Willingness to Pay for a Potential Insurance Policy: Case Study of Trout Aquaculture

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Using trout producer survey data and the contingent valuation method, we estimate willingness to pay for a potential insurance policy. The survey was conducted in 2005 across the United States; 268 producers completed the survey instrument, resulting in a response rate of 81 percent. Design of the contingent valuation method takes into account two coverage levels and four premium rates. Using standard willingness-to-pay techniques, we assess the premium rate that producers with varying practices and regions are willing to pay for two different coverage levels of insurance. In general, trout producers appear willing to pay premium rates of 2 to 11 percent for these coverage levels.

Key Words: willingness to pay, subjective elicitation and survey data, aquaculture trout insurance

The Agricultural Risk Protection Act of 2000 resulted in significant efforts to introduce new agricultural risk management products and expand existing products. The creation of these new products has led to a number of research and development projects that are attempting to generate risk management tools with value to agricultural producers. The development of an insurance product involves many facets that include underwriting and actuarial rating procedures. However, evaluating a new product evokes a fundamental question about whether a potential insurance design appeals to the intended user group. In other words, is the product sufficiently attractive to the potential clientele to justify its development costs? This question clearly applies to private markets, but also affects U.S. Department of Agriculture administrators who must allocate and prioritize research and development efforts.

Frequently the market analysis of a potential insurance product lacks the level of development needed for decision making and often fails to answer the fundamental question, "Are potential buyers willing and able to pay the required premium for an agricultural insurance product?" Coble and Knight (2002) as well as Glauber (2004) review the existing literature on agricultural insurance demand, and both studies note the significant bodies of literature available (e.g., Coble et al. 1996, Smith and Baquet 1996, Barnett and Skees 1995, Goodwin 1993, Schnitkey, Sherrick, and Irwin 2003, and Serra, Goodwin, and Featherstone 2003). However, this literature largely focuses on demand for yield insurance, while relatively little research investigates the demand for revenue insurance. Notably, Sherrick et al. (2004) and Mishra and Goodwin (2003) examine the national demand for crop yield versus revenue insurance using the USDA Agricultural

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Resource Management Survey (ARMS) data. In addition Shaik, Coble, and Knight (2005) examine the demand for revenue insurance using survey data of corn and soybean producers in Indiana, Mississippi, and Nebraska. Shaik and Atwood (2003) examine the demand for optional units compared to basic units.

A common thread throughout these studies is that all analyze existing rather than hypothetical insurance products. These econometric studies generally include explanatory variables such as the first and second moments of return to insurance, risk aversion, wealth, and other demographic variables. Importantly, these studies almost uniformly find inelastic demand elasticities for crop yield and revenue insurance.

A much smaller but significant body of literature addresses the demand for hypothetical agricultural insurance products. The article by Patrick (1988) pertains most to our investigation, specifically the estimation of willingness to pay for a wheat crop insurance policy in Australia for two coverage levels and risk attitudes. Our study involves animal disease insurance and assesses if demand for a potential farm-raised trout aquaculture insurance product exists. Obviously, willingness to pay is a function of policy-specific attributes, and producer and farm characteristics such as risk aversion and the ability to manage risk with other mechanisms. We use the contingent valuation method that asks individuals about their willingness to pay for policies with various features.

The contingent valuation method often analyzes the willingness to pay or the demand for non-market and potential market goods. The areas of environmental economics (Spash 2006, Champ and Bishop 2006), health economics (Alberini et al. 2006, Hammitt and Graham 1999), food safety (Golan and Kuchler 1999), and market analysis (Moon et al. 2002, Alfnes and Rickertsen 2003) all use applications of the contingent valuation method.

We analyze farm-level data collected from a survey of trout producers in 2005. In the next section, we provide a brief account of the U.S. farm-raised trout industry followed by a discussion of the survey and data. Then we present the contingent valuation method used to estimate the willingness to pay and the variables used in the analysis. The final sections present empirical applications, results, and conclusions.

