how quickly deadweight losses rise with the size of the taxes and subsidies associated with the policy.

[6] This paper is, however, limited to cases in which the slopes of the reaction functions have the same sign.

decision can be thought of as having two components. It chooses whether to exert any pressure at all; if that decision is affirmative, it also picks exactly what positive amount of pressure (P) to exert.[7] Group i's participation decision A_i is defined for notational purposes as:

$$A_i = 1 \;\; if \;\; P_i > 0, \quad A_i = 0 \;\; if \;\; P_i = 0 . \tag{1}$$

If $A_i = 1$, group i chooses P_i to maximize its utility $U_i(P_i)$ conditional on P_j, where

$$U_i(P_i) \; = \; U_{0i} \; + \; P_i(a_i + b_i\overline{P}_j) \; - \; (.5P_i^2 + \; A_i z_i) \; - \; c_i\overline{P}_j \tag{2}$$

with $a_i, c_i, z_i > 0$ for $i = A, F$. The first term is the baseline level of utility. The second term gives the gross benefit to group i of its own pressure. The third term is the cost of exerting pressure, which has a variable and a fixed component. The fourth term is the cost imposed on group i of group j's pressure, which exists even if group i opts not to participate in the competition for influence. The solution to the maximization problem is:

$$P_i^* \; = \; a_i + b_i\overline{P}_j \tag{3}$$

With this information and the assumption that the groups choose simultaneously, the game can be collapsed to a simultaneous decision of whether or not to exert P_i*. If $A_j = 0$, the payoffs to group i of its two available strategies are:

$$\begin{aligned} &A_i = 0 \;\Rightarrow\;\; U_i \; = \; U_{0i} \\ &A_i = 1 \;\Rightarrow\;\; P_i^* = a_i, \quad U_i(P_i^*) \; = \; U_{0i} \; - \; z_i \; + \; .5a_i^2 \end{aligned} \tag{4}$$

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[7] These are not sequential decisions, but components of a choice that is made at one time.

If $A_j = 1$, and stability is imposed on the Nash-equilibrium of the choices of P_i^* and P_j^* by assuming $b_i b_j < 1$, then the payoffs to group *i* are:

$$\begin{aligned} &A_i = 0 \;\Rightarrow\; U_i = U_{0i} - c_i a_j \\ &A_i = 1 \;\Rightarrow\; P_i^* = \frac{a_i + b_i a_j}{1 - b_i b_j} \equiv \Pi_i^*, \quad U_i(\Pi_i^*) = U_{0i} - c_i \Pi_j^* - z_i + .5 \Pi_i^{*2} \end{aligned} \tag{5}$$

Hence, group *i*'s payoff matrix can be written as:

Group *i*'s Payoffs

	$A_j = 0$	$A_j = 1$
$A_i = 0$	U_{0i}	$U_{0i} - c_i a_j$
$A_i = 1$	$U_{0i} - z_i + .5\, a_i^2$	$U_{0i} - z_i - c_i \Pi_j^* + .5\, \Pi_i^{*2}$

Following the expository tactics of B&R (1991), the payoff matrix can be clarified by defining:

$$\begin{aligned} U_{1i} &\equiv U_{0i} - c_i a_j \\ \delta_{0i} &\equiv .5 a_i^2 - z_i \\ \delta_{1i} &\equiv .5(\Pi_i^2 - a_i^2) - c_i \Pi_j + c_i a_j \end{aligned} \tag{6}$$

Then the payoff matrix can be re-written as:

Group *i*'s Payoffs, Simplified

	$A_j = 0$	$A_j = 1$
$A_i = 0$	U_{0i}	U_{1i}
$A_i = 1$	$U_{0i} + \delta_{0i}$	$U_{1i} + \delta_{0i} + \delta_{1i}$

With this notation, it becomes clear that the Nash-equilibrium strategy choices can be written simply as:

$$A_i^* = 0 \quad \Leftrightarrow \quad \delta_{0i} + A_j^* \delta_{1i} < 0 \tag{7}$$

A number of papers have illustrated that games like this can have poorly defined reduced forms.[8] Heckman (1978) shows that the problem can be resolved by assuming that the payoffs of one side are unaffected by the actions of the other; that approach, however, rules out the hypothesis that this paper aims to test. B&R (1990, 1991) find that it is sufficient to constrain the range of values taken by δ_{1i}. Specifically, they assume that δ_{1i} is negative. That makes economic sense in the case they highlight (entry into a new market) because $U_{0i} = U_{1i}$, and $\delta_{1i} < 0$ means only that a monopolist's profits fall when a competitor enters its market. In a model of interest-group competition, however, $U_{0i} > U_{1i}$, and the assumption of $\delta_{1i} < 0$ is not trivial.

For $\delta_{1i} < 0$ to hold true, the following condition must be satisfied:

$$\delta_{1i} < 0 \quad \Leftrightarrow \quad c_i(\Pi_j^* - a_j) > .5(\Pi_i^{*2} - a_i^2) \tag{8}$$

This is effectively a condition that requires c_i, the damage done to group *i* by a unit of pressure from group *j*, to be "big". To illustrate, consider the completely symmetric case, and recall that $|b| \in [0,1)$. For a given slope of the reaction functions, Equation 8 yields the condition that *c* must be x times greater than *a* to have $\delta_{1i} < 0$. That factor x is traced out in Figure 1; x grows as *b* grows. Intuitively, if *b* is large and positive, then pressure from group *j* actually helps group *i* by increasing the marginal benefit of its own pressure; *c* must be especially large to counteract that. Since there is no reason to assume that $\delta_{1i} < 0$, this paper presents the results of two econometric analyses: one

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[8] See, for example, Amemiya (1974) and Heckman (1978).

assumes that δ_{1A} and δ_{1F} are negative, and the other maintains the hypothesis that δ_{1A} and δ_{1F} are positive.

