RURAL ECONOMY

An Econometric Analysis of Donations for Environmental Conservation

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I. INTRODUCTION

Funding for the protection and enhancement of the environment has traditionally come from general tax revenues. Fish and wildlife habitat enhancement and endangered species protection are prominent examples of this phenomenon. In the past few years, however, several aspects of this situation have changed. First, as provincial governments have trimmed budgets, fewer funds are available for environmental conservation programs. Second, many jurisdictions have adopted a model by which private interests and/or users of the resource base help to fund these projects. Examples include the North American Waterfowl Management Program, land purchases by the Nature Conservancy, the Buck-for Wildlife project (in Alberta), and various other public-private joint ventures (Porter and van Kooten 1993). In many of these programs the private funding component is based on memberships or donations to private organizations (e.g. Nature Conservancy, Ducks Unlimited). Thus, funding for conservation is relying more heavily on donations to environmental causes either through direct giving of funds or through memberships in organizations.

For wildlife habitat management, a major environmental initiative, a third element of change is that traditional supporters - recreational hunters and anglers - are decreasing in number, particularly in Canada (e.g. Boxall et al. 1991). Traditionally, these supporters were responsible for much of the funding of wildlife habitat conservation programs either through license sales, special ‘check-offs’ that accompany license sales, or through membership fees and donations to fishing and hunting related organizations. For example, Ducks Unlimited and Trout Unlimited began as hunting and angling organizations respectively and much of their funding has been based on contributions from hunters and anglers. With the numbers of hunters declining 17% over the last 10 years (Filion et al. 1993), and anglers also declining over the same period (e.g. 26% in Alberta), will this traditional funding base remain?

This paper explores some determinants of private contributions to environmental conservation activities through an econometric analysis of donations and memberships relating to wildlife habitat protection and enhancement. We are interested in the factors affecting donations[1] in part because we wish to determine if continuing declines in the numbers of hunters and anglers will affect the level of donations to conservation activities. We are also interested in understanding the relationships between income, marginal tax rates (the price of donations) and other variables on the propensity to donate. Given the increasing importance of private funding of wildlife programs, knowledge of these relationships will be important for public and private agencies involved in wildlife conservation.

In order to examine the process generating donations for wildlife causes we employ data from a 1991 survey conducted in the three prairie provinces that provides information on donation behaviour, income, wildlife related activity, household compositions and a variety of other factors. In order to fully utilize the information in this database, the analysis must consider the fact that the vast majority of individuals do not donate to wildlife causes. Each individual is essentially facing two decisions - a decision of whether to donate or not and a decision on how much to donate, conditional on deciding to donate. Our econometric analysis incorporates the two-level decision structure and the possibility of correlation between the two decision processes. We also use the model to forecast

[1] We refer to monies spent on memberships in wildlife conservation organizations as well as gifts to these organizations as donations, even though in the case of memberships a product is being purchased. The membership funds are typically targeted to support wildlife enhancement programs and thus we assume they are effectively donations to wildlife relate d causes.

donations under conditions of falling hunting and angling participation rates to investigate the impact of further declines in these activities on donations.

Previous research on wildlife donations has involved examinations of after tax check-offs in the U.S.[2] These studies suggest that knowledge of wildlife or in participation in wildlife related activity are important explanators of involvement in the check-offs (Applegate 1984; Brown et al. 1986; Manfredo and Haight 1986; Harris et al. 1992). However, these results are not directly comparable since we are interested in donations that are considered as reductions to taxable income (and thus individuals in different income brackets have different prices for donations). Thus, income and other factors such as education, may play a role in the probability of donation as well as the amount of donation. The U.S. studies, however, have not considered the joint decision to donate and the amount of donation. They also tend to be based on small samples of individuals from specific states. Our analysis more closely parallels the type of research performed on general donations.

Kitchen (1992) and Kitchen and Dalton (1990) examine donations in Canada. These authors indicate that income, marginal tax rates (effectively the price of donations) and region within Canada are factors that affect donation behaviour. Also, donation behaviour appears to be different for religious donations than for other types of donations. Kitchen (1992) and Kitchen and Dalton (1990) use a Tobit model framework to take into account the limited dependent variable nature of the data. This model assumes that the decision to donate or not and the decision on the magnitude of the donation are affected by the same parameters on the same variables. In our analysis we relax this

[2] In many U.S. states individuals are given the opportunity to give a part of their tax refund to wildlife conservation programs by writing an amount on their tax forms.

assumption and employ a double-hurdle model to allow for the effects of independent variables to be different in the participation and frequency portions of the donation behaviour. We also address a concern in the literature regarding functional form in double-hurdle (or Tobit) models by employing an inverse hyperbolic sine transformation. These models, and a more formal presentation of the theoretical underpinnings of the situation, are described below.

II. THE MODEL

Following the literature on charitable giving, an individual's optimal donation can be derived within the constrained utility maximization framework. That is, the individual maximizes utility subject to a budget constraint:

$$\underset{y,\boldsymbol{c}}{\text{Max}}\,[u(y,\boldsymbol{c};\boldsymbol{h})\,|\,py+\boldsymbol{qc}=m]\ , \qquad (1)$$

where y is donation, $\boldsymbol{c}$ is a vector of other consumer goods with corresponding price vector $\boldsymbol{q}$, $\boldsymbol{h}$ is a vector of personal characteristics, p is the price of donation, and m is budget. Assuming the utility function $u(\cdot)$ is continuous, increasing and quasi-concave, then the optimal donation can be expressed as a function of prices and personal characteristics. Denote these determinants of donation as a vector $\boldsymbol{x}$ and assume a linear functional form for the donation equation. Then, for individual t, the optimal donation y_t^* can be written as

$$y_t^* = \boldsymbol{x}_t\beta + v_t\ , \qquad (2)$$

where $\boldsymbol{\beta}$ is a vector of parameters and v_t is a random error. The demand equation (2) represents the 'notional' or 'latent' demand for donation and is the result of utility maximization without nonnegativity constraints. In reality, an individual's choice is also subject to nonnegativity constraints and therefore corner solutions could result. One way to accommodate corner solutions is to use the Tobit model (Tobin 1958), in which case observed donation, denoted y_t, relates to the latent donation such that

$$\begin{aligned} y_t &= \mathbf{x}_t\beta + v_t \quad \text{if } \mathbf{x}_t\beta + v_t > 0 \\ &= 0 \quad \text{otherwise}. \end{aligned} \tag{3}$$

