Reservation Prices and Willingness to Accept Price Offers for Nonindustrial Forest Landowners in Western Virginia

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ABSTRACT

The purpose of this thesis is to examine what motivates nonindustrial private forest landowners to accept bids of various levels for harvesting. Through the use of a survey we specifically consider what preferences and landowner characteristics effect these decisions. Landowners were randomly selected from counties in Southwest Virginia. The participants were presented a payment table in which they were asked to indicate the level of certainty with which they would accept bids of various levels for their timber. The information obtained for the survey was used in a LOGIT model to examine which variables were most important both in determining the certainty respondents attached to different bid levels, and the likelihood of accepting a bid of any size. Our most important results show that factors such as bequest motives, tract size, absentee status, and environmental preferences influence the bid acceptance decision for landowners in the sample.

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TABLE OF CONTENTS

I. Introduction

Previous landowner-based models of timber supply have focused on probabilities of harvesting, or the level of harvesting, with little in-depth understanding of the decision process by which these probabilities arise. Especially relevant is the forest landowner's decision of whether to accept a bid price for harvesting timber, which should depend on preferences and expectations. In this study, we propose to examine the conditions under which a given landowner will enter a market for harvesting timber. This decision depends on the unobserved 'reservation price' specific to each landowner that is linked to their preferences and expectations of future market opportunities.

Reservation prices are defined as the minimum prices landowners will accept to harvest their forests (e.g., see Brazee and Mendelsohn 1988). Only when the landowner observes (or is offered) a market price that equals or exceeds their individual-specific reservation price will the landowner choose to harvest. In some cases, landowners who do not harvest will never do so, because either their reservation price is higher at that moment than the prevailing market price, or their preferences are such that the reservation price is so high that they will never harvest (i.e., the reservation price specific to the landowner is considerably higher than the market price). Thus, an important landowner decision that we will study, along with the decision of accepting a price to harvest, is the decision to never harvest and enter the market for timber. This second decision has not been the subject of previous research, but it is important to understanding those types of landowners who purchase land with no intention of harvesting.

Since reservation prices should be based on landowner preferences (Brazee and Mendelsohn 1988), differences in attitudes for harvesting and other management

decisions will be realized through the likelihood that landowners will accept a given price. For example, landowners with very high reservation prices might be those that associate lower risk with growing timber than those with low reservation prices, or they may be those with lower debt, higher preferences for amenities, or higher incomes. In addition, expectations about the path of future prices (price risk) may influence reservation prices that landowners hold for harvesting timber.

There has been some recent work that considers how various types of landowners make a range of decisions (Conway et al. 2001, Conway 1998). By and large, this literature establishes that decisions regarding harvesting and other behavior depend on whether the landowner is considered absentee or resident, where the distinction depends on the distance landowners live from their properties. Absentee landowners are defined, according to the literature, as those that live more than 50 miles away from their property (Shaffer 1997). These landowners may not have the same preferences for harvesting as resident landowners, as they may be holding their land more for recreational purposes or places for eventual retirement. If these landowners do indeed behave differently, then this will be realized in their willingness to accept a price offer for harvesting; alternatively, the reservation price for these landowners would be different than for resident landowners, and the probability that the absentee landowner accepts an offer bid could be substantially different than residents.

Other characteristics of landowners could also be important in driving reservation prices and decisions to accept price bids for harvesting. Those with large tracts might be more willing to accept bids than those with small tracts. Landowners with timberland bequest motives could be less likely to accept price offers than those that do not intend to bequeath their land or have no heirs. The landowner's financial position could effect

reservation prices and decisions to enter markets. Those landowners with low incomes or high debt should be more willing not only to harvest, but to accept lower prices in times of financial need. Although the debt effect is unclear, as those with high debts might be forced to take the first price offered. In their case the cost of searching for another price is too costly. Other characteristics such as ownership objectives (land speculation v. forest management), and owner characteristics (e.g., age, demographics) may also have substantial influences on preferences and the ability to enter markets for timber. These will be again reflected in reservation prices.

The objectives of this thesis are to examine what motivates landowners to accept a variety of bids offered for timber sale, determine what motivates landowners to never harvest, or to harvest certain percentages of their tracts at various bid prices. In addition, by developing LOGIT models for the decision to harvest we hope to offer a way for further research to determine what landowner exist at the margin. That is what a landowner are close to participating in timber sales at certain market price. This knowledge will have implications with timber supply models. Part of our approach will be to use a multiple discrete choice bounded model, similar to those used in the contingent valuation literature, where multiple bids are offered and a landowner has the opportunity to not only vote on accepting the bid, but also to indicate the degree of confidence they attach to their vote. We will go further to also determine how the answers to the bid voting question depends on various landowner and market characteristics such as absenteeism, tract size, landowner debt, and landowner timber bequest motives (following newer studies, such as Conway et al. 1998 who establish the importance to landowner decisions of such characteristics).