Each of these econometric models is tested against the null hypothesis that the interest groups are not behaving strategically. Such “irrational” behavior is more difficult to model in economics, since most economic theory is predicated on the assumption of rational behavior. However, non-strategic behavior may be represented here by setting b_A and b_F equal to zero, as each group ignores the impact of the other’s pressure on the marginal product of its own lobbying. Such shortsighted behavior yields group *i*’s payoffs given as:

Group *i*’s Non-Strategic Payoffs

	$A_j = 0$	$A_j = 1$
$A_i = 0$	U_{0i}	U_{1i}
$A_i = 1$	$U_{0i} + \delta_{0i}$	$U_{1i} + \delta_{0i}$

If group *i* is not acting strategically, its choice of A_i should be independent of the other group’s characteristics and choices. This model yields such a decision rule easily; the groups decide whether or not to exert any pressure according to:

$$A_i^* = 0 \quad \Leftrightarrow \quad \delta_{0i} < 0 \tag{9}$$

In the framework of this paper, the hypothesis of non-strategic behavior reduces conveniently to the assumption that $\delta_{1i} = 0$.

3 Econometrics

Independent variables and stochastic error terms are worked into the model as follows. For interest group *i* = *A* or *F*, let

$$\begin{aligned}\delta_{0i} &= X_i\beta_i + \varepsilon_i \equiv u_{Mi} + \varepsilon_i \\ Y_i^* &\equiv u_{Mi} + A_j\delta_{1i} + \varepsilon_i\ ; \\ u_{Di} &\equiv u_{Mi} + \delta_{1i}\end{aligned} \qquad \textbf{(10)}$$

where X_i is a matrix of independent variables, β_i is a vector of coefficients to be estimated, ε_i is a random error, A_j is an indicator variable for whether the other group does any lobbying, and δ_{1i} is a constant to be estimated.[9] Under the framework of Equations 7 and 9, and given the specification set forth in Equation 10, interest groups' observed choices of whether to exert pressure are related to observed and unobserved factors according to:

$$A_i^* = 0 \quad \Leftrightarrow \quad Y_i^* < 0 \qquad \textbf{(11)}$$

In order to estimate an econometric model based on Equation 11, a coherency restriction on the signs of δ_{1A} and δ_{1F} must be made. Model 1 assumes that δ_{1A} and δ_{1F} are negative; this is the restriction made by B&R in their work. The resulting map of equilibrium strategies into the space of unobserved error terms is given in Figure 2 (where N refers to the number of interest groups that exert non-zero levels of pressure).[10] Most notably, the middle rectangle can support two pure-strategy equilibria: "$A_A = 0$, $A_F = 1$" and "$A_F = 0$, $A_A = 1$". Roughly, this area exists because when both sides are moderately motivated to exert pressure, either one could profitably act as the lone group submitting comments, but the cost of having a competitor is great enough to preclude a duopoly. As B&R point out, this region of non-uniqueness imposes observational equivalence

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[9] δ_1 may also be specified to have a random component as long as the support of the distribution of the random term is limited to be consistent with the coherency restriction. See B&R (1990, 1991) for details and an example.

[10] Figures 2, 3, and 4 are adapted from similar figures in B&R (1991).

between the two “N=1” outcomes. Thus, this model distinguishes only between three outcomes: “N=0”, “N=1”, and “N=2”. The observational equivalence means that the coefficients β and δ_1 in the two equations must be estimated to be the same for both interest groups.

The likelihood function for Model 1 is constructed by assuming that ε_A and ε_F are distributed bivariate standard normal with correlation coefficient ρ. Then the likelihood contribution of observation n, P_n, falls into one of three categories:

$$\begin{aligned} A_A=0,\ A_F=0:\quad & P_n = Pr(\varepsilon_A < -X_n\beta\ ,\ \varepsilon_F < -X_n\beta) = \Phi(-X_n\beta,\ -X_n\beta,\ \rho) \\ A_A=1,\ A_F=1:\quad & P_n = Pr(\varepsilon_A > -(X_n\beta - \Delta)\ ,\ \varepsilon_F > -(X_n\beta - \Delta)) = \Phi(X_n\beta-\Delta,\ X_n\beta-\Delta,\ \rho) \\ \textit{otherwise}:\quad & P_n = 1-\Phi(-X_n\beta,\ -X_n\beta,\ \rho)-\Phi(X_n\beta-\Delta,\ X_n\beta-\Delta,\ \rho) \end{aligned} \qquad \textbf{(12)}$$

This model is estimated constraining $|\rho| \leq 1$ and $\Delta > 0$ (so $\delta_1 < 0$) .

