Consumer willingness to pay a price premium for standing-dead Alaska yellow-cedar

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Abstract

Alaska yellow-cedar has declined in Southeast Alaska over the past 100 years, resulting in half a million acres of dead or dying trees. The natural decay resistance of Alaska yellow-cedar means that many of these trees are still merchantable. However, the topography of Southeast Alaska is such that selectively harvesting Alaska yellow-cedar may often require helicopter-yarding. This paper tests two hypotheses. First, do consumers perceive salvage logging of standing-dead Alaska yellow-cedar as more environmentally friendly than harvesting living trees, and therefore, are they willing to pay a price premium for products manufactured from standing-dead Alaska yellow-cedar? Second, should such a price premium exist, is it sufficient to justify the expense of helicopter-yarding? By using contingent valuation techniques, it is estimated that consumers are willing to pay $1,948 for a children's play structure made from Alaska yellow-cedar sawn from standing-dead trees, compared to $1,000 for an identical play structure sawn from living Alaska yellow-cedar. This price premium is sufficient to justify the additional cost of helicopter-yarding.

Alaska yellow-cedar *(Chamaecyparis nootkatensis)* has declined over the last 100 years in disparate stands throughout Southeast Alaska (Hennon et al. 1990). As yet, no definitive explanation has emerged for this increase inmortality, though current theories favor site, as opposed to biotic, causes (Hennon et al. 1997). This century-long decline has resulted in half a million acres of dead or dying Alaska yellow-cedar in Southeast Alaska (Hennon et al. 1990). The natural decay resistance of Alaska yellow-cedar is well documented (Grace and Yamamoto 1994). Because of this decay resistance, many of the standing-dead trees are still merchantable (Hennon et al. 2000).

Alaska yellow-cedar *(not* including standing-dead) constitutes 9.7 percent of the growing stock on unreserved [1] national forest land in Southeast Alaska (Wilson 2002). Historically, Alaska yellow-cedar has been harvested by clear or partial cut, along with the more prevalent species western hemlock *(Tsuga heterophylla)* and Sitka spruce *(Picea sitchensis).* Harvest levels of all species from the Tongass National Forest in Southeast Alaska have declined precipitously in the last 10 years, from 472 million board feet (MMBF) in 1990 to 44 MMBF in 2001 (USDA Forest Serv. 2001), reducing the available volume of Alaska yellow-cedar. The closure of Southeast Alaska's two pulp mills, re-

cession in the Japanese economy, and changes in forest policy have all contributed to the decline in harvest levels. Therefore, increasingly selective harvesting may be required to access Alaska yellow-cedar, given the low volumes being currently harvested conventionally. The limited infrastructure and rugged topography of Southeast Alaska mean that selective harvesting may often require helicopter-yarding.

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[1] Unreserved lands are defined as all lands except wilderness and national monument areas.

are they willing to pay a price premium for products manufactured from standing-dead Alaska yellow-cedar? Formally:

$$H_0 : WTP_{SD} = WTP_L$$
$$H_A : WTP_{SD} > WTP_L$$

where:

WTP_{SD} = consumer willingness to pay for a product sawn from standing-dead Alaska yellow-cedar

WTP_L = consumer willingness to pay for the same product sawn from live Alaska yellow-cedar

Second, should such a price premium exist, is it sufficient to justify the expense of helicopter-yarding? Formally:

$$H_0 : WTP_{SD} - WTP_L \{ (Cost_H - Cost_{CC}) * Size$$

$$H_A : WTP_{SD} - WTP_L \} (Cost_H - Cost_{CC}) * Size$$

where:

$Size$ = volume (1,000 board feet [MBF]) of Alaska yellow-cedar lumber in the product under study

$Cost_H$ = per MBF cost of yarding Alaska yellow-cedar by helicopter

$Cost_{CC}$ = per MBF cost of cable-yarding Alaska yellow-cedar from a clearcut

Literature review

I could find no evidence in the wood products literature of studies quantifying a price premium for salvage-logged wood. However, the question of whether consumers are willing to pay a price premium for eco-labeled wood has received considerable attention. There are several different organizations that certify eco-labeled wood products. While the standards used by these organizations vary, they all certify that forestry practices associated with the production of a particular wood product are sustainable, and meet a predetermined set of guidelines (Jenkins and Smith 1999). Ozarme and Vlosky (1997) used cluster analysis and descriptive analysis to estimate consumer willingness to pay for a range of certified wood products. Consumer willingness to pay varied between 4.4 and 18.7 percent, depending on the product. They found that 37 percent of the sample was not willing to pay a price premium of any size for certified wood

products. The segment of the population most likely to pay a price premium was politically liberal and female.