To know how likely it is that different types of landowners will eventually harvest, and how different policies will affect the decisions of landowners to enter the market, we need to understand how reservation prices differ across landowner types. When we better understand how reservation prices vary across different landowners, this information can be used in conjunction with current market conditions and future market forecasts. It will improve the prediction of future timber sale activity, in that it will provide a means to determine what kind of landowners exist at the "margin," that is, are closest to participating in sale activities. We will also be able to test for the importance of future speculations and expectations in affecting timber markets.

The work in this thesis contributes to existing research by being among the first to study the reservation price decision empirically. In the theoretical literature, it has been assumed that prices arrive each period according to some statistical distribution, and the landowner at each point in time decides whether to accept the price realized and harvest, or continue without harvesting and wait for the next period price. This work largely focuses on specific landowner optimization problems that are used to define the optimal reservation price strategy over time. However, there has been no work that empirically estimates reservation prices for forest landowners, despite the preponderance of theory that establishes the relevance of these prices to harvest decisions, and the importance of landowner utility and preferences to reservation prices. Therefore, we have no way of knowing how far certain landowners are from participating in forest harvesting (i.e., how different are their reservation prices from the prevailing market price), and we have little idea as to the types of landowner characteristics that drive reservation prices or decisions to accept price offers. The existing simple choice models, which evaluate landowners' discrete decisions to harvest, continue to require substantial

data for landowners that have recently harvested. Yet most landowners do not harvest or have not harvested recently, but they do possess reservation prices that could be used to tell us when they will enter the market, and if they enter what prices would they accept.

The remainder of this thesis is organized as follows. In Section II, we review the literature concerning non-industrial private forest landowners, with particular attention paid to harvesting and landowner characteristics identified as important for landowner behavior. In Section III, we present a simple model of landowner behavior where we show the derivation of the reservation price in a world of certainty. In Section IV, we discuss our survey instrument. Given that our survey approach is similar to contingent valuation referendum approaches, we also show how our survey follows the guidelines set forth in this literature. In Section V, we discuss data collection and review descriptive statistics from the landowner data. Section VI reports results from our empirical model, where we investigate the probability that landowners in the sample are willing to accept a variety of prices, and we estimate the decision of never harvesting. Finally, section VII reports the conclusions of the study.

II. Nonindustrial Private Forest Landowners

Over the years there has been extensive research on nonindustrial private forest (NIPF) landowners. The motivation for such research is clear. Nationwide, NIPF landowners control approximately 58% of the forestland. In the state of Virginia, out of 15.4 million total forested acres, nonindustrial private owners control 77% (Scrivani 1998). The first studies of NIPF's were mainly motivated by fears that private lands could not meet the demands for timber production. As time progressed there was a

change in focus. Researchers began to try to understand landowners' diverse characteristics and concerns (e.g., see Egan 1997 for a historical perspective).

Early NIPF studies in the forties, fifties, and sixties concentrated on timber management rather than forest management. Even though it was acknowledged that NIPF landowners were a diverse group, they were regarded as a group separate from the general public, and they were aggregated together with no regard to differences in characteristics that might determine decision-making. Studies since then have shown that this was not best way to look at NIPF's (e.g. Bliss and Martin 1989). In general, researchers took the stance that the landowners primarily owned forest resources for economic gain. The "problem", from the perspective of researchers, was that NIPF's were not being managed in a way that was economically optimal. Forests were perceived as not making their full potential contribution to the nation's forest economy. However, there was never acknowledgement of the reasons why landowners hold forests; i.e., the only assumption was that landowners were managing for financial gain related to timber production. Other nontimber benefits, such as recreation and maintaining scenic beauty, were hardly ever addressed until the work of Gregory (1957). Gregory showed how management of a forest could be undertaken with multiple objectives, including financial gain and nontimber benefits (Egan 1997).

Since this early literature, researchers have studied the numerous reasons for owning forests, both from the perspective of trying to determine the preferences of nonindustrial landowners (See Kuuluvainen et al. 1997 for a recent review of this work) and from the perspective of determining what landowner characteristics determine harvesting behavior (e.g., Young and Reichenbach 1987). Starting in the 1970's, research began to consider landowners as individuals with diverse motivations for forestland

management. The terms ‘timber management’ and ‘forest management were no longer being looked at as synonymous terms (Egan 1997).

The literature has since reflected the view that there are diverse objectives associated with forest management. Different studies all over the United States have identified nontimber benefits that contribute to the management of NIPF’s (e.g., Jones and Finley 1995). These nontimber benefits may include recreation, aesthetic value, a heritage for future generations, protection of the land, and others. For example, a survey of Virginia NIPF landowners conducted by Hodge and Southerland (1992) showed that the main reasons that they owned forestland were to preserve nature, maintain scenic beauty, and for viewing wildlife.