U.S. Trout Industry

U.S. farm-raised trout production represents a relatively mature industry, particularly since the 1970s (Hinshaw, Fornshell, and Kinnunen 2004). The species produced primarily consist of rainbow trout, with limited production of brook and brown trout. Production in Idaho accounts for up to three-fourths of total U.S. production, and the states of North Carolina, Pennsylvania, California, and Colorado account for most of the other main production areas. U.S. production is widespread, however, as trout farms can be found in 42 states. Hinshaw, Fornshell, and Kinnunen (2004) note that while most trout farms are generally small and family-owned, most of the production originates from a few large firms. Thus, the structure of the trout industry has similarities to much of production agriculture.

Farm-raised trout production in the United States has been relatively stable over the last decade, with production ranging between 50 and 60 million pounds annually. The annual value of production exhibits slightly more variability, but is still relatively consistent. In 2006, U.S. trout sales were almost $75 million, and as of 2005 trout ranks fourth among U.S. aquaculture commodities in total sales. Trout prices over much of this same period exhibit relatively low volatility.

The primary source of production loss in the trout industry is disease, according to both National Agricultural Statistics Service (NASS) production reports and the Risk Management for Aquaculture Survey. However, major production states frequently encounter other perils as primary causes of loss, such as predators in Idaho and drought in North Carolina (Hinshaw, Fornshell, and Kinnunen 2004). Other sources of loss experienced throughout the industry include floods and theft, and not all of these losses, such as predation and theft, represent insurable perils. However, perils such as flooding and a number of diseases characterize inclusions under specific insurance designs.

Risk Management and Willingness to Pay

Expected utility theory asserts that a risk-averse individual has a diminishing marginal utility of wealth. Thus, each additional dollar of wealth is less valuable to the risk-averse individual than the last, or, conversely, each additional dollar of loss is more undesirable than the last. Faced with a fair gamble that has an expected value of $\$X$, the risk-averse individual will always prefer an amount with certainty, $\$Y$, where $\$Y < \$X$. The value $\$X - \$Y$ is the risk premium, which represents the individual's maximum willingness to pay to avoid the gamble.

Expected utility theory implies that willingness to pay is a function of two key variables: (i) the individual's level of risk aversion (or the degree of curvature of his or her utility function over wealth), and (ii) the individual's perception of the magnitude of the gamble (or variance in returns). Holding variance constant, increases in risk aversion should be associated with increases in willingness to pay. Similarly, holding risk aversion constant, increases in variance of returns should be associated with increases in willingness to pay. Depending on the characteristics of the individual, a number of variables such as beginning wealth, age, farm size, etc., may affect the level of risk aversion. At the same time, a number of variables may affect individual perceptions of riskiness. In the survey, we attempt to elicit multiple measures of both risk aversion variables and riskiness variables. We then use this information to examine willingness to pay for an insurance product designed to help shift risk on trout farms.

Risk Management for Aquaculture Survey and U.S. Trout Data

NASS was contracted to survey trout aquaculture producers in order to obtain historical and future production/loss information and willingness-to-pay information. NASS conducted the survey from July 1, 2005, through August 12, 2005, in 20 trout-producing states. The agency contacted and surveyed a total of 735 producers of farm-raised trout, primarily in person using enumerators. In order for a producer to complete a Risk Management for Aquaculture Survey, the producer's operation had to grow trout in raceways, and at the time of the survey the producer must have intended to produce in 2006. If the producer satisfied the criteria from these two questions, then a face-to-face interview was completed. Appropriate responses to the two questions below from the trout survey instrument qualified respondents to continue with the survey:

> During 2006, do you plan to continue your freshwater trout operation by managing trout in a continuous flow-through system constructed of concrete, dirt, fiberglass, plastic, and/or other materials?
>
> Is your trout operation a non-profit organization (such as a research facility or for public recreation)?

These two questions screened out 405 producers from the total 735 trout producers. Of the remaining 330 trout producers, 268 producers actually completed the survey instrument, resulting in a response rate of 81 percent. To ensure confidentiality, those states not individually identified are grouped into regions under the headings North (Connecticut, Massachusetts, Maine, New York, and West Virginia), South (Georgia, Tennessee, and Virginia), Central (Michigan and Missouri), and West (California, Colorado, Idaho, Oregon, Utah, and Washington). We report the following states individually: Pennsylvania, North Carolina, and Wisconsin.