A second strategic model can be constructed by assuming that δ_{1A} and δ_{1F} are positive. The resulting map of strategies into the error space is shown in Figure 3. The center rectangle once again supports two pure-strategy Nash equilibria, but now that region supports either N=0 or N=2. The rough intuition here is that since the net effect of having an opponent is beneficial, groups with errors that fall in the rectangle can gain if both exert pressure on the agency; however, no one group is motivated enough to comment if the other group does not join in. In this model, the two “N=1” outcomes can be differentiated. However, if ε_A and ε_F are reasonably similar, their magnitude cannot be identified; “N=2” and “N=0” are observationally equivalent. That equivalence plays a role in constructing the likelihood function. It does not, however, force the β and δ_1 coefficients to be estimated to be the same for the two groups. Given the same distributional assumptions over ε_A and ε_F that were made for Model 1, the likelihood contribution of an observation in Model 2 is:

$$
\begin{aligned}
A_A=0,\ A_F=1:\quad P_n &= Pr(\varepsilon_A < -(X_n\beta_A+\Delta_A)\ ,\ \varepsilon_F > -X_n\beta_F\ ) \\
&= \Phi(-(X_n\beta_A+\Delta_A)) - \Phi(-(X_n\beta_A+\Delta_A),\ -X_n\beta_F\ ,\ \rho) \\
A_A=1,\ A_F=0:\quad P_n &= Pr(\varepsilon_F < -(X_n\beta_F+\Delta_F\ )\ ,\ \varepsilon_A > -X_n\beta_A\ ) \\
&= \Phi(-(X_n\beta_F+\Delta_F\ )) - \Phi(-(X_n\beta_F+\Delta_F\ ),\ -X_n\beta_A\ ,\ \rho) \\
\textit{otherwise}:\quad P_n &= 1 - \Phi(-(X_n\beta_A+\Delta_A)) + \Phi(-(X_n\beta_A+\Delta_A),\ -X_n\beta_F\ ,\ \rho) \\
&\quad - \Phi(-(X_n\beta_F+\Delta_F\ )) + \Phi(-(X_n\beta_F+\Delta_F\ ),\ -X_n\beta_A\ ,\ \rho)
\end{aligned}
\qquad \textbf{(13)}
$$

This model is also estimated constraining $|\ \rho\ | \leq 1$ and $\Delta_i > 0$ (which in this case makes $\delta_{1i} > 0$) .

Figure 4 shows the map of outcomes into the random-variable space under the assumption of non-strategic behavior. With bivariate-normal error terms, this base-case model is a simple bivariate probit. There are four outcomes that can be identified, and the probability of each corresponds to the probability that the random variables fall in each of the four areas shown in the figure. Note, however, that if Model 1 or Model 2 is estimated under the hypothesis that $\delta_{1A} = \delta_{1F} = 0$, the result is not exactly a bivariate probit. In each case, two outcomes are maintained as observationally equivalent, and thus the probability assigned to any such outcome is greater than it is in the similar bivariate probit. The test for strategic behavior is a test for $\delta_1 \neq 0$, but the comparison models use limited information.

The relationship outlined in Figure 1 indicates that Model 1 is relatively more likely to obtain when the reaction functions slope down, and Model 2 is more likely when the reaction functions slope up. However, testing the models against one another would not constitute a true test of whether pressure from interest-groups are strategic complements or substitutes. The empirical approach taken in this paper can only really test the null hypothesis of no strategic behavior at all.

4 Case Study Data

The ESA directs the administering agencies (largely the FWS[11]) to develop and maintain a list of species designated as endangered or threatened. Each addition to the list is supposed to be made only on the basis of whether scientific evidence exists to show that a species is in danger of extinction. Once a species is officially on the list, it becomes illegal for anyone to "take" that species, where "take" is defined as "to harass, harm pursue, hunt, shoot, wound, kill, trap, capture, or collect" a member of the species. This proscription often yields restrictions on how land can be used, both private and public. Hence, there are winners and losers associated with each new listing. Agents (individuals and groups) who want to prevent land from being developed or exploited gain from the listing of a species, whether because they care deeply about the species that depend on that land or because they want to protect the land for aesthetic, recreational or moral reasons. On the other hand, owners of private land and users of public land may suffer losses as a result of the listing of a species that occurs on the land they own and use. Development may be halted, or may have to be redesigned to prevent harm to the protected species; exploitative activities such as logging, mining, and grazing may be curtailed or halted for the same reason; groundwater pumping may be restricted to prevent depletion of pools and springs in which rare species reside.

Every time the agency places a proposal in the *Federal Register* to add new species to the list, interest groups coalesce on each side of the proposal. The group opposed to a given listing can include any combination of local land owners, local citizens that may be affected by water-use restrictions, and firms and workers associated with industries (like logging and mining) that are likely

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[11] The National Marine Fisheries Service has jurisdiction over marine species and anadromous fish (like salmon). These species comprise a small part of the endangered species list, and are not included in the current study.

to be adversely affected by the listing. On the other side, support comes from environmental groups (both local and national), scientists, and individual local citizens. Ando (1997a) shows that while almost all species proposed for listing are eventually listed, interest-group pressure can affect how long the species waits to be listed (and hence protected); support shortens the wait, and opposition drags it out. Since delay postpones the costs and reduces the benefits of a listing[12], these groups have something to gain by pressuring the agency.[13]

This paper analyzes pressure in the form of comments submitted to the FWS during the comment period that follows the agency's proposal to add a species (or group of species) to the list.[14] There may be other facets of pressure exerted by the groups on the FWS, but comments are an important component of such pressure, and the presence or absence of comments is likely to be a good indicator of the existence or non-existence of pressure overall. Comments are observable and quantifiable, since the FWS summarizes the number of comments it receives in favor of and in opposition to each listing proposal in *Federal Register* notices of final listing. Comment data are also well-suited to the purposes of this paper because the "game" of submitting comments is structured in reality to have simultaneous moves; there is no compelling reason to argue that one particular group submits its comments first, after which the other group responds.[15]

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[12] Land users can take irreversible actions (like cutting trees or laying the foundation for a building) during the delay that would have been precluded had the species been listed more promptly. The species may become extinct while it waits to be protected. Less dramatically, its numbers may dwindle to where recovery is made very difficult.