While the different nontimber benefits that are important to NIPF owners have been recognized, it is important to realize that when landowners make management decisions, multiple objectives may come into play, included timber harvesting. Even though some landowners may not be timber oriented they still may harvest during their lifetime. Hodge and Southerland (1992) found that approximately 56% of NIPF landowners in Virginia have harvested timber at some time. The diverse objectives of individual NIPF landowners and other market factors all contribute to a decision to harvest. Others have shown that harvesting and reforestation decisions of forest landowners are related to market, landowner, and timber characteristics (e.g., Hyde and Newman 1992 and Kuuluvainen et al 1996 provide recent surveys; see also Birch (1992), Greene and Blatner (1986), Royer (1987), Romm et al. (1987), and Dennis (1989, 1990)).

Since the nontimber and timber objectives in forest management have become evident to researchers, there have been attempts to empirically estimate the probability of harvest. Examples of such studies include Kline et al. (2000), Dennis (1989), and

Conway et al. (2001). This work to a large extent seeks to determine how the likelihood of harvesting depends on characteristics of the market and of landowners.

Our approach in studying reservation prices is similar to these studies in that we assume that landowners have multiple objectives and many characteristics that drive decision making regarding harvesting. However, we hope to extend the understanding of NIPF landowners by empirically determining the likelihood landowners accept various bids for harvesting timber, and then investigating how the likelihood of accepting a bid depends on landowner preferences and characteristics. We will also go beyond the literature to determine whether landowners are likely to harvest all of their forest holdings at the offered bid price, or whether they are never willing to harvest timber (thereby never accepting a bid). This will provide more meaningful information than simply determining what motivates landowners to harvest.

In the analysis of landowner responses to willingness to accept questions we found it appropriate to look at large and small tracts, those timber bequest motives, and resident/absentee status. These characteristics have been established in past literature as influential components of NIPF landowner behavior. The size of forest holding can greatly affect harvest decisions. It has been found that there is a positive correlation between tract size, forest investment, and timber production (Straka et al. 1984). Part of the relationship between tract size and timber production can be attributed to the decreasing marginal utility of nonmarket benefits. As acreage increases there may be more incentive for timber production due to the fact that demand for amenities can be met with a portion of the land. Therefore, landowners with larger tracts may be involved with different timber related activities. Another important distinction that we make is if an owner has intentions to timber bequest. This group may behave differently when

offered various bids. The intention to leave land to their heirs may play a key role in harvest decisions. We also break landowners down into resident and absentee status. In a study by Robert Shaffer (1997) reported that sixteen percent of NIPF landowners in Virginia were absentee. This not a very large percentage, however it still accounts for a considerable amount of land. This group may have different preferences and these may result in different harvest strategies. Shaffer indicates that past literature has shown that absentee landowners may be more likely to actively seek professional forestry information and assistance.

III. Derivation of a Reservation Price

We will now develop an econometric model for estimating landowner reservation prices which is based on the theoretical two period model introduced by several others (Conway 1998, Amacher and Brazee 1997, Koskela 1989). This model assumes a representative landowner i who maximizes the following utility function,[1]

$$U^i(C_1, C_2, Q; \Omega) \tag{1}$$

subject to the following budget constraints:

$$C_1 = P_1 X_1 - S_1 - wE \text{, and} \tag{2}$$

[1] In a departure from the literature, we have not assumed that Q is additively separable from consumption in the utility function. Thus, there will be income and substitution effects that are important in the decision to bequeath or to not harvest timber, and these will be important in the empirical section.

$$C_2 = \frac{1}{(1+r)}\{[(K_0 - X_1) + F(K_0 - X_1, E) - Q]P_2 + (1+r)S_1\}, \quad (3)$$

where Q represents unharvested timber stock left after the second period, C_1 and C_2 are consumption in periods 1 and 2 respectively, P_1 and P_2 are stumpage prices in periods 1 and 2, X_1 is timber volume harvested in period 1, S_1 is savings in period 1, r is interest rate, and K_0 is timber bequest from the previous generation (or standing timber stock). The concave forest growth function F(.) describes total volume of timber stock available in the second period—timber growth depends on unharvested timber from the first period (K_0-X_1) and investment in reforestation effort, E. As is normally assumed, reforestation is undertaken at a constant marginal cost, w. Bequeathed forest stocks Q yield utility if the landowner receives benefits from not harvesting timber and setting it aside for future generations. As a result, the decision to harvest in the first period, and the decision of how much timber to set aside and <u>not</u> harvest in the second period, completely specify the landowner's decisions. This model follows several two period representations found in the literature.

Unharvested timber, savings, timber volume harvested, and reforestation effort (Q, S_1, $X_{1,E}$) are *endogenous* variables. The landowner takes the market prices for timber and the costs of reforestation parametrically. Not surprisingly, Q also takes on some similarity with nontimber benefits. This has been argued already in the theoretical literature (see for example, Ollikainen 1998, Amacher and Brazee 1997 and Amacher et. al 1998). In our model, and for the purposes of the econometrics, it is important to realize that increasing Q is consistent with either bequeathing increasing amounts of timber, or not harvesting and preserving timber for "nontimber utility." Thus, without

loss of generality, timber bequests and nontimber benefits can be considered interchangeably. The Ω term represents other characteristics of the landowner that are important to preferences, such as the landowner type (i.e., absentee or resident, owner of large or small tracts, etc), risk preferences concerning timber investments, and other demographic characteristics.