Forsyth et al. (1999) conducted interviews at three Canadian home improvement stores to determine consumers willingness to pay for eco-labeled wood products. Cluster analysis revealed four distinct groups of consumers. Consumers most likely to pay a price premium for certified wood products tended to be female, urban, and professional .

Winterhalter and Cassens (1993) studied the preferences of consumers whose household income exceeded $50,000. They found that 19 percent of the sample was not willing to pay a premium for eco-labeled wood, 56 percent was willing to pay 1 to 10 percent more, 19 percent was willing to pay 11 to 20 percent more, and 3 percent was willing to pay more than 20 percent.

Veisten (2002) conducted a phone survey of British and Norwegian consumers to determine what price premium consumers were willing to pay for furniture made from eco-labeled wood. The base price was $332 in Britain, and $275 in Norway. To counteract the potential upward bias of hypothetical questions, respondents were asked how certain they were of their response. Only respondents who were "absolutely sure" were included in the analysis. Results indicated that British consumers were willing to pay an additional 1.0 percent for the eco-labeled furniture, while Norwegian consumers were willing to pay an additional 1.6 percent.

Murray and Abt (2001) approached the question of environmental certification from the supply side; they estimated the price premium suppliers would need to make the production of environmentally certified wood economically feasible. They found that relatively low levels of price compensation would be required to produce certified wood on much of the timberland in the southeastern United States. These compensation requirements were lower for the Piedmont region and hardwood forests than for coastal and softwood forests.

Methods

Helicopter-yarding costs

This study compares the per MBF costs of selective harvesting using a helicopter with the cost of a cable-yarded clearcut. The cost of helicopter-yarding

is dependent on yarding distance. In Southeast Alaska, these costs vary between $283 per MBF for 1,200 feet; to $360 per MBF for 3,600 feet (Housley 2002). These are net log costs (merchantable plus net utility logs) for a clearcut, including felling and bucking costs. Comparable data are not available for partial cutting so an adjustment factor of 1.23 is used to approximate the costs of a partial cut based on 90 percent retention (Housely 2002). A 90 percent retention was chosen because Alaska yellow-cedar constitutes 9.7 percent of the growing stock on unreserved national forest land in Southeast Alaska. However, given the dispersion of Alaska yellow-cedar, harvest costs may be higher. Therefore, the highest yarding cost of $360 is used in the analysis. Standing-dead Alaska yellow-cedar weighs less per board foot than green Alaska yellow cedar. Therefore, an adjustment factor of 0.88 is used to reflect the higher volumes of standing-dead Alaska yellow-cedar that can be yarded per turn (Housely 1988).

In comparison, the cost of a cable-yarded clearcut, including felling and bucking, is $129 per MBF. Therefore, the difference in per MBF harvest cost between a cable-yarded clearcut of living trees and a partial helicopter harvest of standing-dead trees with 90 percent retention is $275 per MBF.

This cost differential is based on log scale, so there is the potential for inaccuracy when it is applied to the lumber volume of a finished product. However, this recovery discrepancy is most pronounced for smaller trees (under 12 inches). Therefore, as a majority of standing-dead Alaska yellow-cedar logs are larger than 12 inches, the assumption is made that 1 MBF log scale equates to 1 MBF lumber tally.

It is not the intent of this study to suggest that all standing-dead Alaska yellow-cedar is harvested using a helicopter, and that all living Alaska yellow-cedar is harvested using cable-yarded clearcuts. Rather, given the greatly reduced volumes of timber being harvested using terrestrial systems in Southeast Alaska, accessing significant volumes of standing-dead Alaska yellow-cedar may increasingly require helicopter-yarding.

