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Title: Factors Influencing West Tennessee Farmers' Willingness to Pay for a Boll Weevil Eradication Program

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Abstract: Data from a survey were used to evaluate Tennessee farmers' willingness to pay for the boll weevil eradication program. Producer experience, boll weevil control costs, and attitudes about boll weevil damage and insecticide usage after the program were significant explanatory variables and had a positive influence on willingness to pay.

Keywords: Contingent valuation, cotton, regional pest control, pest management groups

Introduction

The boll weevil has been an important pest problem for U.S. cotton growers. Farmers in many areas of the U.S. Cotton Belt have implemented the boll weevil eradication program (BWEP) to control this pest. The BWEP is an area-wide cotton insect management program designed to eliminate the boll weevil (U.S. Department of Agriculture, 1997). The program has been successfully implemented in many areas of the U.S. Cotton Belt. In most states, the BWEP can only be started after 67% of growers vote positively in a referendum. Once the program is implemented, all cotton producers are required by state law to participate. Producers pay a yearly assessment that lasts from 5 to 7 years to fund the program. BWEP personnel, rather than farmers, are responsible for boll weevil control after the program starts. Farmers are still responsible for controlling other cotton insects. Producers may opt out of the program by not growing cotton. This study deals with some of the factors that influence cotton producers' willingness to pay for the BWEP currently being implemented in West Tennessee.

Robinson et al. evaluated producer willingness to pay for the BWEP for the Texas Gulf Coast area. They found that approximately 75 percent of individuals surveyed were supportive of the BWEP and would be willing to pay $64.89 per acre annually for five years. The largest component of the elicited willingness to pay value was the estimated $46 per acre reduction in boll weevil control expendit

ures. Other than the Robinson et al. study, analysis of factors that influence farmers' willingness to pay to be in a pest management group such as the BWEP has been largely

neglected in the literature. The objective of this study was to evaluate the factors that influence West Tennessee farmers' willingness to pay for the BWEP.

Methods and Data

The contingent valuation (CV) method was used to estimate willingness to pay. The CV procedure, which involves the elicitation of decision makers' willingness to pay for a specific good or service, is often used to evaluate extra market goods and services (Kenkel and Norris). The CV approach is appropriate for this analysis because of producer uncertainty about the actual cost and benefits of the BWEP in West Tennessee.

Survey Data

Data for this analysis were from a mail survey of Tennessee cotton producers (Edens et. al.). An open-ended question format was used in a mail survey to elicit producers' willingness to pay for the BWEP. Survey participants were asked a series of preliminary questions before they answered the willingness to pay question. These questions queried producers about their cotton production practices, insect control problems, insect damage, insect control practices, sources of information used by the decision maker to make choices about the BWEP, and their attitudes about the BWEP. The purpose of these questions was to encourage producers to think about the cost of boll weevils and to determine a realistic willingness to pay value. Producers were then asked to indicate the maximum dollar amount, on a per acre basis, they would be willing to pay for an entire boll weevil eradication program that lasts 5 to 7 years. Respondents were asked to read a short description about the BWEP before answering the willingness to pay

question. In addition, information about the principle operator's personal and farm financial characteristics were also collected.

Following procedures outlined by Dillman, a cover letter explaining the survey, the questionnaire, and a postage-paid return envelope were sent to 2,327 cotton producers (Bradley; Fraser). The first mailing of the survey instrument was on February 28, 1997. On March 7, 1997, a reminder postcard to return the questionnaire was mailed to all cotton producers. A follow-up mailing with another cover letter indicating the importance of the survey and enclosing the questionnaire was sent March 21, 1997, to producers that had not responded to the first mailing or the reminder postcard. The total number of responses to the survey was 802 out of 2,327 for an overall response rate of 34 percent. Of those respondents, 258 farmers provided data on their cotton practices. The other respondents indicated that they did not or were no longer producing cotton. The total number of producers who answered the willingness to pay question was 161.