Pre-testing of the survey instrument was conducted at the annual U.S. Trout Farmers Association meetings and representative trout farms. Based on the feedback from pre-testing of the survey instrument, adjustments were made to the subjective, historical, and willingness-to-pay questions.

Contingent Valuation Method to Estimate Willingness to Pay

We use a single-price contingent valuation instrument to examine mean willingness to pay for an insurance product as well as the factors that influence individual willingness to pay. The dichotomous choice or referendum-style approach represents the preferred method for contingent valuation implementation since the publication of the NOAA Blue Ribbon Panel report on contingent valuation (Arrow et al. 1993). Carson, Flores, and Meade (2001) and Carson and Groves (2001) demonstrate that single-price contingent valuation maximizes incentive compatibility, thereby minimizing strategic behavior. General references to contingent valuation methods can be found in Champ, Boyle, and Brown (2003).

Arrow et al. (1993) suggest that inclusion of a "don't know" response to the contingent valuation question may improve estimates, but results from studies employing this approach are mixed (Champ, Alberini, and Correas 2005, Wang 1997). Although inclusion of a "don't know" category does increase the number of censoring intervals, conceptually improving estimates, willingness to pay remains fully censored. Follow-up questions to the "don't know" category will improve the precision of econometric estimates (Hite, Hudson, and Intarapapong 2002). These authors employed a simple follow-up question whereby subjects who responded "no" to their stated price were asked: "Would you pay any positive amount?" This follow-up maintains the single-bounded nature of the question, but allows differentiation between positive WTP responses from zero (or negative) WTP responses. The approach allows for greater precision as suggested by Arrow et al. (1993), but also allows for a greater and more definitive delineation of censoring points on the likelihood function. We follow the approach used by Hite, Hudson, and Intarapapong (2002).

We base the computation of the estimate of the willingness to pay for an insurance product on the results of the two survey questions below. In estimating the willingness to pay for an insurance product, we utilize two coverage levels—85 percent and 95 percent—for the four pre-specified premium rate levels: 1 percent, 4 percent, 7 percent, and 10 percent.

Q1. If the coverage level for the policy is __ percent and the premium rate is __ percent, would you be willing to purchase the insurance?

Q2. If your answer to item 1 is NO, would you be willing to pay any amount for this policy with a __ percent coverage level?

For a pre-specified coverage and premium rate level, an answer to question (1) in the affirmative indicates that the pre-specified premium rate is the lower bound of the distribution of the willingness to pay, while infinity marks the upper bound. However, question (2) serves as a follow-up question in the event of a negative response to question (1). An affirmative answer to question (2) indicates zero and represents the lower bound, and the pre-specified premium rate represents the upper bound. However, a negative answer to question (2) means the lower bound of the distribution is negative infinity and the upper bound is zero. The survey elicits willingness to pay for each producer for a specific coverage and premium rate level; hence, the individual willingness to pay provides the distribution of the willingness to pay for the coverage and premium rate combinations.

Figure 1 presents the flow diagram of the willingness-to-pay outcomes of trout producers. Table 1 presents the number and percentages of producers' responses to the two questions for the two coverage levels and the total number of observations used in the analysis. Out of 138 total trout observations, 80 producers are willing to purchase an insurance policy with a particular coverage and premium rate. The remaining 58 producers are not willing to purchase a particular insurance policy for the given coverage-level–premium-rate combination. Out of these 58 trout producers, 35 are willing to pay some positive amount, while 22 of these producers are not willing to purchase the given coverage level for any positive amount. The 80 producers who positively responded to the purchase of an insurance policy are divided equally between the two coverage levels; however, in terms of percentages the 95 percent coverage has a 64.6 percent response rate, while the 85 percent coverage has a 52.6 percent response rate. Of the remaining 58 producers unwilling to purchase the insurance policy, 22 producers were asked about 95 percent coverage, and 36 producers were asked about 85 percent coverage, constituting 35.4 percent and 47.4 percent, respectively. The number of producers responding positively to the second question is higher for 95 percent coverage than for 85 percent coverage, while the inverse was true for the negative response variables.