[13] Interest-group pressure may also affect decisions made by the FWS after the species has been listed, such as how much critical habitat (land subject to special restrictions) to designate for the species.

[14] Usually, species that go through the administrative listing process in groups have something like habitat range or species type in common.

[15] One potential argument, however, is that groups which support new listings may be more alert to proposals of such listings, since these groups are often responsible for bringing the species to the attention of the FWS through petitions. This may make them Stackelberg leaders, particularly in the case of species that were the subject of petitions. The effect of that change in the game on Model 1 is to eliminate observational equivalence; B&R show that the middle rectangle goes to the leader. Future extensions of this paper may evaluate the theoretical effect on Model 2, and estimate the two models given the

This study uses data on 172 proposals to add species to the endangered species list that were promulgated during 1989-1994. Table 1 gives the number of observations that received a given number of comments for and against the proposal. These counts exclude comments that the FWS identies as having arrived after the initial 90-day comment period, in order to measure only the initial pulse of pressure. Some listing proposals generate extremely large amounts of interest-group pressure; the number of comments ranges up into the thousands. These large outliers make testing for strategic behavior difficult to accomplish in an econometric framework based on linear or limited-dependent-variable methodology. At the same time, the table reveals that many observations receive no opposing and/or supporting comments. The decision of whether to participate in the comment process is empirically an important facet of the interest-groups' strategies; these data are well-suited to the discrete methodology adopted by this paper.

The number of proposals that attract no opposition is greater than the number that attract no support. This may be in part because the FWS tends to classify essentially neutral rubber-stamp approvals from other agencies as "support."[16] Since that kind of support is not really pressure from a supporting interest group, the categorization of whether or not a species received any support is modified by subtracting one from the number of supporting comments reported by the agency.[17] The final dependent variables, A_A and A_F, are given in Table 2. The cross-tabulation illustrates that all combinations of A_A and A_F are found in these data.

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assumption of Stackelberg timing.

[16] This statement is based on my perusal of the Federal Register final listing decisions, in which the FWS often summarizes the content of the comments it received on the case at hand.

[17] That modification is not crucial to the qualitative results of the analyses performed herein. However, future refinement of this paper will aim to reduce the bias in reported numbers of comments in a less arbitrary fashion.

Both the gains and losses associated with a listing may grow with the amount of new land protected as a result of the listing. Hence, proposed listings that will result in relatively widespread new land-use restrictions may generate stronger support and opposition. This study uses data on three species characteristics that are likely to affect the quantity of new land protected as a result of a listing; these characteristics comprise the matrix X of variables that are likely to have a similar influence on both groups' propensity to comment.[18] First, vertebrates tend to have larger ranges than plants and invertebrates. Second, while foreign species are added to the list, the power of U.S. law to protect them is limited; the ESA can reduce trade in such species, but it can not be used to place restrictions on the use of land in foreign countries. Third, some new listings are made in areas where a large number of species have already been put on the endangered species list. If species in the same area have overlapping habitat, then the new listing may result in little additional land being affect by use restrictions.

Table 3 gives summary statistics for the precise variables used. "Vertebrate" is an indicator variable of whether all the species in a proposal are vertebrates (as opposed to plants or invertebrates). "Domestic" is a dummy for whether the species occur in the United States. *Federal Register* notices of proposals and final listings provided information on whether the species in each proposal were vertebrates and domestic species, and dates for the 172 proposals. The statistic summarized in "Density previously listed" is one-hundred times[19] the number of previously-listed species per square kilometer in the counties that comprise the habitat of the newly-proposed species

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[18] Because Model 1 requires the coefficients β to be constrained to be the same in both equations, this study can only consider X variables that are likely to play similar roles in both equations. For an analysis of interest-group pressure regarding endangered-species listings that includes more variables but does not test rigorously for strategic behavior, see Ando (1997b).

[19] This scaling factor is for convenience only.

at the time of the new proposal. This density was constructed using data from several sources. Census data from 1990 provided the land area of each county. A data set maintained by the Environmental Protection Agency's Office of Pesticide Programs identified the counties in which listed species are found. Where needed, those data were supplemented with information from the Fish and Wildlife Service's Internet site, which also provided the dates of final listing for all species on the list.

5 Results

For a given proposal to add species to the list and a given interest group, the econometric model specifies $X\beta$ to equal the expected value of δ_0. As defined in Equation 6, δ_0 is intuitively the net benefit to the group of submitting comments to the agency in the absence of pressure from the other group. Thus, positive coefficients correspond to proposal features that increase what a group thinks it has to gain from pressuring the agency.