Model Estimation

The following willingness to pay model was estimated using the survey data and ordinary least squares:

$$\begin{aligned} WTPAY_i = {} & b_0 + b_1 AGE + b_2 EDUC + b_3 EXPER + b_4 INCOME + b_5 BWCOST \\ & + b_6 BWPOP + b_7 EXTEN + b_8 MEDIA + b_9 FARMERS \\ & + b_{10} PROFIT + b_{11} BWD + b_{12} OID + b_{13} INSECTUSE + e. \end{aligned} \quad (1)$$

The dependent variable, $WTPAY_i$, is the total dollar amount per acre a producer is willing to pay for the BWEP. The random error term in equation (1) is represented by ϵ. A

summary of the independent variables used in the model and the hypothesized relationships between the dependent and explanatory variables are in Table 1.

Producer age (*AGE*) was expected to be inversely related with willingness to pay. Older producers may resist change or may have a different planning horizon when compared with younger farmers (Turner et al.; Goodwin et. al.). Older farmers may expect fewer benefits from the BWEP because of this shorter horizon. Years of formal education (*EDU*) and years of experience growing cotton (*EXPER*) were both expected to positively influence willingness to pay. Education may foster a positive attitude toward new ideas and a closer examination of the costs and benefits of the BWEP (Goodwin et. al.). Farmers with more experience may be more aware of the risks of not adopting new technology such as the BWEP (Kenkel and Norris).

Monetary income in the model was represented by total 1996 taxable income (*INCOME)*. The income question in the survey was structured to let respondents check one of nine categories that were in $30,000 increments. In examining responses, five farmers were in the top income category with most of the other producers in the two lowest income categories. Consequently, the income variable was structured as a 0-1 binary variable where 1 is for income of $230,000 or more and 0 otherwise. Income was expected to be positively related with willingness to pay. Farmers with a larger income may have fewer financial constraints to adopting new technologies (Ervin and Ervin).

Costs of the boll weevil were included in the model through two explanatory variables: (1) boll weevil control costs and (2) boll weevil yield losses. *BWCOST* is

average boll weevil control costs reported by producers for the 1994, 1995, and 1996 growing seasons. Larger expenditures were expected to positively impact willingness to pay (Robinson et al.). Because activities to control boll weevils may also influence other insect pests, the marginal impact of each dollar increase in control costs on producer willingness to pay may diminish. Therefore, the log base 10 of this variable was used to impose diminishing marginal willingness to pay. Spring-time boll weevil pheremone trap count data were used as a proxy for boll weevil yield damage. *BWPOP* is average spring-time boll weevil populations for 1994, 1995, and 1996 (Jones). Because high boll weevil populations may be associated with other insect problems, producers were expected to increase their willingness to pay at a decreasing rate with higher population levels. The log base 10 of this variable was used to impose diminishing marginal willingness to pay.

The following sources of information that may have been used by producers in making decisions about the BWEP were evaluated in the model: extension service (*EXTEN*), magazine and newspaper articles (*MEDIA*), and other farmers (*FARMERS*). Extension service information was hypothesized to positively influence producers' willingness to pay. Producers frequently use the extension service as a source of information for decision making (Amponsah; Brown and Collins). The hypothesized relationship between magazine and newspaper information and willingness to pay was uncertain. Turner et al. indicate that producers who read trade magazines may be more open to the adoption of new ideas, suggesting a positive influence on willingness to pay. On the other hand, negative reports in the media about problems with the program may

erode producer support. For example, other insect problems allegedly caused by the BWEP led to a recall vote to terminate the program in Mississippi (Luttrell et. al.). Producer reliance on information from other farmers was expected to negatively impact willingness to pay. Farmers that rely on one another for information may be considered less innovative (Turner et al.).

Growers were also asked how they expected farm profitability (*PROFIT*), damage from boll weevils (*BWD*), damage from other insects (*OID*), and insecticide use after the program (*INSECTUSE)* to change after the program is completed. Studies such as Carlson et al have indicated that yields should rise and total insecticide costs should decrease after the BWEP. Because higher yields and lower costs positively impact farm profitability, the expected relationship between *PROFIT* and willingness to pay was expected to be positive. Elimination of yield damage by boll weevils after the program was expected to positively impact willingness to pay. On the other hand, there have been articles published about the alleged adverse effect of the BWEP on damage from other insects and insecticide use (Sandusky; Jones 1995; Luttrell et. al.; Smith; Layton et. al.; Williams and Layton). Based on this information, producers may believe that insecticide use will rise after the BWEP to compensate for increased damage from other insects. Farmer perceptions about the possibility of increased damage from other insects may negatively influence willingness to pay. Therefore, the hypothesized relationships among other insect damage and willingness to pay and insecticide usage and willingness to pay were uncertain.