We determined that the most appropriate technique to capture the probability distribution of willingness to pay from producers for two coverage and four premium rate levels is the contingent valuation method. The contingent valuation method is one-half bound since a follow-up question occurs only if a producer answers in the negative to the first question. The main areas of focus include collecting producer characteristics, farm characteristics, production practices, and other farm characteristics.

Table 2 presents the summary statistics of the variables used in the analysis. The wealth variable is computed as a product of the median of the six categorical responses to the total market value of the assets in the trout operation (less than \$100,000; \$100,000 to \$499,999; \$500,000 to \$999,999; \$1,000,000 to \$1,999,999; \$2,000,000

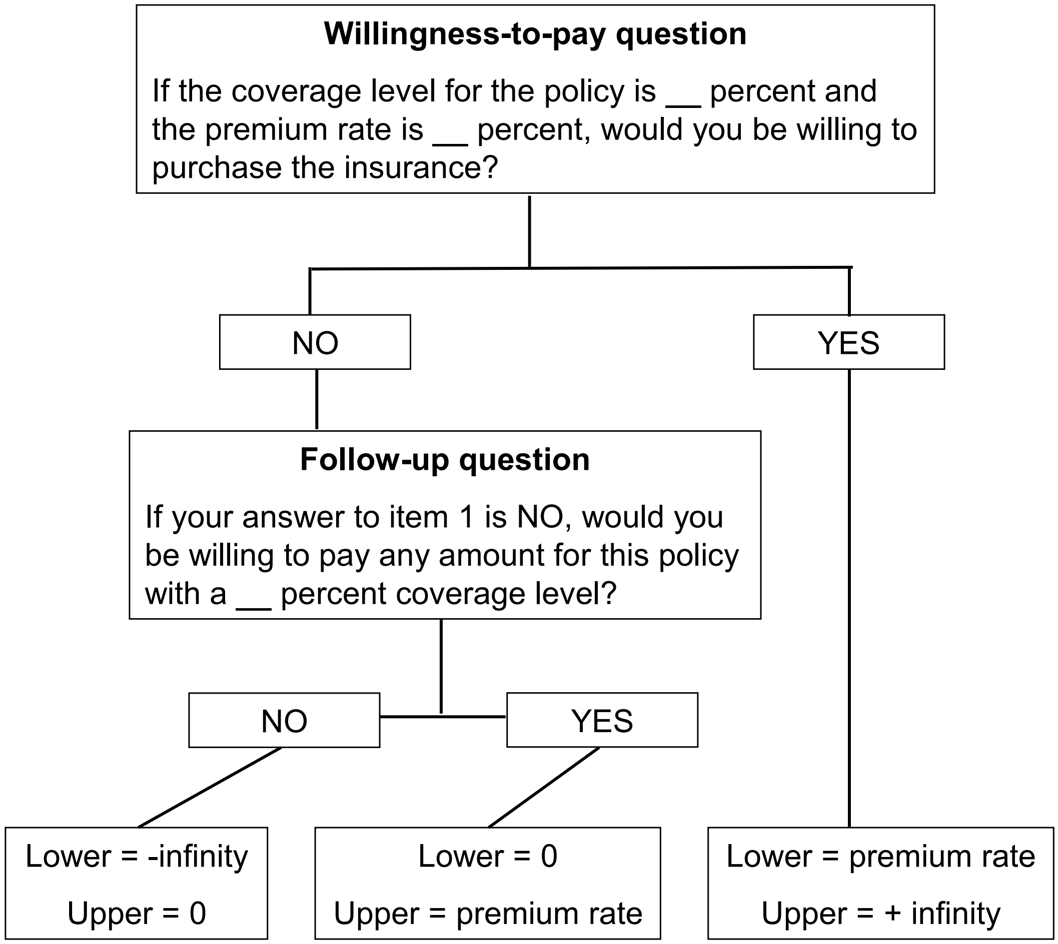

Figure 1. Flow Diagram of Trout Producers' Willingness-to-Pay Outcomes

to $4,999,999; and $5,000,000 or more) multiplied by one minus the percentage of a producer's dollars invested in his or her trout operation. On average, the wealth of trout farms was around $500,000. Risk aversion is measured through the Likert-scale question that asks, "On a scale of 1 to 5, where 1 indicates highly unwilling and 5 indicates highly willing, how would you rate your willingness to take financial risks?" For the analysis, the five Likert-scale questions are reduced to a dummy variable, with one indicating somewhat unwilling, highly unwilling, and neutral to taking risks, and zero indicating somewhat willing and highly willing to take risks. The average risk aversion response of 0.254 is consistent with a fairly high level of risk aversion. On average 55.6 percent of the raceway trout producers surveyed had previously purchased some kind of liability coverage for their operation. This liability coverage refers to protection against injury or damage claims made by other parties against the trout operation and is not related to production loss insurance. A dummy variable for coverage levels of 95 and 85 percent indicates that 36.7 percent of the trout producers chose the 95 percent coverage level. On average only 25.3 percent of the U.S. raceway trout producers surveyed raise trout for human consumption. Trout are produced either as food fish for human consumption or for stocking bodies of water for recreational fishing purposes. Also, the average total farm production per trout operation is around 100,000 pounds, with a minimum of 1,000 pounds and a maximum of 950,000 pounds. Trout producers in

Table 1. Response to Willingness-to-Pay Questions 1 and 2 by Coverage Level

Question	*Q1. If the coverage level for the policy is __ percent and the premium rate is __ percent, would you be willing to purchase the insurance?*			*Q2. If your answer to item 1 is NO, would you be willing to pay any amount for this policy with a __ percent coverage level?*		