Table 1. - *Bid distribution for contingent valuation survey.*

Standing-dead play structure price	Count
($)	
1,050	27
1,100	12
1,250	18
1,300	11
1,400	16
1,500	9
2,000	20
2,500	8
3,000	4

Contingent valuation methodology

This paper uses contingent valuation techniques, the method employed by Veisten (2002), to quantify consumer willingness to pay a price premium for eco-certified wood products. Contingent valuation is a well established valuation technique that is often used when data on consumer choice are not available (Loomis 1988). The environmental economics literature contains numerous examples of the use of contingent valuation to value environmental goods, such as changes in water quality (Loomis et al. 2000), and preservation of wildlife (Jakobsson and Dragun 1996). In addition to Veisten (2002), contingent valuation has been used in the wood products literature by Donovan and Nicholls (2003a) to estimate consumer willingness to pay for character marked birch, and to estimate consumer willingness to pay a price premium for made-in Alaska secondary wood products (Donovan and Nicholls 2003b).

In the absence of consumer choice data, contingent valuation estimates consumer willingness to pay by asking respondents how much they would be willing to pay for a given good or attribute of a good. The most common form of contingent valuation uses a dichotomous choice format (Loomis 1988), where respondents are asked whether they would pay a given price premium for the good under study. The price premium that consumers are asked to pay varies between different versions of the survey. Typically demographic data, such as age and income, are also collected.

The problem of determining the optimal price range for dichotomous choice contingent valuation surveys has re-

ceived considerable attention in the literature (Cooper 1993, Judez 2000). I follow the method developed by Boyle et al. (1988). Pre-test data were used to generate a cumulative distribution function showing the proportion of the sample willing to pay progressively higher price premiums. Respondents in the pretest were shown a picture of the play structure and asked the open-ended question, "How much more would you be willing to pay for the play structure sawn from standing-dead trees?" This cumulative distribution function was used to transform 125 random numbers, generated on the interval zero to one, into bid amounts for different versions of the survey. **Table 1** contains the distribution of bids.

A discrete choice logit regression model was used to analyze survey data and calculate estimates of consumer willingness to pay (Hanemann 1984).

The logit model is useful because it yields a close-ended expression for mean willingness to pay in terms of estimated regression coefficients and independent variable means (Loomis 1998).

$$Mean WTP = \frac{B_0}{-B_1} \quad \text{[1]}$$

where:

B_0 = either the estimated constant, if there are no additional independent variables, or the sum of the estimated constant plus the product of all other independent variables multiplied by their means

B_1 = the estimated coefficient on the bid amount $X

Confidence -intervals around estimates of mean willingness to pay cannot be calculated conventionally, as mean willingness to pay is a non-linear func-

tion of estimated regression coefficients, which are random variables. Therefore, I follow the simulation approach developed by Park et al. (1991). A multivariate normal distribution is generated by using the means and variance covariance matrix of the bid coefficient, the intercept, and the coefficients of all other significant independent variables. There are 1,000 draws made from this distribution, allowing 1,000 estimates of mean willingness to pay to be calculated. This distribution of estimates of mean willingness to pay is used to calculate confidence intervals.

Survey methodology

A principal concern when designing the survey was selecting an Alaska yellow-cedar product relevant to respondents. Primary Alaska yellow-cedar products, such as dimension lumber, were rejected as they would be unfamiliar and of little interest to a significant proportion of the sample. The natural decay resistance of Alaska yellow-cedar makes it well suited to outdoor applications; therefore, potential examples were limited to secondary products designed for outdoor use. Among possible secondary applications, a children's play structure was selected because it is a product familiar to most of the sample, even those without children.

Catalogs obtained from seven manufacturers of children's wood play structures were used to design a play structure based on commonly occurring design features. The final design (Fig. I) used 276 board feet (BF) of lumber.