The first order conditions can be obtained by substituting C_1 and C_2 into (1) and differentiating with respect to the decision variables Q, X, and S. The first order condition for the unharvested stock, Q, is:

$$\frac{\partial U(\cdot)}{\partial Q} - \frac{\partial U(\cdot)}{\partial C_2}\left(\frac{1}{(1+r)}P_2\right) = 0.$$

Rearranging terms, we obtain the following:

$$\frac{\partial U(\cdot) \big/ \partial Q}{\partial U(\cdot) \big/ \partial C_2} = \frac{1}{(1+r)}P_2. \qquad (4)$$

Equation (4) implies the landowner chooses to leave unharvested stock in period 1, Q, so that the marginal rate of substitution (MRS) for consumption and nontimber benefits between periods equals the marginal discounted value of harvesting.

The first order condition for period one harvesting, X_1, is:

$$\frac{\partial U(\cdot)}{\partial C_1}P_1 + \frac{\partial U(\cdot)}{\partial C_2}\left(\frac{1}{(1+r)}\right)\left[-1 - F_X(K_0 - X_1, E)\right]P_2 = 0 \qquad (5)$$

Where $F_X(.)$ is the partial derivative of growth F(.) with respect to harvesting, X_1. Equation (5) shows that the landowner harvests such that the marginal utility of consumption is equal over the two periods, a standard result.

The first order condition for savings (or debt if savings is negative), S_1, is given by:

$$-\frac{\partial U(\cdot)}{\partial C_1}+\frac{\partial U(\cdot)}{\partial C_2}=0 \qquad (6)$$

In equation (6), the landowner saves (or accumulates debt) so that the marginal utility of consumption remains constant between time periods. Substitution for $\partial U(\cdot)/\partial C_2$ from equation (6) into equation (5) yields:

$$\frac{\partial U(\cdot)}{\partial C_2}P_1+\frac{\partial U(\cdot)}{\partial C_2}\left(\frac{1}{(1+r)}\right)\left[-1-F_X\left(K_0-X_1,E\right)\right]P_2=0\,.$$

Simplifying, we have:

$$\frac{P_1(1+r)}{P_2}=F_X\left(K_0-X_1,E\right)+1\,. \qquad (7)$$

At the optimum, harvesting will take place so that the value of the ratio of discounted stumpage prices for the two time periods is equal to growth of the forest stock.

To further examine the condition for harvesting, we can solve equation (4) for P_1 and substitute into (7), to obtain:

$$P_1\left(\frac{\partial U(\cdot)/\partial C_2}{\partial U(\cdot)/\partial Q}\right) = F_X\left(K_0 - X_1, E\right)+1. \qquad (8)$$

Specifically, the landowner harvests so that the marginal product of growth (RHS) equals the price, multiplied by the MRS between consumption and nontimber benefits (LHS). Thus, harvesting depends on preferences for non-market goods. If amenity values did not exist, harvesting would depend only on land and owner characteristics such as timber stock, stumpage prices, access, and risk preferences.

To obtain a representation of the reservation price for harvesting, we can solve for the price at the corner solution for equation (8). This new condition describes the price that would make the landowner just indifferent between harvesting and not harvesting,

$$P_1 < \frac{[F_X\left(K_0 - X_1, E\right)+1]\,\partial U(\cdot)/\partial Q}{\partial U(\cdot)/\partial C_2} \quad . \qquad (9)$$

This price can be expressed as a general function of preferences (Ω), a measure of forest assets such as stocking, species, and land characteristics (S), variables important to consumption (C), and market variables important to harvesting (X),

$$P = \Phi[\Omega, C, S, X] \qquad (10)$$

The LHS of the inequality in (10) is equal to an individual's reservation price. This depends on landowner's preferences such as recreational opportunities, aesthetic quality, and timber harvesting. These preferences are also contained in the utility function. The consumption possibilities that a landowner could face in the second period, if the decision were made to harvest, are represented by C. X represents the timber, which could be harvested in period 1 if a price offer is accepted. When the LHS of (10) is replaced by the reservation price, a landowner's decision to harvest can be summarized by the following inequality:

$$P_R \geq \Phi[\Omega, C, S, X],$$

where P_R is the landowner's reservation price, A landowner will only harvest timber if the reservation price is greater than the market price.