The Tobit model can be estimated by the maximum likelihood (ML) method, typically by making some distributional assumptions about the error term v_t (Amemiya 1985). The Tobit model has been used in previous studies of donation in Canada (Kitchen 1992; Kitchen and Dalton 1990), in the U.S. (Brown 1987; Lankford and Wyckoff 1991; Reece 1979; Reece and Zieschang 1985, 1989; Schiff 1985), and in U.K. (Jones and Posnett 1991a).[3]

One restricted feature of the Tobit model is that a zero donation is viewed as a corner solution in a consumer choice problem. In particular, the specification (3) suggests that the stochastic process (and hence the sets of parameters and variables) that determines the binary outcome (participation) also determines the level of the dependent variable. This may not apply for the case of donations. For instance, some would never consider giving for whatever reason. In the case of specific donations, like wildlife conservation donations, modelling the participation decision and factors affecting participation becomes particularly important as specific individual attributes may play a large role in explaining behaviour. But for those who choose to donate, the level of donation may well be determined by a completely different set of factors, or in a completely different manner, from those

[3] Lankford and Wyckoff (1992) accommodate skewness of the error term by using the Box-Cox transformation on the dependent variable.

determining the binary outcome (to give). One model that characterizes such a decision process is the double-hurdle model--a parametric generalization of the Tobit specification. In the double-hurdle model, the Tobit mechanism is augmented by a separate stochastic process to determine participation. Denote the participation equation as $\boldsymbol{z}_t\boldsymbol{\alpha} + u_t$, where $\boldsymbol{z}_t$ is a vector of explanatory variables, $\boldsymbol{\alpha}$ is a conformable parameter vector, and u_t is the error term. Then, the double-hurdle model can be expressed as:

$$\begin{aligned} y_t &= \boldsymbol{x}_t\beta + v_t \quad \text{if} \quad \boldsymbol{z}_t\alpha + u_t > 0 \quad \text{and} \quad \boldsymbol{x}_t\beta + v_t > 0 \\ &= 0 \qquad \text{otherwise} . \end{aligned} \tag{4}$$

Thus, for positive donations to occur, two hurdles have to be overcome: to participate ($\boldsymbol{z}_t\boldsymbol{\alpha} + u_t >$ 0) and to actually donate ($\boldsymbol{x}_t\boldsymbol{\beta} + v_t > 0$).[4]

In empirical applications of the double-hurdle model the error terms u_t and v_t in (4) are often assumed to be independently and normally distributed (Atkinson, Gomulka, and Stern 1984; Blundell and Meghir 1987). A more generalized alternative is that the errors are distributed as bivariate normal, *viz*.,

$$(u_t, v_t) \sim N(0, \Sigma_t), \quad \Sigma_t = \begin{bmatrix} 1 & \sigma_{12} \\ \sigma_{12} & \sigma_t^2 \end{bmatrix}. \tag{5}$$

Dependence of the error terms allows interactions between the participation and level decisions and a better characterization of the stochastic processes behind these decisions. The likelihood function for the dependent double-hurdle model can be constructed using (4) and (5); see, for instance,

[4] In an analysis of charitable donations by U.K. households, Jones and Posnett (1991b) used the generalized Tobit model (Amemiya 1985), in which zeros are determined exclusively by a binary stochastic process, that is, $y_t = \boldsymbol{x}_t\boldsymbol{\beta} + v_t$ if $\boldsymbol{z}_t\boldsymbol{\alpha} + u_t > 0$; $y_t = 0$ otherwise, where the error terms u_t and v_t are distributed as bivariate normal. Specification of the generalized Tobit model is slightly different from that proposed by Cragg (1971), in which u_t and v_t are independent and v is zero-truncated.

Blundell and Meghir (1987) and Jones (1989, 1992).

In limited dependent variable models, ML estimation based on the normality assumption produces inconsistent parameter estimates when the error terms are not normally distributed (Robinson 1982). To allow for non-normal errors, one can consider transformations to the dependent variable y_t. We use the inverse hyperbolic sine (IHS) transformation (Burbidge, Magee, and Robb 1988)

$$\begin{aligned} y_t(\theta) &= \log[\theta y_t + (\theta^2 y_t^2 + 1)^{1/2}]/\theta \\ &= \sinh^{-1}(\theta y_t)/\theta \end{aligned} \tag{6}$$

where θ is an unknown parameter. Because the transformed variable is symmetric about 0 in θ, one can only consider $\theta \geq 0$. The transformation is linear when θ approaches zero and behaves logarithmically for large values of y_t for a wide range of values for θ. The transformation is scale-invariant (MacKinnon and Magee 1990), is known to be well suited for handling extreme values (Burbidge, Magee, and Robb 1988), and avoids some of the drawbacks of the commonly used Box-Cox transformation (MacKinnon and Magee 1990; Poirier 1978). By applying the IHS transformation to the dependent variable y_t in (4), the IHS double-hurdle model can be expressed as

$$\begin{aligned} y_t(\theta) &= \mathbf{x}_t\beta + v_t \quad \text{if} \quad \mathbf{z}_t\alpha + u_t > 0 \quad \text{and} \quad \mathbf{x}_t\beta + v_t > 0 \\ &= 0 \qquad \text{otherwise}. \end{aligned} \tag{7}$$

Using (5), (6) and (7), the sample likelihood function for the IHS double-hurdle model is

$$\begin{aligned} L &= \prod_{y_t=0}\left[1 - \Phi\left(\mathbf{z}_t\alpha, \frac{\mathbf{x}_t\beta}{\sigma_t}, \rho_t\right)\right] \\ &\times \prod_{y_t>0}\left\{\left(1+\theta^2 y_t^2\right)^{-1/2}\frac{1}{\sigma_t}\phi\left[\frac{y_t(\theta)-\mathbf{x}_t\beta}{\sigma_t}\right]\Phi\left[\frac{\mathbf{z}_t\alpha + \rho_t\left(\frac{y_t(\theta)-\mathbf{x}_t\beta}{\sigma_t}\right)}{\left(1-\rho_t^2\right)^{1/2}}\right]\right\}. \end{aligned} \tag{8}$$

where $\Phi(\cdot)$ and $\phi(\cdot)$ are the univariate standard normal distribution and density functions, respectively, and $\Phi(\cdot,\cdot,\cdot)$ is the bivariate standard normal distribution function. Detailed derivations of the likelihood function, along with the expressions for the probability, conditional mean, and unconditional mean of y_t, are presented in the Appendix.

