Land Preservation in British Columbia: An Empirical Analysis of the Factors Underlying Public Support and Willingness to Pay

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This study extends previous empirical research on land preservation by considering an actual land preservation scheme, the agricultural land reserve in British Columbia, Canada. The reserve was established in 1973 to ensure that development did not occur on the province's most productive agricultural land. 'To ensure that local food production is maintained,' 'the economic importance of British Columbia's agricultural sector,' and 'to protect the environment' are the most important factors that underlie support for the reserve. Aggregate, provincewide willingness to pay to maintain the land reserve is substantial, with our most conservative estimate being Can$91.18 million per year.

Key Words: agriculture, contingent, land, preservation, valuation

JEL Classifications: Q15, Q24, Q28, Q51

If a researcher conducting a person-to-person survey were to ask 10 different people why they thought that preserving agricultural land was important, that individual could easily end up recording 10 different responses. Several of the respondents would likely comment on the importance of maintaining the food production capability in the region of interest. Other respondents would be expected to comment on the economic importance of

the agricultural sector of the economy, the possibility that development in the region might be more 'orderly' if highly productive agricultural land were to be preserved, the likely environmental benefits, the recreational opportunities that are provided by agricultural land, . . .

The empirical economics literature on land preservation originates with three papers published in the 1980s (Beasley, Workman, and Williams; Bergstrom, Dillman, and Stoll; Halstead). In each case a hypothetical land preservation scenario was established in a contingent valuation survey, and mean willingness to pay to preserve agricultural land was estimated. More recent research has focused on identifying the factors that underlie public support for land preservation (Duke and Aull-Hyde; Kline and Wichelns 1996b; Rosenberger).

This paper extends both streams of the literature. Willingness to pay to preserve agricultural land in British Columbia, Canada, is estimated, and the factors that underlie public support for land preservation in the province are examined. In addressing these issues a critical factor distinguishes this study from previous research. An actual land preservation program—British Columbia's Agricultural Land Reserve (ALR)—is examined. Whereas in the earlier studies information was collected on entirely hypothetical land preservation programs, we are able to determine (1) which factors motivate respondents to support an actual land preservation scheme, and (2) how much respondents across the province are, on average, willing to pay to maintain an existing program. As a result of concern that the province's most productive agricultural land was being lost to development, the government of British Columbia established the ALR in 1973 to ensure that agricultural land in the province was preserved for farm and ranch use. The ALR currently encompasses 4.76 million ha (Agricultural Land Commission).

To address the issues of concern, a survey based upon the contingent valuation method was mailed to 1,200 potential respondents across the province. For the respondents to our survey, 'to protect the environment' along with 'to ensure that local food production is maintained' and 'the economic importance of British Columbia's agricultural sector' were regarded as being, essentially, of equal importance. Since the provincial mandate of the ALR only includes the latter two objectives,[1] if our findings are representative of the views of British Columbia residents, then they suggest that the provincial government should consider modifying the mandate of the Commission to ensure that land is added to the reserve for the perceived environmental benefits. Regarding our second issue, aggregate willingness to pay to ensure that development did not occur on land in the ALR was conservatively estimated to be Can$91.18 million per year.

In the second section of the paper, previous research on land preservation is briefly summarized. The ALR is discussed in greater detail in the third section, whereas the design of the survey is considered in the fourth. The results of the survey are then presented and discussed in the fifth section. To assess "the degree to which the findings of [the] study are consistent with theoretical expectations" (Mitchell and Carson, p. 206) a modified version of the Tobit procedure is utilized in the regression analysis to correct for both censoring and selectivity bias in the sample of willingness-to-pay values. In the final section of the paper we offer conclusions.

Review of the Literature

Estimates of the willingness to pay to preserve agricultural land have been reported in several studies. Halstead used an iterative bidding approach to estimate the amount that households in three Massachusetts towns were willing to pay to prevent light, moderate, and heavy development on nearby agricultural land. In a similar vein, Beasley, Workman, and Williams also used an iterative bidding approach to estimate household willingness to pay to prevent a moderate or large increase in housing development on urban-fringe agricultural land in two areas of Alaska. In a third early study, Bergstrom, Dillman, and Stoll used a payment card approach to estimate the amount that households in Greenville County, SC, would be willing to pay to prevent residential, industrial, or commercial development in their county.

More recent studies on the willingness to pay to preserve agricultural land include those of Bowker and Didychuk, and Rosenberger and Walsh. In a rare Canadian study, Bowker and Didychuk estimated "the nonmarket value for retention of farmland in the Moncton area of New Brunswick" (p. 218). In the hypothetical scenario, individual respondents were first assigned "one of four acreage retention

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[1] To be more precise, maintaining the province's food production capability, and "the encouragement and enabling of farm businesses" are key goals of the Commission. "The ALR provides a sustainable agricultural land base that supports, and creates opportunities for, a safe and secure source of food and other agricultural products. The protected land base also provides for agricultural expansion and compatible economic activities." (Ministry of Sustainable Resource Management, pp. 11 and 13).

quantities" (p. 220): they then selected a maximum willingness-to-pay value from a payment card. Rosenberger and Walsh also used a payment card approach to estimate willingness to pay to preserve ranch land in Routt County, CO. In this instance, however, respondents first chose the amount of land that they wished to protect and then expressed their willingness to pay.