We can also obtain a condition which shows when the landowner would never harvest and would instead bequeath forest to heirs or hold it for nontimber amenities. Such a condition can be obtained from the corner solution for nontimber activities (Q=0):

$$\frac{\partial U(\cdot)}{\partial Q} < P_2\left(\frac{1}{(1+r)}\right)\frac{\partial U(\cdot)}{\partial C_2} \Leftrightarrow Q = 0 . \qquad (11)$$

The landowner will choose <u>not</u> to reserve timber for amenities or bequeath it when this inequality holds because, when this is the case, the marginal utility from not cutting (LHS) is less than the discounted marginal utility of potential harvest income (RHS). Therefore, we would expect high amenity values (measured by U(·)) to encourage a landowner to hold standing timber and bequeath it, while factors contributing to high

stumpage prices would lead to increased harvesting because condition (11) is more likely to hold. We will examine both (10) and (11) empirically later in the thesis.

One final interpretation comes from examining the corner solution for where harvesting is zero (where $X_1 = 0$); this is a case where a landowner *will* always harvest at some prevailing price,

$$P_1\left(\frac{\partial U(\cdot)/\partial C_2}{\partial U(\cdot)/\partial Q}\right) > F_X\left(K_0 - X_1, E\right) + 1 \qquad (12)$$

Harvesting is more likely if prices are high or marginal nontimber benefits, $\partial U(.)/\partial Q$, are low. Although it is not explicit, a perception of increased risk to timber production represents a positive marginal utility from harvesting (existing timber); in this case, the equation is less likely to hold (because the LHS increases). While such landowners would be more willing to harvest existing timber, they would be less willing to invest in timber production. Further, if debt is high, savings is low, implying a low net income. The marginal utility of consumption is therefore high, and the landowner would be more likely to harvest (because the LHS is higher).

IV. Survey Instrument and Design

Reservation Price and Willingness to Accept

The probability that a landowner will accept a bid for harvesting timber depends on the reservation price, or the minimum price that landowners will accept for timber sales. As we showed in the theory section, capitalized into the landowner's reservation

price is the value of the timber that would be harvested and the compensation for lost amenities associated with standing timber. These amenities may include scenic beauty and recreation, among others. An individual's reservation price also depends on his or her preferences and expectations about future market prices and conditions.

The link between reservation prices and the contingent valuation literature should be clear if one considers that a reservation price could also be thought of as willingness to accept (WTA). Thus it is the minimum that someone is willing to accept to harvest their timber. WTA and willingness to pay (WTP) data are generally used with the valuation of nonmarket goods. Referendum type questions and bidding games are among the elicitation techniques used to gather WTA and WTP data in the literature. Similar to considerations with nonmarket goods and services, an individual's reservation price is unobservable unless he or she enters a market. Quite simply the only way to know what someone's unobserved reservation price is to ask them. Economists who want to obtain WTP and WTA values for nonmarket goods use a survey approach called contingent valuation (CV). To determine the minimum payment landowners are willing to receive in order to harvest their timber we use an approach very similar to the contingent valuation method.

WTP and WTA are theoretical constructs, however. They are unobservable for environmental goods. Our case is different in the sense that the WTA values that we are trying to determine are related to an individual's reservation price for market activities (harvesting timber). This reservation price is not a theoretical construct and would be observable under certain market conditions. However, many of the questions concerning the validity of contingent valuation and stated preference techniques are still applicable to

our survey design. We will review these first before showing how our survey instrument follows the set of guidelines set forth in this literature.

The Contingent Valuation Method

The Contingent Valuation Method (CVM) is a process in which surveys are used to estimate values for goods that are not traded in a market system. When a good or service is traded in an open market, demand or preferences are revealed directly through observing purchasing and selling decisions. To estimate the monetary value of certain nonmarket goods like environmental amenities, CVM is a direct approach to determine an individual's preferences. With the aid of a survey instrument, participants are asked their willingness to pay (WTP) for a change in the level of provision of a nonmarket good. This change is contingent on a hypothetical situation that is described in the survey. The hypothetical situation that is described must include the creation of a market or a means of payment in order for the good in question to be valued in monetary terms.

CVM methods were first developed so that benefit-cost analysis (BCA) could better account for human preferences. BCA compares the benefits and costs of a proposed project or policy. When the application of BCA requires the consideration of nonmarket goods and amenities, analysts needed a way to measure changes in public welfare. During the 70's, open ended and iterative bidding were the first CV methods used to measure consumer surpluses. These first methods received considerable criticism from some economists. Their main argument was that these techniques were not reliable and that they could not accurately estimate changes in welfare. Then during the 80's, advances in economic theory and econometric techniques led to improved CV methods. In an effort to present a format that would be more familiar and incentive capable for survey participants, surveys were designed with discrete dichotomous choice type

questions. An elicitation format is incentive-capable if there are no incentives for the survey participant to misrepresent his or her true preferences. As the methodologies improved in reliability, CV became a more widely accepted means of valuation.