The IHS double-hurdle model includes as special cases a list of specifications used extensively in the empirical literature. First, when $\theta = 0$, $y_t(\theta)$ reduces to y_t,[5] the jacobian term vanishes, and the model (8) reduces to the standard dependent double-hurdle model considered by Blundell and Meghir (1987) and Jones (1989, 1992). Second, setting $\rho_t = 0$ leads to the independent IHS double-hurdle model. Third, restrictions $\theta = 0$ and $\rho_t = 0$ lead to the independent double-hurdle model (Atkinson, Gomulka, and Stern 1984; Blundell and Meghir 1987). Fourth, setting $\rho_t = 0$ and $\Phi(\mathbf{z}_t\boldsymbol{\alpha}) = 1$ leads to the IHS Tobit model considered by Reynolds and Shonkwiler (1991). Finally, the model obviously reduces to the standard Tobit model (Tobin 1958) when $\rho_t = 0$, $\theta = 0$, and $\Phi(\mathbf{z}_t\boldsymbol{\alpha}) = 1$. Because of this nested structure tests of the full model against these restricted models can be done conveniently by the likelihood-ratio tests.

III. THE DATA

Data from the 1991 National Survey on the Importance of Wildlife to Canadians (NSIWC) for the three prairie provinces were used in this study. The 1991 survey is one of three completed under the sponsorship of federal and provincial wildlife agencies (Filion et al. 1993), and was conducted as a supplement to the Canadian Labour Force Survey (LFS) which is administered by Statistics Canada on an ongoing basis (Statistics Canada 1976). The LFS is a monthly household

[5] This can be shown by using l'Hopital's rule; see Burbidge, Magee, and Robb (1988).

survey whose sample is representative of the civilian non-institutionalized population over 15 years of age. The NSIWC is administered to sub-samples of the LFS sample, such that the results are representative by province of non-institutionalized residents 15 years of age and older. Therefore, for the three prairie provinces the 1991 survey results will accurately represent the wildlife-related activities of 3,422,000 residents (Filion et al. 1993).

The 1991 survey involved self-administered mail back questionnaires with two follow-up reminders and in some cases, telephone follow-ups to ensure statistically valid responses. Initial samples sizes were 9,267 for Alberta, 7,523 for Saskatchewan and 6,955 for Manitoba and response rates of 70.9%, 74.0%, and 70.2% were achieved respectively. Investigations of nonresponse bias suggested nonrespondents were not restricted to specific groups of individuals, nor were they located in specific geographic areas (Yiptong and DuWors 1990). Completed questionnaires were processed under rigorous protocols which included exhaustive edit procedures to identify erroneous records and ensure data quality, and a method to match respondent demographic data from the LFS to their NSIWC survey answers. Measures of statistical confidence were conducted such that all information used satisfies a minimum level of reliability. Further details on the survey can be found in Filion et al. (1993) and Yiptong and DuWors (1990).

Information from 13,572 individuals was extracted from this database and a set of variables thought to influence their wildlife donations was devised (Table 1) based upon previous studies (e.g. Applegate 1984; Brown et al. 1986; Manfredo and Haight 1986; Harris et al. 1992). Note that these independent variables are generally of three types: socioeconomic (income, education, etc.), attitudinal (attitude indices on wildlife preservation, etc.), and participatory (days and expenditures spent on wildlife activities). In order to compare our findings with previous studies of donation behaviour (e.g. Kitchen 1992) and to develop elasticities across various socioeconomic groups, we stratified the sample into three income groups: low, which includes those reporting personal 1991 income ranging from $0 to $9,999; medium, where it ranged from $10,000 to $29,999, and high where it ranged from $30,000 to over $50,000. In addition, the 'price' of a donation was calculated as 1−marginal tax rate. For each individual in the sample their marginal tax rate was calculated based on standard deductions for the 1991 tax year.

Sample statistics of variables in the income strata and for the entire sample are shown in Table 2. For the full sample 10.1% of the individuals reported a donation and the average amount per individual was $0.78. However, the average amount for those reporting a positive donation was $7.77. The participation in donating, and the amount donated, increases across the income strata.

IV. RESULTS OF ESTIMATION

Parameter Estimates

We estimate the dependent IHS double-hurdle model for all three income strata and for the full sample. ML estimation was carried out by maximizing the logarithm of the likelihood function (8), using the quadratic hill-climbing algorithm (Goldfeld, Quandt and Trotter 1966).[6] The full sets of parameter estimates are presented in Table 3.

The IHS parameter (θ) is significantly different from 0 for all samples considered, suggesting that the standard (untransformed) double-hurdle specification would be misspecified. For the low-income stratum, the covariance parameter (σ_{12}) is significant at the 0.10 level of significance; thus the consideration for dependence between the participation and level decisions is justified. The

[6] Analytic derivatives of the log-likelihood function are available from the authors.

covariance is not significant for the other income strata or the full sample, however.

For the low income stratum the propensity to donate is significantly affected by 3 variables which reflect direct or incidental involvement with wildlife-related activities. In contrast, the level of donations for the stratum are affected by education level, gender, residence in a rural area, and expenditures - only one of the involvement variables (Days residence) affects both the participation and level of donation. The paucity of explanatory variables in either of the hurdles for the low income group probably mirrors their low involvement in donation activity (Table 2).

For the medium- and high-income strata, however, more variables become significant in both of the donation decisions. For participation, the socioeconomic variables Education, Age, Rural, and Male affect participation in the medium stratum, while only Rural does for high income earners. Of the attitudinal variables only Preserving influences participation in the high income stratum, but only at the 10% level of significance. Almost all of the intensity-of-participation variables affect donation participation in both strata. In explaining the level of donation, age and residence in a rural area affect medium income individuals, while income level and education do so for those in the high income group. Attitudes towards wildlife abundance affect the donation level in both strata, as do days spent on nonconsumptive activity in the province, days in incidental wildlife encounters, and total expenditures on wildlife-related activities.

Significant parameters across the income groups include (1) days spent fishing affect the participation decision in each stratum; (2) days spent incidentally encountering wildlife and days spent on wildlife activities around residences or cottages affect one or both of the donation decisions in each income group; and (3) total expenditure levels on wildlife-related activities affect the level of donation, but not participation in donating in each stratum.

It is noteworthy that the parameter estimates on tax price were not significantly different from 0 for either donation decision in each stratum. This finding also appears for the tax price parameter in the full sample model (Table 3). The full sample model also suggests that income is important in the level of donation and an apparent negative influence is associated with residing either in Alberta or Manitoba (relative to Saskatchewan).