In the five aforementioned studies, information on willingness to pay to preserve agricultural land was collected from households living close to the land that was at risk from development. A major benefit of this approach is that the households are likely to be familiar with the particular parcels of land under development pressure. A modification to this approach would entail the contact of households living at greater distances from the agricultural land of interest. This would be appropriate because households concerned with preserving particular parcels of agricultural land do not necessarily live nearby. It should also be noted that no attempt was made to relate willingness to pay to the factors that underlie public support for land preservation in the five studies.

The more recent literature on land preservation includes a separate stream that attempts to determine precisely what underlies public support for land preservation programs. Kline and Wichelns (1996b) applied factor analysis to the data obtained from a survey of residents of Rhode Island. The most important factors that underlay public support were environmental in nature, whereas agrarian factors were of secondary importance. Rosenberger carried out a similar analysis for Routt County, CO, and found that although environmental factors were once again of primary importance, agrarian factors were dominated by open-space amenities. Duke and Aull-Hyde utilized a different methodology—the analytic hierarchy process—while obtaining similar results; agrarian and environmental factors were dominant.

Duke and Ilvento attempted to integrate the two streams of the literature. They related the overall level of support for land preservation (nonmonetary) to the various attributes

of preserved land. Although the level of support was positively related to the measures of the agrarian and environmental attributes, this did not follow for the open-space attribute. Also, the difference in support for the agrarian and environmental attributes was not statistically significant. With regard to the second stream of the literature, the lack of a statistically significant difference in the levels of support for the agrarian and environmental attributes ensured that differences in marginal willingness to pay for these attributes would also *not* be statistically significant.

Agricultural Land Reserve

British Columbia's agricultural land commission (the Commission) was established in 1973. The Commission's primary objectives were to "(a) preserve agricultural land for farm use [and] (b) encourage the establishment and maintenance of family farms and land in an agricultural land reserve, for a use compatible with the preservation of family farms and farm use of the land" (Land Commission Act, section 7). The rationale for creating a land reserve was straightforward: prime agricultural land is quite scarce in the province, in that "less than 3% [of the province's land] is capable of supporting a range of agriculture" (Quayle, section entitled 'Report Summary'). By 1974 the province's ALR encompassed 4.72 million ha (Agricultural Land Commission). The agricultural capability of a particular parcel of land determined whether that parcel was included in the ALR. The fact that the agricultural capability of the province's land had already been determined as part of the Canada land inventory survey was what allowed the ALR to be created so quickly (Coombs and Thie).[2] The information on the

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[2] Although it was not mentioned in the questionnaire, since its establishment land has been both added to the ALR and removed from it on a yearly basis. For the period 1974–1987, an average of 5,364 (7,165) ha were added to (removed from) the reserve each year. More recently—1988–2003—additions (removals) have averaged 6,318 (2,033) ha per year (Agricultural Land Commission). Landowners must apply to the Commission to have land added to or removed from the reserve.

ALR that was provided to respondents to the questionnaire is given in the Appendix.

Methodology and Survey Design

Two issues are the primary focus of our research: what motivates the people of British Columbia to support having an ALR that preserves the province's agricultural land, and how much would they be willing to pay each year to ensure that development does not occur on land in the ALR. To address these issues, a survey based upon the contingent valuation method (CVM) was mailed to 1,200 individuals across the province. The province was first divided into seven regions—Vancouver Island, Lower Mainland, Southern Interior, Kootenay, Cariboo, Skeena, and Omineca–Peace. Since the vast majority of the province's population lives in the Lower Mainland— which includes Greater Vancouver—random sampling procedures would have entailed most of the questionnaires being sent to that region. As a consequence, a stratified sample was instead selected with the remaining regions of the province being oversampled relative to the lower mainland to ensure that the views of all British Columbians would be reflected in the survey's results.[3] Of course, the stratified nature of our sample must be taken into account in the statistical analysis that follows.

Before its being mailed to potential respondents, the questionnaire was pretested in a classroom environment on two occasions.[4] Dillman's method (Dillman) was followed, to the extent that the research budget allowed, in an attempt to maximize the response rate. Potential respondents were first sent a letter on institutional letterhead indicating that they had been selected to participate in a survey that focused on British Columbia's agricultural land reserve. One week later the selected individuals were sent the actual questionnaire along with a cover letter, again on institutional letterhead. Finally, in another 2 weeks the individuals were sent a postcard thanking them if they had sent in the questionnaire, and asking them to do so if they had not.