CV began to find its way into court when the public sought compensation for damage done to natural resources by individuals and corporations. In 1989 when the *Exxon Valdez* ran aground in Prince William Sound, EPA and other public interest groups demanded compensation for the damage. In addition to losses to the fishing and other commercial industries, the *Exxon* Corporation was sued for the loss of environmental amenities. CV was used to estimate these non-use values. Needless to say the retribution that the public was asking for was considerable and Exxon assembled a panel of leading economists to tear away at the validity of CV. In the end the case was settled out of court, but advocates of CV were forced to reevaluate elicitation techniques and how they should be used.

Soon after the trial concluded, the National Oceanic and Atmospheric Administration (NOAA) put together its own panel of experts to access the reliability of the CVM. The conclusion of the panel was that CV was an acceptable means of measuring passive-use values, but only if certain guidelines are met. A summary of these guidelines can be found in Bishop (1998).

It is these guidelines that must be followed in the design of our survey instrument, keeping in mind that our survey elicits responses for a market good. Among the recommendations put forth by the panel is that a referendum (single bounded dichotomous choice) format should be used. This is a format where individuals are presented with potential bids (for WTA or WTP), and they decide whether to accept or reject the bid (i.e., their response is a qualitative response). This type of format is

preferable due to the fact that is familiar to respondents and that for the most part it is incentive capable. The panel also recommended the use of a 'no answer' or 'not sure' voting option. Since then, there has been some argument about whether 'not sure' really represents a 'no' vote (Carson 1996).

Multiple Bounded Discrete Choice

Our version of the referendum approach for eliciting responses to bid offers follows the newer literature of multiple bounded discrete choice (MBDC) approaches (Welsh and Poe 1998). This is the approach we use to determine the probability landowners accept bids for harvesting, but we will follow the recommended techniques discussed in Bishop (1998) for survey design of CVM approaches.

MBDC allows survey respondents to express their level of certainty when offered different prices for their timber. Sociologists first used this type of method to provide contingent valuation estimates of WTP. The design that was first used for contingent valuation consists of a table with different bid prices on the vertical axis. On the horizontal axis is a spectrum of levels of certainty, ranging from the option of definitely not accepting a bid, to not being sure about a bid, to definitely accepting the bid. For each price offered respondents are asked whether they would not accept, probably would not accept, are not sure, would probably accept, or would accept.

There are many advantages to using MBDC. It is well documented that different elicitation techniques produce different WTP/WTA estimates, and in fact there may exist a wide range of WTA values for an individual (Welsh and Poe 1998). Welsh and others show that there is a "close correspondence" between different levels of certainty in MBDC and different elicitation techniques. For example, those that say that they are "not

sure" in MBDC would probably vote "yes" with a dichotomous choice format. For values given open-ended and payment card formats, higher levels of certainty are expressed with MBDC. One of the recommendations of the NOAA panel was that a single bounded dichotomous choice should be used whenever possible. However, some worry that method may overstate WTP/WTA estimates. With dichotomous choice one also has to choose a distribution of dollar levels. For our study, we used market information and pre-testing to identify the appropriate levels. Since market information and stocking levels are generally available, we were able to postulate a range of values for under-stocked and highly stocked forests.

In a way, dichotomous choice could be thought of as a special case of MBDC. Instead of being offered one price, respondents are able to indicate their level of certainty that they would accept over a range of prices. With these aspects of MBDC it is reasonable to say that this approach builds off the positive aspects of dichotomous choice. At the same time it addresses some of the issues that have been raised concerning dichotomous choice.

Survey Instrument

The model above indicates that, to understand why a landowner adopts a certain bid, information needs to be collected on a variety of preference characteristics for the landowner. This information was obtained using a survey format. The survey questionnaire used in this study is presented in Appendix 1.

The questions in the survey were designed to effectively gather information pertaining the land tract characteristics, land use decisions, timber harvesting, landowner preferences, nontimber activities, and demographic information. Referring to the

appendix, question 1 asks how the owner first acquired the land and for how much. We also ask the landowner if their property is a residential neighborhood. If the answer to this question is yes we ask them to not answer any more questions and to return the survey. Question 2 asks how long the owner or the owner's family has been in possession of the land, and question 3 asks for how much would they consider selling the land and timber. In question 4 we ask about the landowners' future plans for the land in the future. Questions 5, 6, and 7 relate to the general terrain, miles of roads, and permanent structures on the property respectively. These questions should be important in establishing the possibility that the landowner could ever have the possibility of harvesting. The next two questions deal with land use. Question 8 asks for the acres of forest, agricultural, and open land the landowner currently owns. Specifics of land conversion over the last ten years are covered in question 9.

In question 10 we present the bid payment table. It is based on the multiple bounded discrete choice (MBDC) approach first developed by Welsh and Poe (1998). In the table respondents are asked to indicate their level of certainty that they would harvest timber on their property for a range of bid prices. Similar to the Welsh and Poe study, our bids are ordered on a logarithmic scale. The range of offers was based on current Timber Mart South prices and bids used in previous research. We also pre-tested the bid ranges with pre-survey mailings (the sample size was 80 landowners each time). This pretest was based on "open-ended" responses obtained from a random sample of 100 landowners in Montgomery County, Virginia.