Results and Discussion

Parameter Estimates

Parameter estimates and relevant statistics are presented in Table 2. Due to missing values for the explanatory variables, 79 observations were used to estimate the model. The model was evaluated for heteroscedasticity using the Park-Glejester test. The null hypothesis of homoscedasticity was not rejected.

The estimated coefficient for producer age had the hypothesized negative sign and indicated that older producers were less willing to pay for the BWEP. A one year increase in *AGE* results in a $3.42/acre decline in producer willingness to pay. The negative impact of decision maker age on willingness to pay was mitigated by the number of years of experience growing cotton. *EXPER* had the expected positive sign on the coefficient and was also a significant factor in explaining producer willingness to pay (α=0.1). For each additional year of experience growing cotton, a producer was willing to pay an additional $2.18/acre for the program, all other factors being equal.

The estimated coefficient for years of education had a negative sign. A positive relationship with willingness to pay had been hypothesized because education is generally thought to encourage a positive attitude toward new ideas. However, *EDU* was not a statistically significant factor in explaining producer willingness to pay. The coefficient for 1996 taxable income had the expected positive sign, which is consistent with other studies where willingness to pay rises as income increases. However, *INCOME* was not a significant factor in explaining willingness to pay.

The coefficient for *BWCOST* had the expected positive sign and was a significant factor in explaining willingness to pay for the eradication program (α=0.05). Producers in the sample estimated that they spent an average of $12.24/acre to control boll weevils (Table 1). These boll weevil control costs are similar to the average of $12/acre estimated for Tennessee for 1986 through 1995 (King et al.; Head; Williams). At the mean expenditure level, marginal willingness to pay for the BWEP is $15.47/ acre. Marginal willingness to pay is greater than *BWCOST* up to approximately *BWCOST*= $18/acre and is less than *BWCOST* thereafter.

The coefficient for *BWPOP* has a positive sign as hypothesized but was not significant in explaining willingness to pay. The statistical significance of *BWCOST* compared with *BWPOP* may indicate that farmers place more weight on control expenditures than yield damage when determining their willingness to pay. Economic studies of the BWEP in other areas have indicated that the yield gain from reduced insect damage is an important benefit of the program (Ahouissoussi et al.; Carlson et al.). Study results may indicate that yield damage is not as important in West Tennessee as other areas or they may indicate a need for more education about potential program benefits.

The estimated coefficients for extension service information, media information, and information from other farmers all had positive signs. The positive sign for *FARMERS* was the opposite of the hypothesized negative relationship with willingness to pay. However, these three sources of information were not significant factors in explaining willingness to pay for the program.

The sign on the coefficient for *PROFIT* was negative, which was the opposite of the hypothesized sign. One explanation for the negative relationship with willingness would be if the respondent misinterpreted the question. The question was worded so that the producer would respond according to what might happen to farm profit after the eradication program. If the respondents answered the question as to what would happen to farm profit during the program, the negative sign may be correct. Nonetheless, producers' profit expectation was not a significant factor in explaining willingness to pay.

The coefficient for *BWD* had the expected positive sign and was a significant factor in explaining willingness to pay (α=10). Farmers who felt that damage from boll weevils would decrease after the eradication program were willing to pay $40.81/acre more for the program. The sign on the *OID* coefficient has the hypothesized negative sign but was not a significant factor in explaining willingness to pay. *INSECTUSE* had a positive sign and was a significant factor in explaining willingness to pay (α=10). Producers who believe that insecticide usage after the program will decrease were willing to pay $22.29/acre more for the program.

Discussion

Taking all variables together, producers who indicated the highest willingness to pay for the BWEP had a great deal of experience growing cotton; had experienced above average levels of boll weevil damage, control cost expenditures, and insecticide usage; and had a positive perception of what boll weevil damage will be after the program. On the other hand, older farmers were less willing to pay for the BWEP. Producers' use of

information from media sources, the extension service, or from other farmers were not statistically significant factors in explaining willingness to pay.