The questionnaire was divided into four sections. Section I obtained information on the importance of the following issues: improving highways, reducing crime, improving the quality of drinking water, improving public libraries, preventing development on agricultural land, improving the quality of education, and improving the quality of health care. More specifically, individuals were asked whether particular issues should be of low, moderate, or high priority for government funding, or whether the individual was not sure. These questions were included for two reasons: to gain insight into how the respondents regarded land preservation relative to other problems, and to obtain information that might later prove useful in explaining willingness to pay.

The second section of the questionnaire first provided background information on the ALR to potential respondents. Various reasons as to why people might support having an agricultural land reserve were then given: the economic importance of the agricultural sector, local food production, more efficient development, environmental benefits, and recreational and open-space benefits were included.[5] The actual information that was given to respondents is provided in the Appendix.

In section III of the questionnaire, potential respondents were first asked whether the reasons given in the previous section for maintaining the ALR and thereby preventing development on agricultural land in British Columbia were either not important, slightly important, important, or very important. These questions were included to determine what underlies the support for land preserva-

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[3] A database that included information from all of the telephone directories in the province was used to select samples by region. The regional samples were not fully random since potential respondents with unlisted telephone numbers were not considered.

[4] One of the coauthors teaches a course in Environmental Economics, and the questionnaire was given to the students as a seminar exercise before contingent valuation actually being discussed in class. A weakness of the pretest is that undergraduates are not representative of the entire population.

[5] The reasons are consistent with previous research on land preservation (Furuseth; Kline and Wichelns 1996a,b).

*If you **could be sure** that the land currently in the A.L.R. would not be developed, would you then be willing to **accept an increase in your household's yearly income taxes** to pay the higher service costs?*

☐ Yes   ☐ No ➡ *Go to Question 8.*

*What is the **maximum your household would be willing to pay each year** to prevent land that is currently in the A.L.R. from being developed? [Please keep in mind that any increase in income taxes will leave less money for other household expenses.]*

$ [____].00 *per year*

tion in the province. The following was then to be considered:

In the next 25 years the population of British Columbia is expected to increase by approximately 40%; from 4.1 to 5.7 million. As a consequence, roughly 900,000 additional housing units (houses/condos/apartments) will be required.

Please consider the following hypothetical situation. *Imagine that:*

- *The government of British Columbia continued to support the ALR, and therefore these lands were not available for development.*
- *New housing developments would therefore be in areas that are more expensive to service (water, roads, etc.), and the British Columbia government would have to raise additional tax revenue to pay the higher costs.*

An open-ended valuation question was therefore used in the survey that forms the basis for this paper: respondents were asked to directly state the maximum that they were willing to pay per year on behalf of their households to ensure that development on land in the ALR did not occur. It should be noted that the hypothetical scenario does not simply ensure the status quo. As was pointed out previously, land is removed from the ALR on a yearly basis. The scenario therefore represents a strengthening of the current policy. Note that in contrast to earlier studies, respondents were not asked specifically about agricultural land located near their residence. A possible consequence of this is an enhanced likelihood

of a protest response from respondents. Also, note that in contrast to earlier studies, respondents were not asked to select either that proportion of land in the ALR that they wanted preserved for agricultural use, or the type of development to be prevented.

Three elicitation formats are currently used in contingent valuation studies: the open-ended, payment card, and dichotomous choice approaches. All three formats face criticism, and consensus has not been reached regarding the appropriate format. Although dichotomous choice valuation questions are incentive compatible, 'yea-saying' is a problem, and estimates of mean willingness to pay are typically much larger than those generated by the other two formats (Alvarez-Farizo et al.; Ryan, Scott, and Donaldson). Payment cards are not incentive compatible, and the distribution of bids possibly affects mean values, i.e., both range and end-point bias are potential problems (Boyle; Hu). Finally, open-ended valuation questions are more difficult to respond to. The response rates to surveys that use open-ended valuation questions are therefore quite low, and a high proportion of respondents either select a value of zero as their maximum willingness to pay, or register a protest to the valuation question (Carson, Groves, and Machina, p. 27). However, the amount of information contained in a single response exceeds that for the other elicitation formats. Because of a limited research budget we chose to use an

open-ended valuation question to maximize the precision of our estimate of willingness to pay.[6]

A further question then raised the issue of where the money would come from to pay the increased taxes. Options included: money to be spent on nonessential food items (candy, soft drinks, . . .), money currently donated to charities, money currently spent on holidays or on entertainment, money currently being saved, and other (to be specified by the respondent). Those individuals who were not willing to pay to prevent development on agricultural land currently in the ALR were then asked—question 8—about their reason. The respondent's selection enabled the researchers to determine whether the response to the valuation question should be classified as being a 'protest response.' The following responses were treated as protest responses: 'Taxes are already too high' and 'It is not fair to expect my household to have to pay the higher cost of providing services to new developments.' Questionnaires were left in the sample if respondents selected either 'Income/financial situation of my household' or 'I do not oppose development on land in the ALR.' Finally, for those individuals who selected 'Other,' the nature of the particular reason given determined whether the response was classified as a protest.

The fourth, and final, section of the questionnaire collected socioeconomic data on the respondent.[7]

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[6] It is well known that various types of bias may arise in contingent valuation studies if the questionnaires are not well designed. See Mitchell and Carson.