Coverage	Response to Q1	Number	Percentage	Response to Q2	Number	Percentage
85%	Yes	40	52.63	Yes	19	52.78
	No	36	47.37	No	17	47.22
95%	Yes	40	64.52	Yes	16	76.19
	No	22	35.48	No	6	23.81
All	Yes	80	57.97	Yes	35	62.40
	No	58	42.03	No	23	38.60

Table 2. Summary Statistics of Variables Used in the Analysis

Parameter	Definitions	Mean	Min.	Max.
Wealth	Wealth (in $ millions)	0.495	0	5
Risk	Risk aversion	0.254	0	1
Liability	General liability coverage for your trout operation	0.556	0	1
Coverage (95%)	Dummy, coded as 1 for 95% and 0 for 85%	0.367	0	1
Pounds (mil.)	Total production in million pounds	0.102	0.001	0.95
Number of losses	Number of losses over 5% of the production incurred in the last 10 years	1.741	0	10
Food fish for human consumption	Dummy coded as 1 for human consumption and 0 for recreation	0.253	0	1
Age	Age in years	52	25	88
Education	Education level	0.442	0	1

the United States on average report that they had experienced 1.74 losses greater than 5 percent of their expected total annual production in the last ten years. The average age of the trout producers was 52 years, with a range of 25 to 88 years. For the analysis, education was reduced to a dummy variable, with one indicating completion of at least one college degree. An average value of 0.44 indicates that the trout producers have some college education.

Estimation of Willingness to Pay

Given the nature of our feasibility project, we elicit producers' willingness to pay for a potential insurance product providing coverage for insurable perils. Furthermore, we conclude that the most appropriate technique to capture the probability distribution of the willingness to pay of producers for two coverage and four premium rate combinations is the one-half bound contingent valuation method. In this case we use a variant of the one-and-one-half bounded model. For example, if the producer expresses a willingness to pay for a pre-specified coverage-premium level combination by answering in the affirmative, no follow-up question is asked. We can model the probability of a producer's willingness to pay for a pre-specified coverage-premium level combination as $Prob(WTP \geq P_j)$, where P_j represents four premium levels (1, 4, 7, and 10 percent) charged for either of the two coverage levels (85 and 95 percent). Next, if the producer answers in the negative, then the follow-up question asks if the producer is willing to pay any positive amount for the insurance. If the producer answers in the affirmative to the follow-up question, then he or she is willing to pay a positive amount. If the producer answers in the negative then the producer's willingness to pay falls below a stated premium level. The probabilities of positive and negative answers to the follow-up question are modeled as $Prob(-\infty \leq WTP \leq P_j)$.