The MBDC approach and the survey itself was constructed to follow guidelines in the literature on contingent valuation, where these methods are used to recover willingness to accept. For example, following Bishop's recommendations, the survey

questionnaire contains a “Not Sure” category in the payment table, which is similar to the “no answer” recommendation of the panel. The panel also recommended the use of a referendum elicitation format, where a single bid is offered to each respondent, and the respondent then is given the opportunity to vote yes or no on whether they would accept the bid. The MBDC approach is an improvement upon the referendum format. The only difference is that participants are offered a range of prices, and for each price they are asked to indicate a level of certainty that they would accept.

After the payment table we give respondents the option of indicating that they would never harvest no matter what price is offered. If they checked the “Not Sure” column anywhere in the table we then ask them various questions concerning why they are not sure, again following Bishop’s recommendations. In the last part of question 10 we also ask what percentages would landowners choose to harvest for the highest and lowest amount for which they checked “Probably Yes” or “Definitely Yes.” Our interest here is in determining whether the likelihood of adopting a price is related to the scale of an activity, i.e., the number of acres of the landowners holdings that might be at “risk.”

Questions 11 and 12 in the survey deal with income that is obtained with the use of their land. In question 13 landowners are asked to indicate (on a scale of 1-5) how important various reasons are in owning their land. The choices range from environmental reasons to land investment opportunities. Questions 15,16, and 17 deal with nontimber activities, while 17-20 deals with timber. Questions 21-30 ask for demographic information. Finally, with the last question in survey we ask the respondent if they were able to understand and complete the survey. If they were not, we ask them to indicate why.

V. Data Collection and Descriptive Statistics

Methods

Sampling Procedure

A random mail survey of 1,270 landowners was conducted in the fall of 2000. Nonindustrial private landowners who owned 20 acres or more were selected at random from county landowner lists. Once the total number of desired names for each county was determined, we randomly selected names from the lists. The lists were organized alphabetically and for each parcel in the county there was an entry. Corporate and residential neighborhood properties were not included in the sampling list.

The survey was pretested on 75 landowners from Montgomery County with a response rate of 38%. The pretest included an open ended question about reservation prices. The pretest allowed us to determine reasonable ranges of bid levels, and also to determine how to refine the survey questions to maximize response rates.

The final survey was sent to 635 landowners in Montgomery County, 260 in Roanoke County, 150 in Pulaski County, and 225 in Giles County. After rejecting those surveys that were returned because they could not be delivered, a total of 358 landowners had responded. Once landowners who own more than one property were accounted for, the final response rate was 30%. There were slight discrepancies between the response rates of different counties. Roanoke County had the highest response rate of 35%. With a 32% response rate Pulaski County was next. Montgomery and Giles County were tied with the lowest response rate of 28%. These responses are favorable compared with other landowner surveys in our area and region (Hodge 1992, Conway et al. 2001, Conway 1998).

The survey mailing procedures followed methods outlined in the classic survey design work of Dillman (1978). The full-blown survey included a postcard follow-up, which was sent to landowners that had not responded within two weeks of the initial mailing. Following the recommendations set forth by the NOAA panel report and Haener et al (1988) a "would not vote/not option" was also offered in conjunction with the payment table. We also offered an option for the landowner to never harvest.

Descriptive Statistics

The descriptive statistics of the survey data are organized by landowner type and tract size and are presented in Table 2. Table 1 also presents definitions of the different variables used in the study. Resident and absentee are the two different landowner types. Landowners whose residences are located more than fifty miles from the tract of land in question are considered absentee landowners according to the literature (Conway 1998). Those who live within fifty miles are considered to be resident landowners. Tracts of land that are more than fifty acres are labeled large for the purposes of our study, and tracts that are less than fifty acres are considered to be small. The statistics that were collected give insight into landowner demographic attributes, ownership characteristics, land characteristics, and landowner preferences that are present in our survey responses. We will break this discussion down into the different landowner attributes.

<u>Demographic Attributes</u>

The average age of the surveyed landowners was 59.6 years. This result is consistent with the findings of past surveys. Conway (1998) who surveyed a similar area in Virginia found the average age to be 60 years. The biggest difference between ages

could be seen between the owners of large and small tracts. The average age of the owners of large tracts was 61.3 years, and the average age of the owners of small tracts was 59.7 years. This difference could be due to the fact that as income increases with age, a landowner tends to accumulate more land. It has also been documented that land parcels have become more and more fragmented. Perhaps there are fewer large tracts of land for young landowners to purchase if this is the case.

Of the landowners that completed the survey, 80% were male, and the average number of children was 2.4. Just about half of the respondents were retired. Over 60% of the owners of large tracts were retired, while only 40% of the owners of small tracts were retired. This is consistent with the fact that owners of the larger tracts were generally older. There was also a notable difference between absentee and resident landowners. Sixty-four percent of the absentee landowners were retired and 49% of the resident landowners were retired.