Two true bivariate probit (BVP) estimations were run as benchmarks, neither of which imposes any observational equivalency on outcomes; those maximum-likelihood results are in Table 4. The first BVP analysis constrains the coefficients to be the same in the equations for supporting and opposing pressure. All three explanatory variables have significant coefficients that bear signs consistent with the hypothesis that interest groups care more about new listings that are likely to place restrictions on large amounts of previously unrestricted land; vertebrates and domestic species are more likely to stimulate comments, and proposals in areas with many previously listed species get less attention. In the second BVP analysis, the coefficient constraints are relaxed. A likelihood-ratio test rejects the hypothesis that those constraints are not binding. However, the coefficients are qualitatively similar in the two equations; both interest groups have more to gain from pressuring the agency over vertebrates and domestic species, and less from pressure regarding proposals in areas that are dense in previously listed species. Most of the coefficients remain significant in the unconstrained BVP analysis (except for the coefficient on "vertebrates" in the equation for support). The correlation coefficient is positive in both BVP estimations, but only significantly different from zero in the unconstrained version.

Table 5 presents the results from two maximum-likelihood analyses designed to test Model 1, which requires the restrictions that $\beta_A = \beta_F$ and $\Delta_A = \Delta_F$. The results in the first columns correspond to the null-hypothesis of no competition where $\Delta = 0$, but the likelihood function still imposes observational equivalence on the outcomes "$A_A = 0$, $A_F = 1$" and "$A_F = 0$, $A_A = 1$" in order to be comparable to the likelihood function for Model 1. Comparing these results to the constrained BVP in Table 4 shows the effect that observational equivalence has on the estimation. The coefficient estimates and standard errors are completely identical; given the coefficient constraints, the observational equivalence induces no information loss that changes the estimates. However, the log-likelihood value is reduced when the two "N=1" outcomes are combined into a single outcome, since that formulation assigns a higher probability to any "N=1" observation than does the true BVP.

The second set of columns in Table 5 contains the results for Model 1 itself. If Δ were estimated to be significantly greater than zero, this analysis would support the hypothesis that interest groups compete strategically. However, the value of the maximized log-likelihood function is not changed with the addition of the parameter Δ, and the other coefficient values are almost exactly the same as they were in the Base Model 1 estimation. The parameter equal to $\ln(\Delta)$ moves toward a large negative number (i.e. Δ very close to zero), and its standard error at the "optimum" is very large. This implies that the gradient of the log-likelihood function with respect to the crucial Δ is very flat, and the constraint of $\Delta>0$ is probably binding. In order to understand the results better, maximum-likelihood estimates of the other parameters were found with Δ fixed at a variety of points. The values of the log-likelihood functions corresponding to these conditional maximum-likelihood estimates are plotted against Δ in Figure 5. The log-likelihood is greatest at $\Delta=0$ (i.e. $\delta = 0$), though Δ gets reasonably large before the drop in the log-likelihood is substantial. These results fail to reject the hypothesis that the interest groups in this regulatory arena do not compete strategically according to the framework described by Model 1.

Table 6 shows results that enable a similar test of Model 2, which does not force the parameter estimates to be constrained across interest groups. The point estimates in the model corresponding to the null hypothesis of Model 2 are qualitatively similar to those found in the unconstrained BVP. However, the coefficients are not identical, and several previously-significant coefficients are now insignificant. It seems that the observational equivalence necessary to render this base model comparable to Model 2 generates non-trivial information loss. Observations with either "N=2" or "N=0" add to the estimation of ρ, but contribute no information to the estimation of the β coefficients; that loss reduces the precision of the estimates.

Model 2 itself performs in much the same way as Model 1. Again, positive estimates of Δ_A and Δ_F would support the hypothesis of strategic competition. Instead, the maximum log-likelihood value and the β coefficients are unchanged from those of the base model, and $\ln(\Delta_A)$ and $\ln(\Delta_F)$ go to large negative numbers in the equations for support and opposition, with large standard errors that signal flat gradients. The maximum log-likelihood conditional on Δ_A and Δ_F (where $\Delta_A = \Delta_F = \Delta$ for clarity in exposition) is traced out in Figure 6. The conditional maximum log-likelihood is greatest at Δ=0; the function declines slowly at first as Δ increases, but drops off sharply beyond values of Δ equal to .1. In much the same way as Model 1, Model 2 does not reject the hypothesis that these interest groups do not compete.

6 Conclusion

In the empirical case study presented here, interest-groups do respond reasonably to species characteristics that can be expected to influence the costs and benefits that accrue to the groups as a result of protecting the species. The groups are not behaving as knee-jerk ideologues. However, the analyses in this paper do not support the hypothesis that these groups compete strategically for influence over the FWS. This is good news for empirical work in the realm of endangered species protection. Researchers have some justsification for suppressing concerns about endogeneity in studies that use data on interest-group activities to shed light on the demand for species protection and the costs to society of such conservation policies.

More case studies must be done, however, before these results can be generalized to the behavior of interest groups in other areas, if such a generalization can ever be made at all. Some of the interest groups opposed[20] to endangered-species listings may be relatively inexperienced in the

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[20] Supporters of new listings often include national environmental groups that have worked this particular political game many times before.

world of political activism, and unaccustomed to the strategic thinking that is relevant to their decisions about lobbying intensity. Also, endangered-species protection tends to be a particularly emotional issue; strong emotions could dominate strategic concerns. Interest groups in other areas of public policy might be more likely to behave according to a paradigm of rational strategic decision making.

More work can be done to develop the methodology, as well. In particular, where the same interest-groups compete repeatedly, the single-move Cournot framework that neglects the connections between individual policy debates may be unrealistic. Future work might do well to explore the potential for using a repeated-game framework in this kind of empirical analysis.