The log-likelihood function of the one-and-one-half bounded willingness-to-pay model is the sum of the three groups: I_1, producers who answered in the negative to the follow-up question; I_2, producers willing to pay a positive amount according to the follow-up question; and I_3, producers who answered in the affirmative to the first question. The log-likelihood function is represented by the following equation:

$$(1)\ LLF = \sum_{i\in I_1} \ln \frac{1}{\sigma}\phi\left(\frac{-x_i\beta}{\sigma}\right) + \sum_{i\in I_2} \ln \Phi\left(\frac{P_j - x_i\beta}{\sigma}\right) + \sum_{i\in I_3} \ln \Phi\left(\frac{x_i\beta - P_j}{\sigma}\right),$$

where ϕ is the probability distribution function; Φ is the cumulative distribution function; the vector $\boldsymbol{X}$ represents wealth, risk aversion, liability, total trout pounds produced, number of losses incurred, age, and education; and dummy variables represent coverage level, market (food fish for human consumption or recreational stocking) for which trout is produced, and state/region. Equation (1) is approximated by a partially censored probit model as defined by Hite, Hudson, and Intarapapong (2002).

Table 3 presents empirical results of the willingness-to-pay model. Results indicate a positive and significant sign on the wealth variable. The positive sign indicates that wealthy producers are willing to pay a higher premium. A lack of significance on the dummy variable for previous purchases of liability insurance suggests that a producer who has purchased liability insurance in the past is not more willing to pay a premium for trout loss insurance. This unexpected result may follow from the fact that producers are often required to purchase liability insurance as a condition of their farm loan agreements. Therefore, previous purchases of liability insurance may not reflect a producer's personal choice but requirements of his or her operation. The statistically insignificant sign on the coverage variable indicates that no statistical difference exists in the willingness to pay between 85 and 95 percent coverage. Thus, producers may be just as likely to purchase 95 percent coverage as 85 percent coverage. This somewhat unexpected finding may result from difficulties in assessing the value of a hypothetical design by producers or may arise from a small utility-theoretic perceived change between 85 and 95 percent coverage.

The positive and significant sign on farm size indicates that producers who produce more total pounds are more willing to pay a higher premium for insurance. This finding may indicate a larger operation and/or that insurance is preferred as more of a producer's income is derived from trout production. Although the variable for number of losses has a positive sign—indicating that producers with more losses are more willing to pay a higher premium rate—this sign is not statistically significant. This variable captures the frequency

Table 3. Trout Willingness-to-Pay Regression Results

Parameter	Estimate	Std. Err.	Prob. > Chi Sq.
Intercept	9.319	3.850	0.016
Wealth	1.331	0.767	0.083
Risk aversion	-1.510	1.353	0.264
Liability	1.474	1.227	0.230
Coverage (95%)	0.888	1.255	0.479
Pounds (mil.)	10.963	5.303	0.039
No. of losses	0.247	0.280	0.378
Food fish for human consumption	-2.568	1.515	0.090
Age	-0.063	0.051	0.217
Education	-2.563	1.176	0.029
Central	-4.631	2.372	0.051
North	2.723	2.470	0.270
North Carolina	4.556	2.730	0.095
Pennsylvania	-3.695	2.328	0.113
South	-1.065	2.416	0.659
West	-2.505	2.108	0.235

of losses and not the magnitude; therefore, a producer who experienced many relatively small losses may be less likely to purchase insurance than someone who experienced one or two substantial losses. This result could explain why no significant difference was found for this variable. Trout producers who primarily raise fish for human consumption are willing to pay a significantly lower rate than producers who raise fish for stocking purposes. Since this coverage and premium rate combination is based on inventory levels of fish, the difference may be explained by the differences in values per pound of food fish versus stocking fish. In 2005 the average U.S. food-size fish value of $1.10 per pound was much lower than the stocker size fish value of $2.59 per pound (NASS 2007). In other words, identical weight inventories of two different size classes of fish have different values. Age of the producer does not play a statistically significant role in the willingness-to-pay estimates. However, producers with more education are willing to pay a statistically lower premium rate.