[7] Questions were asked about the respondent's gender and age, the location of the respondent's residence, their educational attainment, and their annual household income. Other questions included whether the respondent belonged to an organization concerned with environmental or conservation issues at any time over the last 5 years, the number of people living in the respondent's household, whether the respondent spent at least part of his or her childhood growing up in a rural area, the nature of the community or area that the respondent currently lives in, and whether a member of the respondent's household owns farmland or ranch land that is in the ALR.

Results

Of the 1,200 questionnaires that were mailed to people across British Columbia, 185 were returned unopened because the individual had either moved to another address or was deceased (three cases). Of the remaining 1015 questionnaires, 307 were eventually returned, for a response rate of 30.2%.[8] Thirty-four of the returned questionnaires were eliminated from the sample because they were incomplete, and six were eliminated because the willingness to pay was regarded as being an outlier. In determining whether a response was an outlier, the following rule of thumb was used: if the willingness to pay exceeded the mean willingness to pay by three or more standard deviations, the questionnaire was eliminated from the sample. This left 267 responses to be utilized in the statistical analysis, of which 164 (103) were regarded as being nonprotest (protest) responses. Looking ahead to the empirical analysis, the existence of the protest responses raises the possibility of selectivity bias in our willingness-to-pay data (Heckman 1976, 1979).

Priorities and Importance

Table 1 reports the mean values of the level of priority that respondents assigned to various social, economic, and environmental problems. In calculating the mean values, a 'low priority' was assigned a value of 1, whereas 'moderate' and 'high' priorities were assigned values of 2 and 3, respectively. Responses of 'not sure' were dropped.

Although the mean priority for each problem—with the exception of improving public libraries—was in the moderate to high priority range, statistically significant differences were reflected in the Tukey test, which

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[8] The response rate would likely have been higher if the budget had permitted the mailing of a second questionnaire to potential respondents. It should be noted that response rates of 30–40% are not uncommon in contingent valuation studies.

Table 1. Priority of Various Social, Economic, and Environmental Problems for Government Funding

Problems	Mean Values	Level of Significance of the Tukey Test Used to Compare Mean Values						
		1	2	3	4	5	6	7
1. Improving the quality of health care	2.766		***	***	***	***	***	***
2. Reducing crime	2.558					***	***	***
3. Improving the quality of drinking water	2.519					***	***	***
4. Improving the quality of education	2.507					***	***	***
5. Preventing development on agricultural land	2.315							***
6. Improving highways	2.288							***
7. Improving public libraries	1.647							

***Corresponds to a 1% level of significance.

Table 2. Importance Assigned to the Reasons for Preventing Development on Agricultural Land in British Columbia

Reasons	Mean Values	Level of Significance of the Tukey Test Used to Compare the Mean Values				
		1	2	3	4	5
1. To ensure that local food production is maintained	3.31				***	***
2. The economic importance of British Columbia's agricultural sector	3.25				***	***
3. To protect the environment	3.21				***	***
4. To ensure orderly development	2.99					**
5. To provide recreational opportunities and protect open space	2.78					

***Corresponds to a 1% level of significance, and **corresponds to a 5% level.

was used to compare mean values.[9] That 'improving the quality of health care' was regarded as being of higher priority than any of the other problems was not surprising given media coverage of health care issues. To infer, however, that government should focus on health care concerns to the detriment of the other problems would be inappropriate.

In section III of the questionnaire, respondents were asked to assess the importance of various reasons for preventing development on agricultural land. Table 2 reports the importance of the various reasons given in a format analogous to that of Table 1 above. In calculating the mean values in this instance, values of 1, 2, 3, and 4 were assigned to 'not important,' 'slightly important,' 'important,' and 'very important,' respectively.

'To ensure that local food production is maintained,' 'the economic importance of British Columbia's agricultural sector,' and 'to protect the environment' were regarded as being the most important reasons for

[9] Using a series of paired *t*-tests to compare means was not appropriate since the "the level of significance and power for a family of tests is not the same as that for an individual test" (Neter et al., p. 724). The Tukey test, on the other hand, was appropriate because it determines whether a level of overall significance is achieved for a family of tests. It should be noted that before completing the Tukey test, an *F*-test confirmed that the mean priority levels for the seven problems were not identical ($p < 0.01$).

preventing development. Given that maintaining the province's food production capability and "the encouragement and enabling of farm businesses" (Ministry of Sustainable Resource Management, p. 13) are key goals of the Commission, whether statistically significant differences exist in the mean ratings of importance for the aforementioned three reasons for preventing development is of concern. The hypothesis that the three means were equal could not be rejected at even a 50% level of significance. Respondents regarded several reasons for preventing development as being of essentially equal importance; 'to ensure that local food production is maintained' and 'the economic importance of British Columbia's agricultural sector' **were not dominant**. These results are consistent with those of Duke and Aull-Hyde, Kline and Wichelns 1996b, and Rosenberger. If our results are representative of the views of all British Columbia residents, they suggest that the provincial government should consider modifying the mandate of the Agricultural Land Commission to explicitly allow the Commission to add particular parcels of land to the reserve for the perceived environmental benefits.