Examining the Effects of Variables

In limited dependent variable models, it is typically difficult to quantify the effects of explanatory variables on the dependent variable. This is particularly true for the models considered in this study because the double-hurdle parameterization, the dependent error specification, and the IHS transformation all complicate the effects of explanatory variables. In fact, detailed quantitative effects of explanatory variables have often been overlooked in previous applications of double-hurdle models. In this study, we examine the probability of participation in donation and the mean donation conditional and unconditional on participation, and derive the elasticities of these components with respect to all continuous explanatory variables.[7] All elasticities are calculated at the sample means of variables. For statistical inferences, the standard errors for these elasticities are also derived using mathematical approximation (Fuller 1987). The expressions for the probability and the means, conditional and unconditional on participation, along with the derivation of elasticities and the standard errors for these elasticities, are presented in the Appendix. For binary explanatory variables the elasticities are not strictly defined. The values reported in the table of elasticities are actually

[7] Our procedure is similar to that of McDonald and Moffitt (1980), who examine the effects explanatory variables for the standard Tobit model.

changes in the dependent variable in response to the change in the binary variable from zero to one. For each binary variable we assess the impact of a finite change (i.e., from zero to one) on the probability of donation, the amount of donation conditional on choosing to donate, and on the unconditional donation amount, while holding all other variables constant at their sample means.

The elasticities with respect to continuous variables are presented in Table 4. Income has significant and positive effects only on the probability (but not the conditional level) of donation for individuals in the medium-income stratum, but the elasticity is high. In particular, a one percent increase in income increases the probability of donation by about 2.01 percent. Consequently, the elasticity of the unconditional level is also quite high, with a one percent increase in income leading to a 2.45 percent increase in donation. For the high-income stratum, the effect of income on both probability and conditional level (and therefore the unconditional level) of donation are positive and significant, although the elasticities are much lower than those of the medium-income individuals. For the high-income individuals, a one percent increase in income increases the probability of donation by only about 1.07 percent, the conditional level of donation by 0.67 percent, and the unconditional level of donation by 1.73 percent. The statistical insignificance of elasticities suggests income does not play a role on the donation behavior among the low-income individuals.

For the full sample, the income elasticities of all three components (probability and levels) of donation are significant and positive but are much smaller than the corresponding elasticities in the medium- and high-income samples. These relatively low elasticities are obviously the results of low responses to income among the low-income individuals.

Total expenditures have significant and positive effects on probability and levels of donation, although the elasticities are very small, ranging from 0.01 to 0.06. Education and age have positive effects on donation, with the medium-income individuals being more responsive to changes in these two variables than other individuals.

Among the attitudinal variables, Abundance has positive effects on probability and levels of donation for both medium- and high-income individuals. Preserving has positive effects on donation only among the medium-income individuals.

Regarding participation in wildlife-related activity, significant positive effects occur for involvement in residential wildlife activity for two strata, nonconsumptive participation for the high income group, and hunting activity for the top two income strata. Tax price remains statistically insignificant across all income strata.

The effects of binary variables on donation are presented in Table 5. Residence in rural areas have negative effects on donations for the high income strata, and also for the full sample. An interesting finding is that residence in Alberta and Manitoba negatively affects donation probability in all four models. A corollary of this result of course, is that residents in Saskatchewan are more likely to donate than residents in the other two Provinces.

Simulating Changes in Wildlife Donations

We used the estimated model to simulate the impacts of declines in three variables that affect donation behavior. We chose Income and Total Expenditures because of their statistical significance across the income strata in explaining donation behavior, and Days Hunting given its performance in the model and because participation in hunting has been thought by many wildlife managers to influence donations. The scenario examined for each variable was a reduction in its mean value by

15%.[8] The effect of a reduction was investigated by calculating donations (both conditional and unconditional on donating) before and after the reduction using the estimated parameters and the mean values of the all other variables in each stratum. In order to portray the findings in a meaningful context, the results are reported for each stratum by aggregating the unconditional probability results over the total population of the three provinces (Table 6).

Declines of 15% in income have large effects on donations. For the medium and high income groups (about 62% of the sample) this income reduction reduces the probability of donating by 3.84% and 5.12% in the medium and high income groups respectively. Conditional on the decision to donate, this reduces the estimated amount donated from $45.55 to $42.55 (a drop of $3.00) per individual in the medium income stratum, and from $71.71 to $65.07 (a drop of $6.64) per individual in the high income stratum. Unconditional on the decision to donate, the income reduction results in individual donations declining from $5.69 to $3.83, and $23.83 to $18.29 for the income groups respectively. In aggregate terms, wildlife managers and organizations could expect reductions in donations of $2.35 million by middle income earners and $4.74 million by high income earners given a 15% decline in income in the three provinces (Table 6). Using the full sample model, this aggregate impact is estimated to be about $4.7 million.

Reductions in Days Hunting and Total Expenditures have much less impact on donations than reductions in income (Table 6). Hunting participation declines have more impact than expenditures in the middle income stratum, while expenditures have a greater effect than hunting participation in the high income stratum. These results, of course, are due to the differences in the parameter

[8] A 15% change in income could be considered severe. However, we are attempting to compare changes of simila r magnitude in important explanators of donation behaviour.

estimates in the two models (Table 4).

V. DISCUSSION

Zero observations are common features of microdata. The Tobit model has the undesirable parametric restrictions that limit its use in empirical investigations. Most previous studies of donation behavior were based on the Tobit model. Yet donation is one area where the decisions to donate and how much to donate are most likely to be made differently. The IHS double-hurdle model we consider in this study accommodates such decision structure; it also allows for nonnormality in the error distribution.

The double-hurdle model has been used frequently in microeconometric modelling. However, the empirical results in these studies have not been fully explored because the parameter estimates alone do not reveal a complete picture of the effects of explanatory variables on the dependent variable. We explore the effects of explanatory variables by examining the probability of donating, and the conditional and unconditional level of donations and deriving the elasticities of these components with respect to the explanatory variables. Such decomposition of elasticities is particularly important when the participation and level decisions are correlated and when the dependent variable is transformed, as is the case in the present study.

We believe our findings have some important implications for donations to wildlife conservation. First, in two income strata and the full sample income has the largest effect on donation probability and the conditional and unconditional levels (Table 4). This suggests that recessions may have the most important negative impacts on wildlife donations. This is supported by the fact that total expenditures on wildlife-related activities, which are also affected by economic declines, also play an important, although smaller, role in donations. Our results suggest that the effect of income declines may not be offset by increases in participation in various wildlife-related activities.