Nonetheless, the results of this relatively simple case study do show that if empirical work and policy prescriptions are to be based upon the assumption that interest-groups compete strategically, that assumption needs to be tested. The discrete-dependent-variable econometric methodology used in this paper may prove to be a useful tool in future efforts to conduct such tests.

Figure 1: x such that c >= xa guarantees $\delta_1 < 0$ (given *b*)

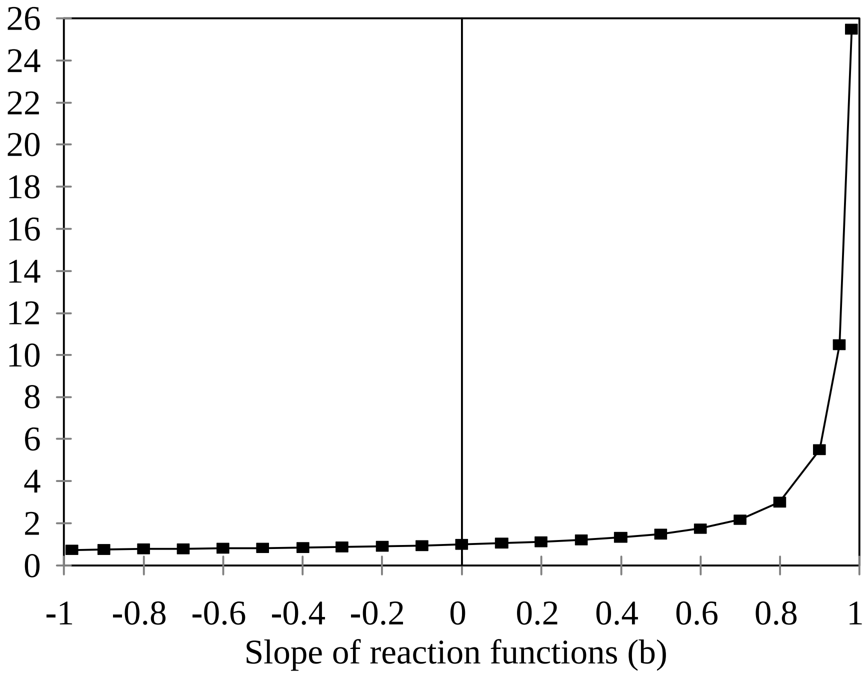


Figure 2: Model 1

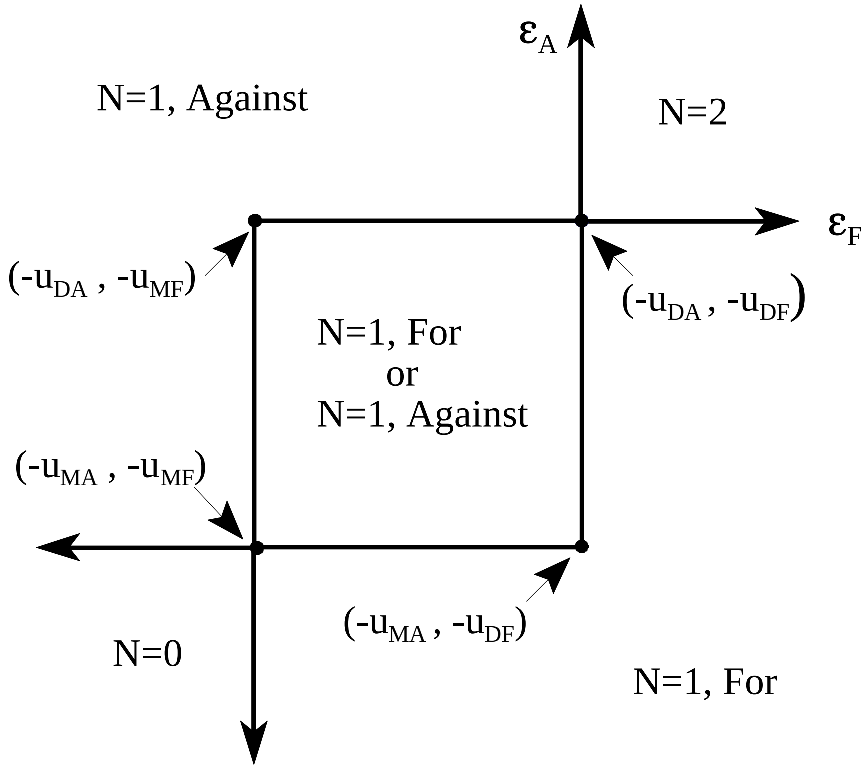


Figure 3: Model 2

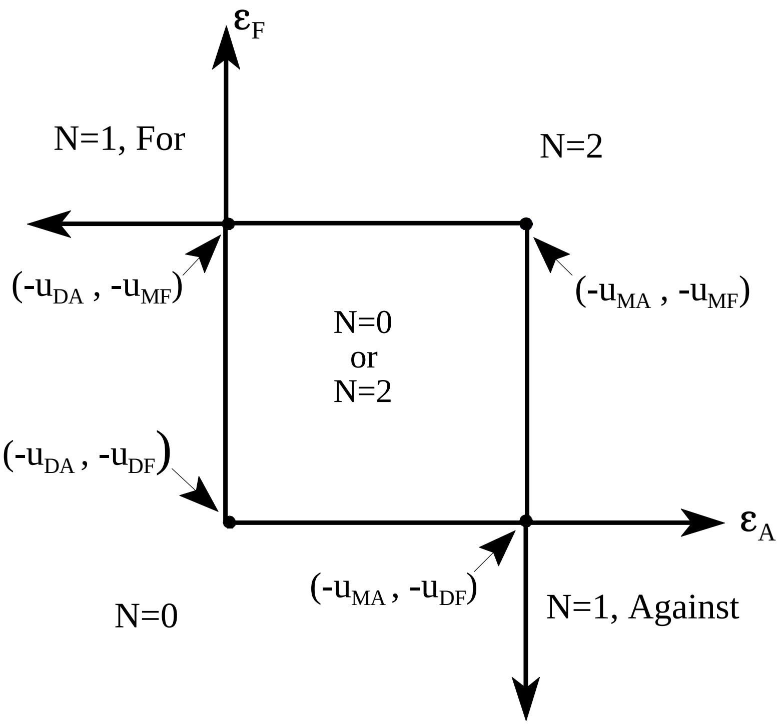


Figure 4: Non-competitive Model

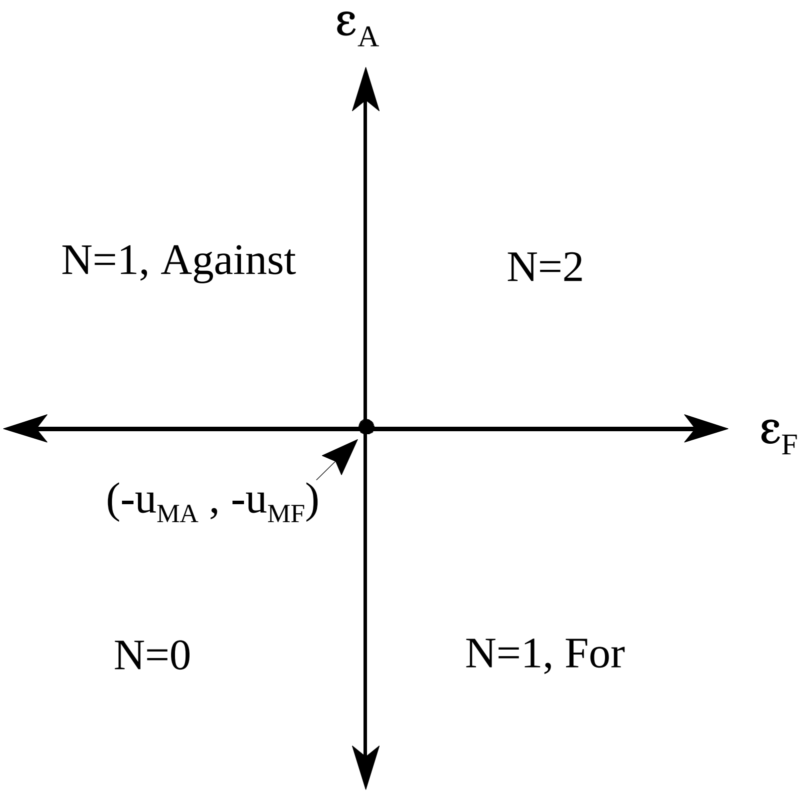
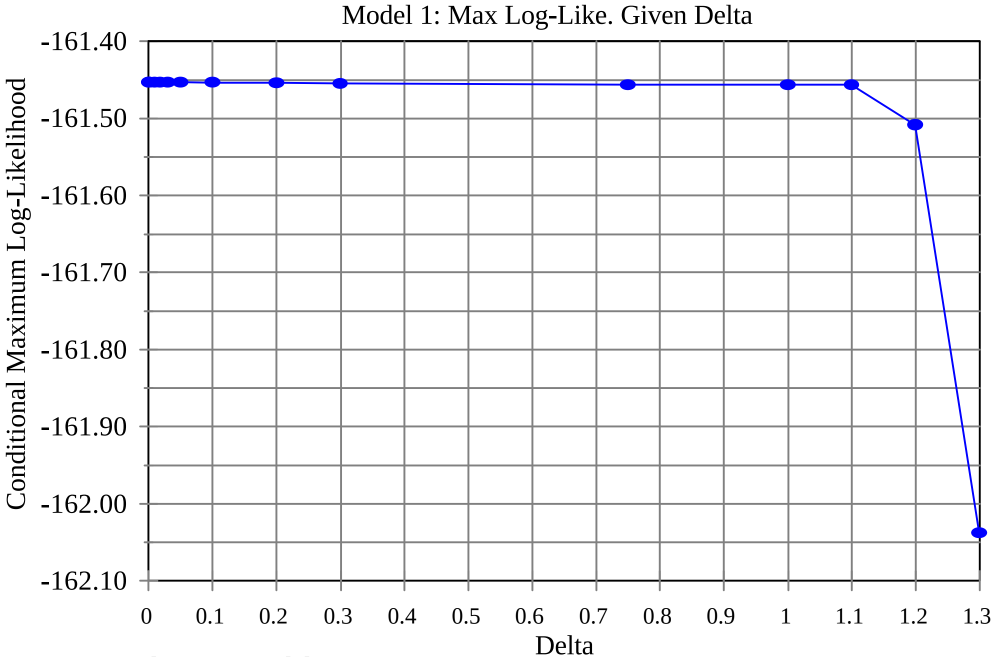
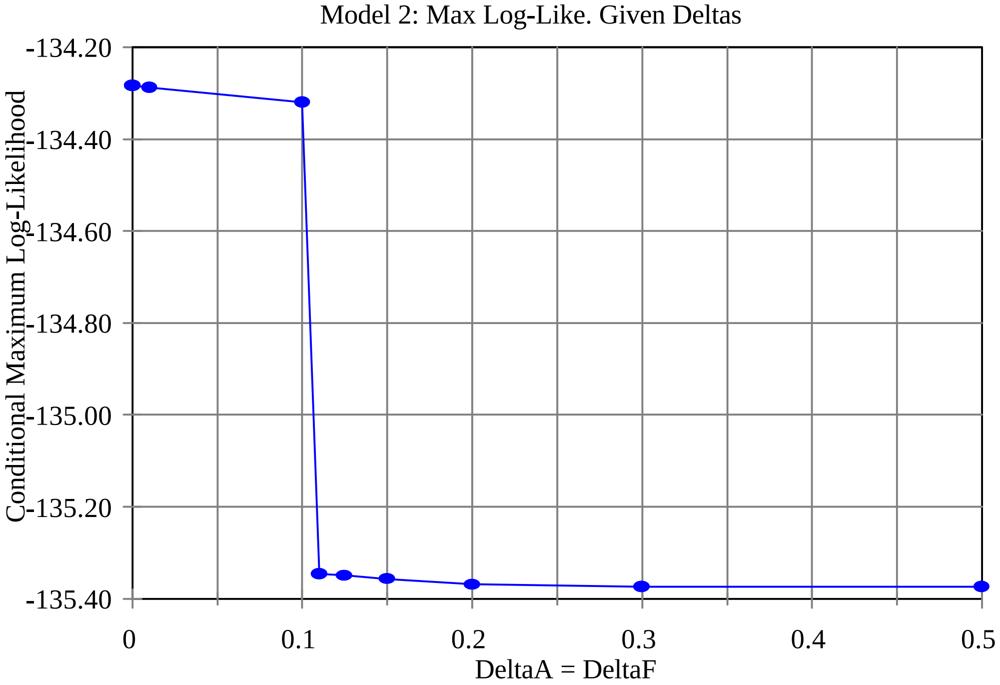