Empirical Analysis

Estimating the amount that residents of the province are willing to pay each year to ensure that development does not occur on land currently in the ALR is this study's second issue of primary concern. For an estimate of aggregate willingness to pay to be defensible, however, individual household willingness to pay should be related to income and other factors in a manner that is consistent with expectations. The CVM questionnaire discussed above yielded willingness-to-pay values for 164 respondents. In addition, 103 respondents registered a protest to the valuation question. The existence of the protest responses is important because, as a consequence, the willingness-to-pay data contains an inherent selectivity bias (Heckman 1976, 1979): willingness to pay is only reported by those respondents who do not submit a protest response.

Censoring also arises in our willingness-to-pay data. Recall that in the questionnaire respondents were first asked whether they would be willing to accept an increase in their household's yearly income taxes to ensure that land in the ALR would not be developed. Respondents selecting 'No' were then asked to specify a reason for their choice. Those who selected 'I do not oppose development of land in the ALR' may, in fact, have had a negative willingness to pay. Censoring therefore arises because the questionnaire only allowed respondents to record a nonnegative willingness to pay. To deal with both selectivity bias and censoring simultaneously, it was necessary to utilize a modified version of the Tobit procedure.[10]

The Tobit model modified to incorporate sample selection is given by the willingness-to-pay equation

$$wtp_i^* = \beta'x + \varepsilon_i$$
$$wtp_i = 0 \qquad \text{if } wtp_i^* \leq 0$$
$$wtp_i^* = wtp_i \quad \text{if } wtp_i^* > 0$$

and the participation (nonprotest/protest) equation

$$z_i^* = \alpha'w + \mu_i$$
$$z_i = 1 \quad \text{if } z_i^* > 0$$
$$z_i = 0 \quad \text{if } z_i^* \leq 0,$$

where wtp_i^* is latent willingness to pay for respondent i; wtp_i is observed willingness to pay for respondent i; z_i^* is a latent variable that reflects the propensity of respondent i to submit a nonprotest response; z_i is a dummy variable where z_i equals [1|0] if respondent i submits a [nonprotest|protest] response; x and w are vectors of explanatory variables; β and α are vectors of coefficients to be estimated; and ε_i and μ_i are stochastic error terms where $\varepsilon, \mu \sim N(0, 0, \sigma_\varepsilon^2, 1, \rho)$. The log-likelihood function is given by

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[10] More detailed discussions of the required modification to the Tobit procedure may be found in Alvarez-Farizo et al., and Greene.

$$\log L = \sum_{z=0} \log \Phi(-\alpha' w)$$

$$+ \sum_{z=1, wtp=0} \log \Phi_2 \left[-\frac{\beta' x}{\sigma_\varepsilon}, \alpha' w, -\rho \right]$$

$$+ \sum_{z=1, wtp>0} \left\{ \begin{array}{l} -\frac{1}{2} \left[\log 2\pi + \log \sigma_\varepsilon + \left(\frac{\varepsilon_i}{\sigma_\varepsilon} \right)^2 \right] \\ + \log \Phi \left[r_i \Big/ \left(1 - \rho^2 \right)^{\frac{1}{2}} \right] \end{array} \right\},$$

where $\varepsilon_i = wtp_i - \beta' x$, $r_i = \alpha' w + \rho \varepsilon_i / \sigma_\varepsilon$ (Greene, chapter E31, section 2.1), Φ = the standard normal cumulative density function, and Φ_2 = the bivariate standard normal cumulative density function. Joint maximum likelihood estimation of the participation and willingness-to-pay equations can then proceed using LIMDEP, for instance (Greene). It should be noted that it is not possible to estimate the two equations following a two-stage Heckman-like procedure.

Recall that the data that were used in the regression analysis were the result of a stratified sample; all regions of the province were oversampled relative to the lower mainland, where the majority of the province's population lives. The following procedure was utilized within the maximum likelihood estimation to account for the resulting inherent bias in the sample (DuMouchel and Duncan; Winship and Radbill). First of all, the probabilities of being included in each region's (strata's) sample were calculated, and the base weights were generated (Levy and Lemeshaw; Yansaneh). Nonresponse adjustment weights were then generated following an analogous procedure, as it is necessary to account for differences in response rates across regions. The overall sample weight for each region was then obtained by multiplying the base weight by the nonresponse adjustment weight. The overall sample weights along with interaction terms—that is, variables incorporating an interaction between the overall sample weights and other explanatory variables—were then included as explanatory variables in both the participation and willingness-to-pay equations. Second, if the maximum likelihood estimation yielded a coefficient for one or more of these variables that was significantly different from zero, then appropriate location variables or interaction variables including a

locational component were substituted for the corresponding overall sample-weight-based variables. Finally, the participation and willingness-to-pay equations were jointly re-estimated, and the significance of the latter location or interaction variables was determined. The procedure resulted in the addition of two interaction terms to the estimated participation equation.