A related finding here is the observation that tax prices were not significant in explaining donations to wildlife conservation. Kitchen (1992) and Kitchen and Dalton (1990) found similar results in explaining Canadian donations to religious causes. This raises an intriguing question about the degree of similarity of religious and wildlife conservation motives in terms of financial support. On the other hand, this similarity may be related to the fact that these types of donations are focused on specific issues or targets, and are not donations to some more broad-based causes (e.g. poverty).

Second, declines in hunting and angling activity were not found to be as significant in affecting donations as we suspected *a priori*. While angling days were found to be statistically insignificant in explaining donation behavior, hunting days were significant for only the higher income strata. Declines in hunting do suggest an impact on donations, but this impact may not be as large as many wildlife managers suspect.

On the other hand, changes in participation in other types of wildlife activity may have significant effects on donations. For example, involvement in residential wildlife activities, particularly by people in lower and medium-income strata, was found to affect donation behaviour. This activity has been generally overlooked by wildlife management agencies (Boxall and McFarlane 1995; Shaw et al. 1985) and encouraging greater levels of participation in these activities may serve to increase donations. Similarly, participation in nonconsumptive activities, such as taking trips to view wildlife both inside and outside the province of residence, may affect positively donation behaviour. Our findings suggest this may be the case for those earning high incomes. These results have important implications for recent efforts by governments and the private sector to increase levels of ecotourism and ecotourism business opportunities. Increased ecotourism levels may not only promote economic development, but may also serve to increase financial support for wildlife management efforts through donations. Whether changes in nonconsumptive activities can offset declines in donations due to reductions in hunting and fishing activity is an open question, however.

Third, a set of factors that do seem to influence donations are attitudes towards wildlife abundance and preservation, as well as interest in being involved in wildlife-related activity. These findings generally mirror those of U.S. researchers who examine tax check-offs (e.g. Applegate 1984; Brown et al. 1986; Manfredo and Haight 1986; Harris et al. 1992). The importance of attitudinal variables, in conjunction with the apparent significance of education (Tables 2 and 3), suggests that in a climate of declining budgets and government involvement in wildlife management, education efforts directed towards wildlife attitudes and interests may significantly affect private donations.

Finally, we derived an intriguing result which suggests that residents of Saskatchewan are more likely to donate than Albertans or Manitobans. This may be related to a combination of conditions such as: i) unique cultural factors inherent in the history of that province; ii) the fact that more of Saskatchewan's population is rural rather than urban; and iii) the fact that Saskatchewan's major private wildlife organization involves both consumptive and nonconsumptive wildlife recreationists, in contrast to the similar organizations in Alberta and Manitoba.

VI. CONCLUSIONS

In this paper we examine wildlife donations in a manner consistent with economic theory, and utilize econometric methods which effectively capture the varying effects of the probability of participation and the amount. The economic literature on general donations has not utilized econometric methods that capture these effects. Previous studies in the wildlife management literature have used very simple models, and have not generally examined the economic issues of donations. Thus our study makes a contribution to both the applied economics and resource management literatures.

Our empirical results suggest that changes in economic activity will be much more important than changes in participation in any wildlife-related activity. However, declines in hunting and angling will have impacts on donations to conservation causes, but these impacts are not large. Given observed declines in participation in consumptive uses, and increased participation in nonconsumptive uses, reductions in donations from one may be offset by increases from the other. The information required to analyze this issue in detail, however, was beyond the scope of our study. While there are calls for the traditional focus of wildlife management agencies on consumptive users to broaden to include other types of wildlife users, this debate has generally focused on the issue of the revenue captured by the agency. Wildlife managers should realize that their efforts to provide service to and influence other types of wildlife users may also influence the revenue available to private wildlife conservation organizations.

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APPENDIX

Likelihood Function, Probability and Means of y_t, and Calculation of Elasticities

Based on the IHS double-hurdle structure (7) and the bivariate normality assumption of errors (5), the probability of a positive observation is

$$P(y_t>0) = P(u_t > -z_t\alpha, v_t > -x_t\beta) = \Phi\left(z_t\alpha, \frac{x_t\beta}{\sigma}, \rho\right), \tag{A.1}$$

where $\rho_t = \sigma_{12}/\sigma$. The conditional density of y_t can be derived as follows:

$$\begin{aligned} f(y_t | u_t > -z_t\alpha, v_t > -x_t\beta) &= \int_{-z_t\alpha}^{\infty} f(u_t, y_t | u_t > -z_t\alpha, v_t > -x_t\beta)\, du_t \\ &= \int_{-z_t\alpha}^{\infty} f(u_t, y_t)\left[\Phi\left(z_t\alpha, \frac{x_t\beta}{\sigma}, \rho\right)\right]^{-1} du_t = \left[\Phi\left(z_t\alpha, \frac{x_t\beta}{\sigma}, \rho\right)\right]^{-1}\left(1+\theta^2 y_t^2\right)^{-1/2} \\ &= \left[\Phi\left(z_t\alpha, \frac{x_t\beta}{\sigma}, \rho\right)\right]^{-1}\left(1+\theta^2 y_t^2\right)^{-1/2} \frac{1}{\sigma}\phi\left[\frac{y_t(\theta) - x_t\beta}{\sigma}\right]\Phi\left\{\frac{z_t\alpha + \rho\left[\frac{y_t(\theta) - x}{\sigma}\right]}{\left(1-\rho^2\right)^{1/2}}\right\} \end{aligned} \tag{A.2}$$

In (A.2), the term $(1 + \theta^2 y_t^2)^{-1/2}$ is the Jacobian of transformation from (u_t, y_t) to (u_t, v_t). The integration can be accomplished by writing $f(u_t,v_t) = f(v_t)\, f(u_t|v_t)$ and then integrating out the unobserved u_t. The sample likelihood function for an independent sample is

$$\begin{aligned} L = &\prod_{y_t=0} [1 - P(u_t > -z_t\alpha, v_t > -x_t\beta)] \\ &\times \prod_{y_t>0}\left[f(y_t | u_t > -z_t\alpha, v_t > -x_t\beta)\, P(u_t > -z_t\alpha, v_t > -x_t\beta)\right]. \end{aligned} \tag{A.3}$$

Substituting (A.1) and (A.2) into (A.3) gives the sample likelihood function (8).