Compared to a cable-yarded clearcut, helicopter-yarding adds $275 per MBF to the cost of an Alaska yellow-cedar product. Therefore, consumers must be willing to pay a price premium of at least $87 for the above play structure sawn from standing-dead Alaska yellow-cedar to justify the additional costs of helicopter-yarding.

In determining what type of sample to use, there were two conflicting concerns. The desire to reach a broad randomly selected national audience had to be balanced with designing a survey that respondents felt had consequence for them. Several authors have noted that if respondents feel their answers are of no consequence, they may answer randomly (Carson et al. 2000). I decided that a random national audience was appropriate, given the potentially broad appeal of products made from Alaska
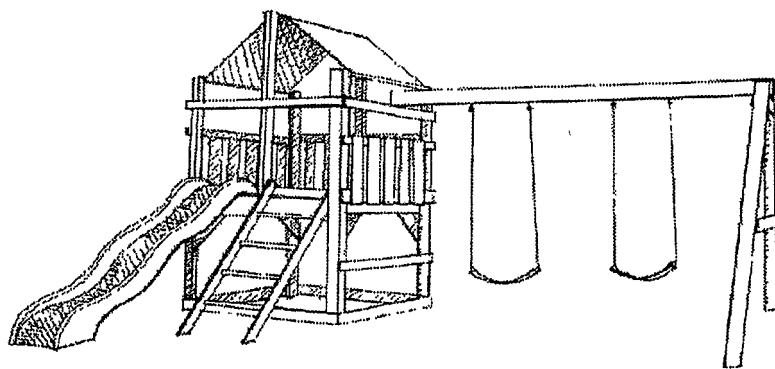
Figure 1. - *Play structure used in survey.*

Table 2. - *Regression results.*

Variable	Coefficient	Std Error	Z-stat.	Prob.
Intercept	2.16	0.482	4.47	
Bid	-0.00204	0.00057	-3.59	0.0003
Children	-0.395	0.22	-1.8	0.0722
Mcfadden r^2 •	0.168			

Table 3. - *Mean willingness to pay and confidence intervals.*

Mean willingness to pay	$948
Lower 95% confidence bound	$505
Upper 95% confidence bound	$1,391

yellow-cedar. To emphasize the importance of the survey, a cover letter was included, which explained that the results would be used by policy makers in Alaska to help determine the course of rural development in the state.

Data were collected using a mail survey during August and September 2002. A national list of approximately 1,000 randomly generated telephone numbers was purchased, and potential respondents were contacted and asked if they would complete a mail survey concerning children's play structures made from Alaska yellow-cedar. Of those contacted, 125 agreed to receive a survey (sample size was limited by budget). Following Dillman's method (2000), respondents were contacted four times. After the initial phone contact, respondents were mailed a survey. One week later a reminder postcard was mailed. A duplicate survey was sent to non-respondents 3 weeks after the initial mailing.

The survey informed respondents that the play structure (Fig. 1) was made of Alaska yellow-cedar lumber from one of two possible sources: either the lumber was produced from living trees or it was sawn from standing-dead trees. Further, respondents were told that the mechanical properties of lumber from both

sources were identical. A dichotomous choice contingent valuation question was then posed, asking respondents to choose between the two play structures made from Alaska yellow-cedar lumber from dead or living trees. The play structure made of lumber from living trees was always priced at $1,000, while the price of the play structure made of lumber from standing-dead trees varied between $1,050 and $3,000. The base price of $1,000 was consistent with similar commercially available play structures. Respondents were also asked if they owned a piece of outdoor playground equipment, if they planned to buy a piece of outdoor playground equipment in the next year, how many children under 18 lived in their household, annual household income, gender, and age.

Non-response bias is a common concern when dealing with survey data. Non-response bias occurs when the sub-sample of the population that did not respond to the survey is significantly different from the sub-sample of the population that did respond. Given that data from non-respondents are not available, a common strategy is to use late respondents as a proxy for non-respondents (Armstrong and Overton 1977). Demographic data from first wave and

second wave respondents were compared (using at-test) and no statistically significant differences were found at the 95 percent level.