Table 3 provides information on the explanatory variables to be used in the maximum likelihood estimation. The first group of explanatory variables reports the priority that respondents assign to the preservation of agricultural land. The second and third groups report the location of the respondent's residence and the annual household income of respondents, respectively. The final five explanatory variables report the gender of respondents, the number of individuals in a respondent's household, whether the respondent spent at least part of his or her childhood growing up in a rural area, whether a member of the respondent's household owned land that was in the ALR, and terms summarizing the interaction between the location of a respondent's household and the priority that a respondent assigned to the preservation of agricultural land.[11]

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[11] The explanatory variables are consistent with previous research (Beasley, Workman, and Williams; Bergstrom, Dillman, and Stoll; Bowker and Didychuk; Halstead; Rosenberger and Walsh). In these studies the following factors were found to be important in explain-?ing willingness to pay: income, the level of development that would be avoided, the distance to nearby agricultural land, the community in which the respondent lived, whether the respondent was the head of the household, whether the respondent was knowledgeable about purchase of development right programs, how long the respondent lived in the area, the respondent's level of educational attainment, the respondent's age, the amount of land that was protected from development, the hypothetical method of payment, whether the respondent had a farming background, whether the respondent was involved in commercial development, whether the respondent was actively involved in farming, whether the respondent was involved with an organization concerned with conservation, the size of the respondent's household, whether the individual visited farmland, the preferred amount of land to be protected from development, and the importance of open space relative to other environmental attributes.

Table 3. Variables Used in the Maximum Likelihood Estimation

Variables	Name	Description
Priority (base case: respondents who either regarded the preservation of agricultural land as being of low priority, or were not sure.)	ModPrio	Respondents who regarded the preservation of agricultural land as being of moderate priority (1 = Yes; 0 = No).
	HighPrio	Respondents who regarded the preservation of agricultural land as being of high priority (1 = Yes; 0 = No).
Location (base case: respondents whose residences <u>were not</u> located on Vancouver Island, in the southern interior, or in the lower mainland.)	VanIs	Respondents whose residence was located on Vancouver Island (1 = Yes; 0 = No).
	LowMain	Respondents whose residence was located in the lower mainland (1 = Yes; 0 = No).
	SouInt	Respondents whose residence was located in the southern interior (1 = Yes; 0 = No).
Income (base case: respondents for whom annual household income was $40,000 or less.)	Inc4080	Respondents for whom annual household income was in the range $40,001 to $80,000 (1 = Yes; 0 = No).
	Inc80+	Respondents for whom annual household income was $80,001 or more (1 = Yes; 0 = No).
Gender	Gender	Gender of the respondent (1 = Male; 0 = Female).
Size of the household	HH	Number of individuals in the respondent's household.
Rural background	GrowRur	Respondents who spent at least part of their childhood growing up in a rural area (1 = Yes; 0 = No).
Landowner	LandOwn	Respondents for whom a member of their household owned land that was in the agricultural land reserve (1 = Yes; 0 = No).
Interaction terms (base case: respondents who either lived outside of the lower mainland, or lived in the lower mainland and regarded the preservation of agricultural land as being of lower priority or were not sure.)	LowMain_Mod	Respondents whose residence was located in the lower mainland, and regarded the preservation of agricultural land as being of moderate priority (1 = Yes; 0 = No).
	LowMain_High	Respondents whose residence was located in the lower mainland, and regarded the preservation of agricultural land as being of high priority (1 = Yes; 0 = No).

Factors Determining the Likelihood of a Nonprotest Response

The results reported in rows 2–4 of Table 4 indicate that respondents who lived on either Vancouver Island or in the southern interior were more likely to submit a nonprotest response to the valuation question than those respondents whose residences were located elsewhere in the province. Given that development pressure is strong in these two regions of the province, we have moderate support for the hypothesis of a positive relationship between the strength of development pressure in the region where the respondent's residence is located and the likelihood of a nonprotest response.

Surprisingly, the priority that the respondent assigned to land preservation was negatively related to the probability of a nonprotest response (see rows 6 and 7). In particular, respondents who regarded the preservation of agricultural land as being of moderate priority were significantly <u>less</u>