The interpretation of results calls for the expressions for the probability, conditional mean, and unconditional mean of y_t. Using the conditional distribution (A.2), the conditional mean of y_t is

$$
\begin{aligned}
E(y_t \mid y_t>0) &= \int_0^{\infty} y_t f(y_t \mid y_t>0)\, dy_t \\
&= \left[\Phi\left(\mathbf{z}_t\alpha, \frac{\mathbf{x}_t\beta}{\sigma}, \rho\right)\right]^{-1} \\
&\times \int_0^{\infty} y_t \left(1+\theta^2 y_t^2\right)^{-1/2} \frac{1}{\sigma}\phi\left[\frac{y_t(\theta)-\mathbf{x}_t\beta}{\sigma}\right]\Phi\left\{\frac{\mathbf{z}_t\alpha+\rho\left[\frac{y_t(\theta)-\mathbf{x}_t\beta}{\sigma}\right]}{\left(1-\rho^2\right)^{1/2}}\right\}
\end{aligned}
\tag{A.4}
$$

Using (A.1) and (A.4), the unconditional mean of y_t is

$$
\begin{aligned}
E(y_t) &= E(y_t \mid y_t>0)\,P(y_t>0) \\
&= \int_0^{\infty} y_t \left(1+\theta^2 y_t^2\right)^{-1/2} \frac{1}{\sigma}\phi\left[\frac{y_t(\theta)-\mathbf{x}_t\beta}{\sigma}\right]\Phi\left\{\frac{\mathbf{z}_t\alpha+\rho\left[\frac{y_t(\theta)-\mathbf{x}_t\beta}{\sigma}\right]}{\left(1-\rho^2\right)^{1/2}}\right\}
\end{aligned}
\tag{A.5}
$$

The bivariate normal probability (A.1), conditional mean (A.4), and unconditional mean (A.5) can be evaluated by Gaussian quadratures. Furthermore, derivation of elasticities calls for differentiation of probability and the unconditional mean. Such differentiation can be done by numerical methods. Given derivatives of the probability and the unconditional mean, the corresponding elasticities are straightforward. Then, the elasticities of the conditional mean can be derived using the adding-up property; see first line of (A.5).

For statistical inferences, we also derived the standard errors of the elasticities. Denote the vector of all unknown parameters as $\tau = [\alpha', \beta', \theta, \sigma]'$, with ML estimator $\hat{\tau}$ and variance-covariance matrix $\mathbf{\Sigma}$, and denote a specific elasticity (a scalar) as $e = h(\hat{\tau})$. Then, by the 'delta method' (Fuller 1987, pp. 85-88), the variance of e can be approximated by

$$
\mathrm{var}(e) = \left[\frac{\partial h(\hat{\tau})}{\partial \tau'}\right]\Sigma\left[\frac{\partial h(\hat{\tau})}{\partial \tau}\right]. \tag{A.6}
$$

The major difficulty with this calculation is the differentiation of the already complicated function for the elasticity $h(\hat{\tau})$ with respect to τ. This can be done by numerical differentiation. The fortran program for computation of the elasticities and the standard errors for elasticities is available from the authors.

Table 1. Definitions of variables used to examine donations to wildlife conservation in three provinces in Canada from the 1991 National Survey on the Importance of Wildlife to Canadians.

Variable	Definition
Donation	Amount spent, in tens of dollars, on membership fee(s) or donation(s) during 1991; dependent variable
Income	Personal income before deduction (1 = 0; 8 = $50,000 or more)
Education	Level of education (1 = 0-8 years; 6 = university degree)
Age group	Age group (1 = 15-16 years; 13 = 70 years or over)
Rural	Resides in a rural community with less than 10,000 people (dummy variable where 1 = yes; 0 = no)
Male	Individual is male (dummy variable where 1 = yes; 0 = no)
Head	Individual is a head of household (dummy variable where 1 = yes; 0 = no)
Abundance	Index of importance of abundance of wildlife[a]
Preserving	Importance of preserving declining or endangered wildlife (0 = not important; 3 = very important)
Some interest	At least some interest in wildlife activities[b] (dummy variable where 1 = yes; 0 = no)
Days residence	Number of days spent on wildlife activities around residence or cottage in 1991 (1=1 to 9 days; 7=200 days or more)
Days in province	Number of days spent on trips inside province of residence in 1991 where the primary purpose of the trip was to encounter wildlife (watching, feeding, photographing or studying wildlife)
Days outside prov	Number of days spent on trips outside province of residence in 1991 where the primary purpose of the trip was to encounter wildlife (watching, feeding, photographing or studying wildlife)
Days incidental	Number of days spent on trips in Canada in 1991 where wildlife was observed, but the main purpose of the outings was other than encountering wildlife (e.g., hiking/picnics) (1=1-9 days; 7=200+ days)
Days hunting	Number of days spent hunting in Canada during 1991
Days fishing	Number of days spent fishing in freshwater, lakes, rivers, or streams in Canada during 1991
Total expenditures	Total expenditures on fish and wildlife activities in $100 (imputed)
Tax price	Tax price (calculated as 1 − estimated marginal tax rate)
Alberta	Resides in Alberta (dummy variable where 1 = yes; 0 = no)
Manitoba	Resides in Manitoba (dummy variable where 1 = yes; 0 = no)

[a] Derived as the sum of scores indicating importance for abundance of waterfowl, other birds, small mammals, and large mammals, each with a value ranging from 0 (not important) to 3 (very important).
[b] Activities include watching, photographing, studying, feeding, hunting, and trapping wildlife; collecting specimens; and observing, collecting, creating wildlife-related art/literature.