Results

The first wave of surveys yielded 67 responses, with a further 19 responses from the second wave, resulting in a response rate of 69 percent. Survey responses allowed Equation [2] to be estimated (bid and number of children were the only significant variables) using a logit functional form.

$$Pay = B_0 + B_1 * Bid + B_2 * Children \quad [2]$$

where:

Pay = respondent's yes/no response to the willingness to pay question

Bid = standing-dead price premium respondents were asked to pay

$Children$ = number of children under 18 living in the household

Regression results for Equation [2] appear in **Table** 2.

The negative coefficient on bid is consistent with economic theory and other contingent valuation studies (Loomis 1988). Economic theory does not predict the sign of the coefficient on number of children. However, the negative coefficient may be interpreted as a reflection of the higher disposable income of households without children. The means and variance covariance matrix of the variables in **Table 2** are used to estimate mean willingness pay a price premium for the play structure sawn from standing-dead Alaska yellow-cedar and associated confidence intervals (Table 3).

The estimate of mean willingness to pay in **Table 3** is a price premium: respondents were willing to pay $1,948 for the standing-dead play structure. The price premium is sufficient to cover the additional cost of helicopter logging, allowing the rejection of both null hypotheses. The additional $275 per MBF cost of helicopter-yarding is based on a maximum yarding distance of 3,600 feet. The size of the standing-dead price premium suggests that standing-dead Alaska yellow-cedar could be profitably harvested and yarded greater distances.

Discussion

Using contingent valuation techniques, this study quantified the price premium consumers were willing to pay for a children's play structure manufactured from Alaska yellow-cedar lumber sawn from standing-dead trees as opposed to living trees. The $948 price premium is sufficient to cover the additional cost of helicopter-yarding standing-dead trees. This study is the first in the wood products literature to quantify a price premium for products manufactured from salvage-logged lumber.

However, the estimate of $948 should be treated with some caution. As with all contingent valuation studies, there is the potential for bias from stated, as opposed to observed, choice data. Veisten (2002) addresses this concern by adding a secondary certainty question to tile survey. In future studies, I plan to add a certainty question. When designing the survey, I was concerned that respondents would not identify with the product selected as an example. The negative coefficient on the number of children was an encouraging result in this respect; it suggests that respondents without children living in their household still identified with the survey. If respondents without children did not care about a children's play structure, they would likely answer randomly, as opposed to the pattern seen here. Finally, a larger project budget would have permitted a larger sample size.

Although there may be upward bias in the estimate of willingness to pay, I believe this does not change the study's conclusion for two reasons. First, the estimate of mean willingness to pay is more than 10 times as large as the threshold required to justify helicopter-yarding. Therefore, even a significantly reduced estimate of mean willingness to pay would be likely sufficient to cover the additional cost of helicopter-yarding. Second, if only a small proportion of the sample was willing to pay a price premium of $948, that is sufficient to demonstrate a market for products sawn from standing-dead Alaska yellow-cedar. I believe this premium is a reflection of consumers' perception that harvesting standing-dead trees is more environmentally friendly than harvesting live trees. The cost of helicopter-yarding used in this study was based on a maximum yarding distance of

3,600 feet. However, given the magnitude of the price premium consumers are willing to pay for standing-dead Alaska yellow-cedar, yarding distances of over 3,600 feet may be justified. Results suggest that with proper marketing, standing-dead Alaska yellow-cedar trees may be more valuable than living trees, and should be preferentially harvested. This result could be significant for salvage-logging other tree species killed by disease or fire.

This study may also interest manufacturers who want to market eco-labeled products. The results from this study show that respondents were willing to pay a price premium of approaching 100 percent for a play structure made from lumber sawn from standing-dead trees as opposed to living trees. Previous studies have found that consumers are willing to pay a substantially smaller price premium for eco-labeled wood products. It may be that consumers are not aware of the practical impact eco-labeling has on forestry practices. In contrast, the choice between harvesting a living tree and a standing-dead one is far less abstract than asking consumers to pay for "sustainability." Therefore, emphasizing the tangible benefits to the forest that result from a given management regime may allow manufacturers to capture a higher price premium.

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