The predicted average willingness to pay for the BWEP, using the sample means in Table 1 and the parameter estimates in Table 2, was $58.26/acre. To evaluate how total willingness to pay varies with each independent variable, the sample minimum and maximum values for the variable of interest were used in equation (2), while holding the other variables constant at their sample means. The results of these calculations are presented in Table 3. For example, if a farmer had the maximum number of years of experience growing cotton (40 years), his/her maximum willingness to pay was estimated to be $107.18/acre. *AGE, EXPER*, and *BWCOST* were the most significant variables influencing willingness to pay when comparing the minimum and maximum values for each variable.

Summary and Conclusions

This study evaluated a cotton farmer's willingness to pay for the boll weevil eradication program in West Tennessee. Years of experience growing cotton, current boll weevil control costs, expectations about boll weevil damage after the program, and expectations about insecticide usage after the program had a significant, positive influence on willingness to pay. Producer age had a significant, negative influence on willingness to pay. The variable with the largest impact on willingness to pay was producer age. Boll weevil control cost was the second most influential variable.

Table 1. Summary of variables used to evaluate cotton producer's willingness to pay for the Boll Weevil Eradication Program

Variable	Description	Expected Sign	Summary Statistics		
			Mean	Maximum	Minimum
WTPAY:	willingness to pay for the eradication program ($/acre)	NA	58.31	180.00	0.00
AGE:	principle operator's age (years)	(−)	42.4	71	22
EDU:	principle operator's formal education (years)	(+)	12.6	18	1
EXPER:	principle operator's experience growing cotton (years)	(+)	17.6	40	1
INCOME:	1 if 1996 taxable income ≥$230,000, 0 if ≤$229,999	(+)	0.06	1	0
BWCOST:	boll weevil control cost, $/acre	(+)	12.24	47.5	0
BWPOP:	boll weevil population–total insects trapped/county/season	(+)	758	2594	13.3
EXTENS:	1 if extension service information about the program was rated as important, 0 otherwise	(+)	0.89	1	0
MEDIA:	1 if newspaper and magazine information about the program was rated as important, 0 otherwise	(?)	0.89	1	0
FARMERS:	1 if information from other farmers about the program was rated as important, 0 otherwise	(−)	0.84	1	0
PROFIT:	1 if farm profit after the eradication program is expected to increase, 0 if expected to remain the same or decrease	(+)	0.67	1	0
BWD:	1 if boll weevil damage after the program is expected to decrease, 0 if expected to remain the same or increase	(+)	0.91	1	0
OID:	1 if other insect damage after the program is expected to decrease, 0 if expected to remain the same or increase	(?)	0.32	1	0
INSECTUSE:	1 if insecticide use after the program is expected to increase, 0 if expected to remain the same or decrease	(?)	0.67	1	0

Table 2. Model to Evaluate Willingness to Pay for the Boll Weevil Eradication Program

Variable	Coefficient	t-ratio	Prob > t/ Statistics
AGE	−3.4244	−3.561	0.0007
EDU	−0.2356	−0.157	0.8760
EXPER	2.1818	2.367	0.0209
INCOME	21.1010	0.954	0.3435
BWCOST	12.5879	2.538	0.0136
BWPOP	5.6159	1.258	0.2129
EXTENS	1.2386	0.072	0.9429
MEDIA	4.8637	0.257	0.7979
FARMERS	11.0426	0.741	0.4616
PROFIT	−8.1607	−0.618	0.5387
BWD	40.8115	1.744	0.0858
OID	−16.5434	−1.310	0.1946
INSECTUSE	22.2920	1.672	0.0994
Constant	51.4102	0.998	0.3222
F-value			4.226
Prob > F			0.0001
Adjusted R-square			0.3497
Observations			79

Table 3. Willingness to Pay Estimates for the Boll Weevil Eradication Program

Variable	Maximum[a] ($/acre)	Minimum[b] ($/acre)
AGE	−39.59	127.99
EDU	56.97	61.05
EXPER	107.18	22.16
INCOME	78.09	56.99
BWCOST	81.17	32.58
BWPOP	68.82	39.21
MEDIA	58.79	54.93
EXTENS	58.40	57.16
FARMERS	60.03	48.99
PROFIT	55.57	63.73
BWD	61.93	21.12
OID	47.01	63.55
INSECTUSE	65.62	43.33

[a] Calculated using the sample maximum value for the variable of interest in the left column while using the sample means for the other explanatory variables.

[b] Calculated using the sample minimum value for the variable of interest in the left column while using the sample means for the other explanatory variables.

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