Table 4. Results of the Maximum Likelihood Estimation

Rows	Variables	Estimated Coefficients	*p*-values
	Participation (Nonprotest/Protest) Equation		
1	Constant	0.5394	0.1005
2	VanIs	0.8277	0.0069
3	LowMain	−0.6081	0.1990
4	SouInt	0.3611	0.0749
5	Gender	−0.2874	0.0967
6	ModPrio	−0.7185	0.0170
7	HighPrio	−0.2354	0.4459
8	LowMain_Mod	1.2268	0.0190
9	LowMain_High	0.7206	0.1614
	Willingness-to-Pay Equation		
10	Constant	−231.096	<0.0001
11	ModPrio	101.167	0.0363
12	HighPrio	216.272	<0.0001
13	GrowRur	44.530	0.1343
14	Inc4080	86.343	0.0071
15	Inc80+	136.932	<0.0001
16	HH	−24.150	0.0333
17	LandOwn	71.329	0.0833
	σ_ε	183.561	<0.0001
	ρ	0.958	<0.0001
	Log likelihood	−884.029	
	Number of observations	267	

likely than those who regarded such preservation as being of low priority (or were not sure) to submit a nonprotest response. This was contrary to expectations. Rows 8 and 9 report how the location of the respondent's residence and his or her attitude toward land preservation interact in determining the likelihood of submitting a nonprotest response. Respondents who lived in the lower mainland <u>and</u> regarded the preservation of agricultural land as being of moderate priority were more likely to submit a nonprotest response. This interaction offsets, at least in part, the negative effect reported in row 6 and discussed above. Finally, the gender of the respondent was a significant factor in determining whether a respondent submitted a nonprotest response (see row 5).

Determinants of Willingness to Pay

An increase in household income would be expected to result in an increase in willingness to pay. The results reported in rows 14 and 15 are therefore consistent with expectations. Recall that respondents who regarded land preservation as being of moderate priority were more likely to register a protest to the valuation question than respondents who regarded such preservation as being of low priority (or were not sure) (see row 6). We were unable to draw any conclusions for high-priority respondents. However, the results of the maximum likelihood estimation (see rows 11 and 12) indicate that both moderate- and high-priority respondents were willing to pay more to preserve agricultural land than low-priority respondents, whereas high-priority respondents are willing to pay more than moderate-priority respondents. Bringing together the results: (1) high-priority respondents were willing to pay more to preserve agricultural land than moderate priority-respondents, whereas moderate-priority respondents were willing to pay more than low-priority respondents; and (2) whereas moderate-priority respondents were more likely than low-priority respondents to protest,

high-priority respondents were not. Also, household size was inversely related to willingness to pay (row 16), whereas the impact of growing up in a rural area was of borderline significance (see row 13). Finally, willingness to pay increased when a member of the respondent's household owned land that was in the ALR (see row 17). This result is important because it provides evidence to counter the argument that individuals who actually own land in the ALR do not support its continued existence. Although it is speculative, landowners are more likely to be concerned with maintaining farming/ranching as a way of life than other nonprotest respondents to the questionnaire.

An attempt was also made to relate the five different reasons as to why people might support having an agricultural land reserve to (1) the likelihood of submitting a nonprotest response to the valuation question, and (2) household willingness to pay. Unfortunately, a high degree of correlation between the levels of importance assigned to the various reasons prevented the determination of their individual impacts on both (1) and (2). Deaton, Norris, and Hoehn found that the likelihood of supporting a land preservation program decreased if the farmland being protected was of low productivity.

Willingness to Pay

In section III of the questionnaire respondents were asked (1) whether they were willing to accept an increase in their household's yearly income taxes to ensure that land in the ALR was not developed, and if so, (2) how much they were willing to pay on behalf of their households. Of the nonprotest respondents, 112 (or 67%) were willing to accept some increase in their household's yearly income taxes. The mean annual household willingness to pay for nonprotest respondents was Can$88.62 per year. Given the (estimated) number of households in British Columbia—1.697 million in 2003 (Ministry of Management Services)—aggregate willingness to pay was estimated to be Can$150.39 million.

In calculating the mean household willingness to pay reported above, it was necessary to account for the stratified nature of our sample. Recall that all regions of the province were oversampled relative to the lower mainland. The mean household willingness to pay for the entire sample ($88.62) is a weighted average of the means for the individual regions, with the weights being the overall sample weights discussed previously. This procedure corrected for the bias inherent in a stratified sample. For the estimate of mean household willingness to pay to be meaningful on a provincewide basis, the information provided by respondents from each region (strata) must also reflect the views of nonrespondents.

A second more conservative estimate of household willingness to pay was obtained by including protest responses, with a willingness to pay of zero. A procedure identical to that outlined above resulted in a mean household willingness to pay of Can$60.56 per year, with aggregate willingness to pay equaling Can$102.77 million per year.

A final estimate of household aggregate willingness to pay was based upon the results of the modified Tobit procedure discussed above. An estimate of the expected household willingness to pay was first generated by substituting the mean values of the explanatory variables into the estimated latent willingness-to-pay equation. Latent willingness to pay was used because the calculation explicitly allows for negative willingness to pay. The resulting value—Can$53.73 per year—was then multiplied by the (estimated) number of households in British Columbia to obtain an estimate of aggregate willingness to pay of Can$91.18 million per year.