Figure 5



Note: Delta>0 gives delta<0

Figure 6



Note: Delta>0 gives delta>0.

Table 1: Tabulation of Numbers of Comments Submitted

# Comments	For	Against
0	21	86
1	25	35
2	18	14
3	14	6
4	11	1
5	6	1
6	10	3
7	8	1
8	5	4
9	9	1
10	3	0
11-2500	42	20
Total	172	172

Table 2: Cross-Tabulation of Dependent Variables

	A_A =	A_A =	Tota
A_F =	35	11	46
A_F =	51	75	126
Total	86	86	172

Table 3: Summary Statistics of Independent Variables

Variable	Mean	Min	Max
Vertebrates	0.23	0	1
Domestic	0.85	0	1
Density previously listed	3.60	0.00	32.8

Table 4: True Bivariate Probit (BVP) Results

	Constrained BVP LL = -204.430			Unconstrained BVP LL = -186.212		
	Coef.	S.E.		Coef.	S.E.	
For : Vertebrates	0.563	0.196	*	0.342	0.278	
For : Domestic	1.107	0.220	*	0.863	0.295	*
For : Density previously listed	-0.052	0.015	*	-0.070	0.021	*
For : constant	-0.557	0.200	*	0.113	0.260	
Against : Vertebrates	Coefficients constrained to be the same in the two equations.			0.841	0.266	*
Against : Domestic				1.731	0.377	*
Against : Density previously listed				-0.036	0.020	+
Against : constant				-1.567	0.367	*
ρ	0.204	0.129		0.440	0.127	*

Note: * means significant at 5% level, + means significant at 10% level.

Table 5: Model 1 Results

	Null Model 1 LL = -161.450			Strategic Model 1 LL = -161.450		
	Coefficient	S.E.		Coefficient	S.E.	
Vertebrates	0.563	0.196	*	0.564	0.232	*
Domestic	1.107	0.220	*	1.107	0.335	*
Density previously listed	-0.052	0.015	*	-0.052	0.019	*
constant	-0.557	0.200	*	-0.556	0.328	+
ln(Δ)	delta equals zero			-6.852	724.600	
ρ	0.204	0.129		0.206	0.923	

Notes: (1) * means significant at 5% level, + means significant at 10% level.
(2) $\Delta > 0$ implies $\delta_1 < 0$. Strategic Model 1 imposes the constraint that $\Delta > 0$.

Table 6: Model 2 Results

	Null Model 2 LL = - 134.28			Strategic Model 2 LL = -134.28		
	Coef.	SE		Coef.	SE	
F : Vertebrates	0.093	0.424		0.093	0.40	
F : Domestic	1.364	0.654	*	1.364	0.59	*
F : Density previously listed	-0.046	0.035		-0.046	0.035	
F : constant	-0.122	0.272		-0.122	0.270	
A : Vertebrates	0.737	0.376	*	0.737	0.361	*
A : Domestic	5.777	0.691	*	5.956	0.419	*
A : Density previously listed	-0.009	0.033		-0.009	0.033	
A : constant	-5.469	0.469	*	-5.648	0.340	*
F : ln(Δ)	deltas equal zero			-13.581	1197.9	
A : ln(Δ)				-12.670	970.6	
ρ	0.255	0.550		0.255	0.494	

Notes: (1) * means significant at 5% level, + means significant at 10% level.
(2) $\Delta > 0$ implies $\delta_1 > 0$. Strategic Model 2 imposes the constraint that $\Delta > 0$.

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