Table 2. Sample Statistics

	Low-income		Medium-income		High-income		Full sample	
Variable	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
Donation	0.261	1.800	0.724	6.176	1.642	15.721	0.784	8.852
	(4.782)[a]	(6.155)[a]	(6.994)[a]	(18.040)[a]	(9.940)[a]	(37.623)[a]	(7.770)[a]	(26.888)[a]
Income	2.109	0.772	4.451	0.498	6.922	0.857	4.204	2.008
Education	2.883	1.422	3.478	1.517	4.205	1.537	3.440	1.574
Age group	6.048	3.892	7.083	3.202	7.079	2.351	6.696	3.336
Rural[b]	0.515		0.448		0.414		0.465	
Male[b]	0.302		0.482		0.755		0.484	
Head[b]	0.264		0.571		0.784		0.511	
Abundance	8.761	3.875	9.351	3.512	9.956	2.962	9.284	3.556
Preserving	2.220	1.002	2.352	0.899	2.471	0.759	2.333	0.912
Some interest[b]	0.769		0.805		0.872		0.809	
Days residence	2.036	2.237	2.255	2.276	2.375	2.228	2.204	2.254
Days in Province	2.680	17.408	3.536	19.458	3.846	18.698	3.295	18.528
Days outside Prov.	0.372	4.858	0.444	3.489	0.679	4.375	0.477	4.267
Days incidental	0.625	1.037	0.754	1.120	0.933	1.231	0.751	1.126
Days hunting	1.040	9.463	1.358	6.939	2.191	10.135	1.450	8.809
Days fishing	2.417	9.797	3.766	11.377	4.969	14.610	3.568	11.800
Total expenditures	1.912	10.594	4.472	27.297	8.521	41.362	4.543	27.574
Tax price	0.924	0.105	0.712	0.015	0.576	0.020	0.757	0.154
Alberta[b]	0.373		0.394		0.446		0.399	
Manitoba[b]	0.303		0.286		0.243		0.281	
Sample size	5059		5075		3438		13572	
Number donating	276 (5.5%)		525 (10.3%)		568 (16.5%)		1369	

[a] Computed from the sub-samples of donating individuals.
[b] Dummy variables

Table 3. ML Estimation of IHS Double-Hurdle Model[a]

	Low-income		Medium-income		High-income		Full sample	
Variable	Particip.	Level	Particip.	Level	Particip.	Level	Particip.	Level
Constant	−1.805	−19.741**	4.947	−19.186	3.874	−20.333	−1.782	−23.542**
	(2.392)	(8.529)	(5.740)	(21.418)	(9.703)	(39.412)	(1.144)	(4.188)
Income	−0.197	0.924	0.365	0.805	−0.071	0.995*	0.036	0.823**
	(0.268)	(0.829)	(0.235)	(0.940)	(0.135)	(0.536)	(0.061)	(0.229)
Education	0.083	0.414*	0.192**	0.220	−0.003	0.565**	0.087**	0.431**
	(0.066)	(0.246)	(0.063)	(0.211)	(0.055)	(0.215)	(0.035)	(0.129)
Age	0.032	0.158	0.056*	0.210*	0.053	0.229	0.043**	0.206**
	(0.028)	(0.109)	(0.033)	(0.119)	(0.038)	(0.151)	(0.020)	(0.076)
Rural	−0.125	1.438**	0.683**	−1.199*	0.373**	−0.777	0.363**	−0.310
	(0.212)	(0.714)	(0.189)	(0.682)	(0.167)	(0.656)	(0.105)	(0.399)
Male	−0.422	1.853**	−0.439**	1.349	−0.048	−0.817	−0.254*	0.604
	(0.268)	(0.827)	(0.224)	(0.869)	(0.221)	(1.069)	(0.136)	(0.538)
Head	0.293	−0.246	0.027	−0.614	0.234	−0.750	0.029	−0.042
	(0.257)	(0.822)	(0.203)	(0.763)	(0.206)	(0.977)	(0.134)	(0.514)
Abundance	0.018	0.256	−0.028	0.428**	−0.003	0.374**	−0.006	0.357**
	(0.044)	(0.185)	(0.051)	(0.183)	(0.041)	(0.177)	(0.026)	(0.098)
Preserving	0.008	0.408	−0.127	1.179*	0.282*	0.987	0.143	0.529
	(0.171)	(0.628)	(0.197)	(0.691)	(0.154)	(0.667)	(0.100)	(0.390)
Some interest	0.365	2.116	−0.141	1.727	0.446	1.578	−0.539	4.546**
	(0.608)	(2.683)	(0.552)	(2.308)	(0.475)	(3.443)	(0.524)	(1.760)
Days residence	0.074*	0.264*	0.029	0.399**	0.143**	0.130	0.091**	0.247**
	(0.041)	(0.158)	(0.042)	(0.154)	(0.042)	(0.148)	(0.025)	(0.090)
Days in Province	−0.004	0.014	−0.006**	0.024**	−0.007*	0.039**	−0.004**	0.022**
	(0.006)	(0.013)	(0.003)	(0.010)	(0.003)	(0.012)	(0.002)	(0.006)
Days outside Prov.	0.403	−0.019	0.145**	−0.035	0.202**	−0.075*	0.242**	−0.037
	(0.303)	(0.054)	(0.052)	(0.036)	(0.093)	(0.042)	(0.083)	(0.024)

Days incidental	0.244**	0.077	0.408**	−0.476**	0.255**	−0.653**	0.271**	−0.291**
	(0.110)	(0.241)	(0.090)	(0.211)	(0.112)	(0.244)	(0.068)	(0.144)
Days hunting	1.186	−0.007	0.451**	0.028	3.053	0.045**	1.949	0.028**
	(1.229)	(0.016)	(0.165)	(0.020)	(2.222)	(0.016)	(1.322)	(0.009)
Days fishing	0.064**	−0.016	0.027**	−0.002	0.028**	−0.002	0.038**	−0.003
	(0.027)	(0.011)	(0.009)	(0.014)	(0.012)	(0.012)	(0.008)	(0.007)
Total expenditures	−0.001	0.042**	−0.004	0.026**	−0.001	0.028**	−0.001	0.024**
	(0.006)	(0.011)	(0.002)	(0.008)	(0.001)	(0.005)	(0.001)	(0.003)
Tax price	0.072	2.143	−11.015	1.875	−10.693	1.221	0.325	4.439
	(1.698)	(5.846)	(9.085)	(34.240)	(15.860)	(64.359)	(0.854)	(3.173)
Alberta	−0.338	−0.288	0.196	−2.316**	0.258	−0.557	0.009	−1.462**
	(0.244)	(0.840)	(0.215)	(0.081)	(0.572)	(2.329)	(0.125)	(0.466)
Manitoba	−0.330	−0.152	0.261	−2.018**	−0.134	−0.841	0.057	−1.091**
	(0.241)	(0.794)	(0.251)	(0.873)	(0.264)	(1.066)	(0.131)	(0.475)
σ		5.610**		6.273**		7.068**		6.550**
		(0.760)		(0.518)		(0.564)		(0.345)
σ_{12}		2.263*		−1.606		−1.082		−0.651
		(1.269)		(1.157)		(1.154)		(0.767)
θ		0.200**		0.205**		0.179**		0.195**
		(0.044)		(0.021)		(0.020)		(0.014)
Log−likelihood		−1586.680		−2805.620		−2992.432		−7437.493

[a] Asymptotic standard errors in parentheses.