The values for mean household willingness to pay reported above are consistent with the results reported in previous research. For instance, Halstead reported that mean household willingness to pay to prevent moderate development on nearby agricultural land ranged from US$44.31 to US$81.03 per year (1981) for households in three Massachusetts towns. Beasley, Workman, and Williams reported a mean household willingness to pay of US$76.00 per year (1983) to prevent a

moderate increase in housing development on urban-fringe agricultural land. Bergstrom, Dillman, and Stoll reported a lower mean household willingness to pay: households were willing to pay an average of US$8.94 per year (1982) to prevent residential, industrial, or commercial development on 72,000 acres of land in their county. The results reported in Bowker and Didychuk are more consistent with those of Beasley, Workman, and Williams, and Halstead in that households were willing to pay an average of Can$86.20 per year (1991) to preserve 95,000 acres of farmland. Finally, Rosenberger and Walsh reported a mean annual household willingness to pay of US$256 (1994) to prevent development on 50,000 acres of ranchland.

Conclusions

Empirical economic research on land preservation has emphasized two questions: (1) how much are people willing to pay to preserve scarce agricultural land, and (2) what factors underlie public support for land preservation? In addressing these questions the existing studies focus on hypothetical land preservation programs. In this study, on the other hand, an actual and well-established land preservation scheme is examined. The results reported herein therefore provide significant additional support for the widely held view that scarce agricultural land should be preserved.

British Columbia's agricultural land reserve was established in 1973 to ensure that the province's most productive agricultural land was not lost to development. Support for the ALR is motivated by a number of factors including: (1) to ensure that local food production is maintained, (2) the economic importance of British Columbia's agricultural sector, (3) to protect the environment, (4) to ensure orderly development, and (5) to provide recreational opportunities and protect open space. An important result of the paper is that reasons (1), (2), and (3) given above for preventing development on land in the ALR were regarded by the respondents to the survey as being, essentially, of equal impor-

tance. Maintaining food production and the economic importance of British Columbia's agricultural sector **were not dominant**. This is noteworthy given that (1) and (2) are, in essence, key goals of the Agricultural Land Commission. If our results are reflective of the views of British Columbia residents, they suggest that the government of British Columbia should consider modifying the mandate of the Agricultural Land Commission to explicitly allow the Commission to add individual parcels of land to the reserve for additional reasons, in particular because of the perceived environmental benefits.

Aggregate, provincewide willingness to pay to maintain the ALR and thereby ensure that development does not occur on the province's prime agricultural land is substantial. Three different approaches were used to estimate aggregate willingness to pay, with the most conservative estimate being Can$91.18 million per year.

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Appendix A. Important Aspects of the Questionnaire

Section II: Information on the Agricultural Land Reserve (ALR)

In 1973, British Columbia's Agricultural Land Commission was established. The Commission's primary mandate is "to preserve agricultural land and encourage the establishment and maintenance of farms." This was to be accomplished through the creation of an agricultural land reserve **(the ALR)**. **Land in the reserve is to be used for agricultural purposes, and *may not be used* for residential, recreational, commercial, or industrial developments.** For development to occur on a parcel of ALR land—including golf courses and soccer fields—formal permission must be given to remove the parcel from the reserve.

Approximately 4.7 million ha of agricultural land, or 5% of the province, is currently in the ALR. The key factor in deciding whether to place a parcel of land in the reserve is the agricultural capability of that parcel.

There are several reasons why people **might support** having an ALR, and thereby prevent development on agricultural land:

A. **Economic**

The agricultural sector is important to the economy of British Columbia. **In 1997**, approximately 33,300 people were directly employed in agriculture, over 200 commodities were produced, and farm cash receipts exceeded $1.7 billion. Food processing resulted in additional employment. When both groups of people spent their incomes, even more jobs were created.

B. **Local food production**

By preventing development on agricultural land, the province's food production capability is being maintained. This limits, to a certain extent, our reliance on imported food, and the food that we would otherwise import will be available to people in other provinces and countries.

C. **More efficient development**

It has been suggested that the ALR has resulted in a more orderly development of urban and rural areas. In particular, urban sprawl may have been reduced, and traditional country life may have been protected.

D. **Environmental benefits**

It is sometimes argued that by preventing development, the ALR has resulted in a variety of environmental benefits. For instance, according to this view wetlands and endangered species are protected, farmland is able to convert organic waste into nutrients for crops, and groundwater aquifers are recharged in agricultural areas.

E. **Recreational and open-space benefits**

Agricultural areas can provide recreational opportunities. For instance, people from urban areas can travel to the countryside for a weekend drive, they can ride their bikes on roads through agricultural areas, they can observe and photograph wildlife, etc. The open space itself is important to people who gain pleasure from viewing or living near a scenic agricultural setting, or simply from knowing that scenic open areas are nearby.

Section III: The Importance of British Columbia's ALR

How important are the reasons given above for preventing development on agricultural land in British Columbia?

Reasons for Preventing Development on Agricultural Land	Not Important	Slightly Important	Important	Very Important
A. The economic importance of British Columbia's agricultural sector	☐	☐	☐	☐
B. To ensure that local food production is maintained	☐	☐	☐	☐
C. To ensure orderly development	☐	☐	☐	☐
D. To protect the environment	☐	☐	☐	☐
E. To provide recreational opportunities and protect open space	☐	☐	☐	☐