The signs on the region dummy variables indicate that producers from North Carolina and the Central region (Michigan and Missouri) are willing to pay significantly more and less, respectively, relative to producers in Wisconsin. Dummy variables for the other regions—the North (West Virginia, New York, Maine, Massachusetts, and Connecticut), Pennsylvania, South (Virginia, Tennessee, and Georgia), and West (Colorado, Idaho, Oregon, Washington, Utah, and California)—were not significant. A number of reasons explain the regional differences in willingness to pay for insurance. The large variability of factors that contribute to the risk of trout losses within and between these geographic regions affects willingness to pay. The variability within regions may explain why only significant differences occur between two regions compared to Wisconsin. Factors that contribute to variability within a region may include differences such as farm size, management practices, market, water source, water quality, water availability, and seed stock quality. Factors that contribute to variability between regions may include differences in the types and severity of diseases in the area, water temperature, and, to a greater extent than water quality, water availability within a region. For example, some regions mainly use groundwater to supply their operation, which typically allows for consistent quality and quantity of water compared to those who use surface water and risk greater chances of drought or floods. Possible explanations for why North Carolina producers are willing to pay more for insurance compared to Wisconsin producers include the fact that the average North Carolina operation does not use well water (0 percent in North Carolina versus 75 percent in Wisconsin), is larger (produced 127,000 pounds versus 20,000 pounds), and provides a greater percentage of the producer's total income (47.9 percent versus 29.8 percent). Conversely, the Central region indicates a lower willingness to pay compared to Wisconsin, and this may be partially explained by the lower market values of the trout operations in the Central region (72.8 percent are less than $500,000 in the Central region versus 80.6 percent in Wisconsin).

The predicted values of the dependent variable—i.e., the willingness to pay—are aggregated and presented in Table 4. The means, standard deviations, and the minimum and maximum values of willingness to pay by region are presented and described in detail below. Table 4 does not indicate a statistical difference between the coverage levels; however, producers given an 85 percent coverage level are willing to pay a premium rate of 5.5 percent compared to a 6.48 percent premium rate for producers given a 95 percent coverage level. On average trout producers in the Central region who have a premium rate of 1.71 percent are willing to pay relatively less than producers in North Carolina (10.87 percent), the North region (9.29 percent), the South region (5.57 percent), the West region (5.48 percent), Wisconsin (5.26 percent), and Pennsylvania (4.45 percent). However, a significant difference exists only between North Carolina and Wisconsin and the Central region and Wisconsin.

Conclusions on the Willingness to Pay or Demand

After conducting an extensive survey of producer willingness to pay for an insurance policy covering fish death loss, we find that producers apparently have an "effective" interest in insurance—that is, they are willing to pay for the product. Using standard willingness-to-pay techniques we

Table 4. Estimated Willingness to Pay or Premium Rates by Coverage Levels and Aqua-Regions for Trout

Parameter	N	Mean	Std. Dev.	Min.	Max.
COVERAGE LEVELS					
85% coverage	76	5.50%	4.97%	-1.42%	18.04%
95% coverage	62	6.48%	4.45%	-3.08%	16.20%
AQUA-REGIONS					
Central	20	1.71%	2.78%	-3.08%	7.67%
North	16	9.29%	2.96%	3.31%	11.86%
North Carolina	22	10.87%	3.40%	6.78%	18.04%
Pennsylvania	19	4.45%	2.34%	-0.77%	7.16%
South	17	5.57%	3.13%	-0.98%	9.37%
West	28	5.48%	4.83%	-1.42%	9.18%
Wisconsin	16	5.26%	4.00%	0.11%	9.98%

assess the premium rates producers with varying practices and regions are willing to pay for two different coverage levels of insurance. In general, producers appear willing to pay premium rates of 2 to 11 percent for insurance.

Well-known caveats (McFadden 1994, Beattie et al. 1998) to contingent valuation techniques exist, but the use of contingent valuation analysis to evaluate insurance demand is conceptually preferable to naïve or ad hoc demand assumptions when considering hypothetical insurance designs. Ultimately, further testing of the relationship between willingness to pay for agricultural insurance in other empirical settings would test the robustness of these results. Natural extensions of this work include observing actual demand if and when an insurance product is introduced. Also, while not reported in this study, producer estimates of the probability and magnitude of fish mortalities appear well correlated with the willingness-to-pay measures. This relationship suggests a degree of internal validity between subjective risk assessments and the willingness to pay for insurance.

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