** Significant at 5% level.
* Significant at 10% level.

Table 4. Elasticities With Respect to Continuous Variables[a]

	Low-income			Medium-income			High-income			Full sample		
Variable	Prob.	Cond. level	Uncond. level	Prob.	Cond. level	Uncond. level	Prob.	Cond. level	Uncond. level	Prob.	Cond. level	Uncond. level
Income	0.442	0.212	0.654	2.011**	0.465	2.477**	1.065*	0.665*	1.730*	0.767**	0.308**	1.074**
	(0.516)	(0.214)	(0.623)	(0.666)	(0.333)	(0.917)	(0.576)	(0.354)	(0.924)	(0.214)	(0.084)	(0.297)
Education	0.424**	0.088	0.512**	0.660**	0.125*	0.785**	0.367**	0.229**	0.597**	0.333**	0.133**	0.466**
	(0.192)	(0.081)	(0.249)	(0.147)	(0.066)	(0.177)	(0.137)	(0.088)	(0.222)	(0.097)	(0.039)	(0.135)
Age	0.339*	0.070	0.409*	0.636**	0.171**	0.807**	0.251	0.157	0.408	0.310**	0.123**	0.434**
	(0.181)	(0.072)	(0.235)	(0.129)	(0.069)	(0.175)	(0.166)	(0.104)	(0.269)	(0.110)	(0.045)	(0.154)
Abundance	0.706*	0.190	0.896	0.761**	0.355**	1.116**	0.576**	0.360**	0.935**	0.731**	0.294**	1.025**
	(0.393)	(0.164)	(0.549)	(0.219)	(0.129)	(0.318)	(0.281)	(0.166)	(0.444)	(0.202)	(0.078)	(0.278)
Preserving	0.270	0.081	0.351	0.443**	0.237*	0.679**	0.377	0.235	0.612	0.279	0.111	0.390
	(0.333)	(0.153)	(0.477)	(0.205)	(0.123)	(0.294)	(0.259)	(0.158)	(0.415)	(0.196)	(0.079)	(0.275)
Days residence	0.204**	0.036	0.240**	0.261**	0.090**	0.350**	0.048	0.030	0.078	0.124**	0.049**	0.173**
	(0.104)	(0.040)	(0.122)	(0.050)	(0.026)	(0.070)	(0.055)	(0.034)	(0.089)	(0.048)	(0.018)	(0.065)
Days in Province	0.008	0.004	0.012	0.006	0.006**	0.012	0.023**	0.014**	0.038**	0.016**	0.006**	0.022**
	(0.012)	(0.005)	(0.013)	(0.008)	(0.003)	(0.010)	(0.007)	(0.004)	(0.011)	(0.004)	(0.002)	(0.006)
Days outside Prov.	0.044	−0.014	0.031	0.043**	0.004	0.046**	−0.008*	−0.005*	−0.013*	−0.002	−0.001	−0.003
	(0.088)	(0.028)	(0.063)	(0.018)	(0.004)	(0.019)	(0.004)	(0.003)	(0.007)	(0.011)	(0.002)	(0.013)
Days incidental	0.062	−0.009	0.053	0.135**	−0.009	0.126**	−0.094**	−0.059**	−0.153**	−0.044	−0.019*	−0.063
	(0.089)	(0.033)	(0.075)	(0.057)	(0.018)	(0.059)	(0.034)	(0.022)	(0.055)	(0.030)	(0.010)	(0.039)
Days hunting	0.381	−0.107	0.274	0.447**	0.052	0.500**	0.015**	0.010**	0.025**	0.065	0.014	0.079
	(0.340)	(0.135)	(0.261)	(0.084)	(0.036)	(0.107)	(0.006)	(0.003)	(0.009)	(0.231)	(0.038)	(0.266)
Days fishing	0.036	−0.017	0.020	0.070**	0.007	0.077**	−0.002	−0.001	−0.003	0.000	0.000	0.000
	(0.090)	(0.029)	(0.066)	(0.025)	(0.006)	(0.027)	(0.009)	(0.006)	(0.014)	(0.014)	(0.003)	(0.016)
Total exp.	0.023**	0.007**	0.030**	0.014	0.009**	0.023*	0.037**	0.023**	0.059**	0.024**	0.009**	0.033**
	(0.008)	(0.003)	(0.008)	(0.010)	(0.003)	(0.013)	(0.007)	(0.004)	(0.010)	(0.003)	(0.001)	(0.005)

Tax price	0.601	0.174	0.775	−5.298	−0.498	−5.796	0.109	0.068	0.177	0.746	0.299	1.045
	(1.332)	(0.582)	(1.869)	(3.770)	(1.968)	(5.232)	(5.728)	(3.577)	(9.306)	(0.526)	(0.211)	(0.736)

[a] Asymptotic standard errors in parentheses.

** Significant at 5% level.
* Significant at 10% level.

Table 5. Elasticities of Binary Variables

	Low-income			Medium-income			High-income			Full sample		
Variable	Prob.	Cond. level	Uncond. level	Prob.	Cond. level	Uncond. level	Prob.	Cond. level	Uncond. level	Prob.	Cond. level	Uncond. level
Some interest	0.054	0.504	0.215	0.037	0.640	0.235	0.078	1.006	0.836	0.148	1.681	0.918
Rural	0.032	0.482	0.152	0.024	−0.263	0.075	−0.040	−0.533	−0.459	−0.011	−0.130	−0.080
Male	0.033	0.780	0.190	0.000	0.418	0.052	−0.042	−0.584	−0.512	0.023	0.263	0.165
Head	0.001	−0.152	−0.010	−0.016	−0.254	−0.104	−0.039	−0.536	−0.470	−0.002	−0.018	−0.011
Alberta	−0.016	0.003	−0.053	−0.050	−0.964	−0.362	−0.029	−0.396	−0.346	−0.060	−0.663	−0.433
Manitoba	−0.012	0.043	−0.039	−0.037	−0.826	−0.289	−0.043	−0.586	−0.508	−0.046	−0.507	−0.337

Table 6. Estimated aggregate reductions in donations to wildlife conservation in prairie Canada given 15% declines in income, hunting days and expenditures on fish and wildlife recreation

Factor reduced	Income strata			Full sample model
	Low Income Model	Medium income model	High income model	
Income	NS[a]	$2,350,000	$4,740,000	$4,700,000
Days Hunting	NS	$540,000	$76,000	NS
Total Expenditures	$17,000	$25,000	$180,000	$154,000

[a] NS indicates that the elasticity was statistically insignificant and thus the reduction would not affect donation behavior