In all, 54% of respondents have completed college. These numbers are similar to those found by Bourke and Luloff (1994). In their survey of NIPF landowners in Pennsylvania they found that 45.7% had completed college. Differences can again be seen between large and small parcel owners, and resident and absentee landowners. A total of 65% of absentee landowners had completed college compared to only 52% of residents. Only 48% of the large tract owners had completed college while 61% of the small tract owners have received a degree.

The average landowner household income was approximately $60,000. Absentee landowners earned considerably more than residents did. The income of an absentee owner was over $90,000 compared to only $61,000 for residents. These reported income levels are considerably larger than past NIPF studies and the mean income levels of

residents in the surrounding area. However, they are consistent with the findings of Conway (1998).

The average debt was reported as being around $66,000 per household. Resident landowners indicated that they had higher debt levels than absentee landowners, and those who own large tracts reported less debt than those who owned smaller tracts. The difference in reported debt levels could be explained by the fact that absentee and large tract owners tended to be older and have higher income.

Ownership Characteristics

The results of our survey showed that around 30% of respondents indicated that they had inherited at least a portion of their land. Seventy-four percent said they had bought some of their land. The results show that resident landowners were more likely to have inherited their land. The fact that residents still live on the land parcel in question may explain the fact that they are more likely to have inherited it. On average, residents have ownership of the tract for a longer period of time than absentee owners. The owners of small tracts have had their land for an average of ten years longer than those who have large tracts. Overall, respondents described the terrain on their as being either mountainous or hilly. These responses are consistent with the type of topography that exists in the area that was surveyed. The average size of the tracts that were sampled was 86.54 acres.

For our study, we defined an absentee landowner as one living more than fifty miles away from the tract of land in question. Previous studies including Shaffer (1997) have used the same criteria for defining absentee owners. Of those who completed our survey, 14% fell under the category of absentee. On average they lived 357 miles away

from their property. Fifty-eight percent of the resident landowners actually reside on the tract of land in question. In a 1997 study conducted by Shaffer, whose purpose was to determine the percentage of absentee NIPF landowners in Virginia, 16% were found to be absentee.

Landowner Preferences

When posed with questions that dealt with the harvesting of timber, 21% of the landowners said that they would never harvest timber regardless of what price was offered. The high response to this question demonstrates how valuable nontimber benefits are to NIPF landowners, and this should play an important role later when we formally examine these conditions. Whether or not they really never harvest, no matter what the price that was offered, is still in doubt. Small tract landowners were more likely to indicate that they would never harvest.

Survey participants were also asked the risk that they associated with growing and losing timber on a scale of one to five (one being the lowest and five the highest). The average response for the risk associated with growing timber was 2.49, and for the risk associated with the loss of timber: 2.96. Resident landowners were more likely to think that there was a risk associated with the growing of timber. The owners of small tracts were more likely to associated risk with the loss of timber.

Twenty-nine percent of landowners who responded have sold timber from their tract of land at some time. This is lower percentage than that found by Hodge and Southerland (1992). They determined that 56% of NIPF landowners in Virginia have harvested timber. Moulton and Birch (1995) reported that in the southern United States 45% of owners have harvested timber. Our survey determined that residents were 6%

more likely to have sold timber when compared to absentee owners, and large tract owners were 10% more likely to have sold timber when compared to small tract owners. The average time since the sale of timber for all positive respondents was 3.8 years.

Many of the survey respondents earn income from agriculture. The large tract owners reported an average annual agricultural income of $75,738. It appears that virtually none of the small tract owners are involved in agriculture. Some landowners reported income from timber in the past year. The income levels from timber were relatively even across landowner types, but large owners earned more than small tract owners and absentee landowners owned more than residents.

Landowners were asked (on a scale of one to five) how important a number of reasons were for owning their land. Environmental reasons received a score of 3.70 across landowners, indicating its general importance (we find a similar conclusion in the estimation section). The option to keep the land for future generations received a score of 4.07. Overall, scenic beauty received a score of 4.18. Resident and small tract holders seemed to value scenic beauty more than others. Income from timber as reason for owning the land received to the lowest score of 1.82. Small tract owners were much less likely to value the land for timber production. When compared to residents, absentee landowners were more likely to consider income from timber as an important reason for owning the land. Small landowners were much less likely to value the land as a real estate investment when compared to others. The importance of the land for recreational uses received a score of 3.69 and hunting and fishing received a value of 2.92.

Some of the questions that we asked landowners in our survey were related to their future plans for the property. Seventy-two percent of the respondents said that they planned to give the land to their heirs in the future. Twenty-five percent said that they

would sell their land in the future. When asked about future plans for the timber, 24% of landowners said they eventually would harvest it. Residents were more likely to indicate that they would cut their trees in the future. These results are somewhat different from those found by Conway (1998). She reported that 53% of landowners intend to bequeath land and/or timber to their heirs. Perhaps the difference could be attributed to the counties that were surveyed in each study. Seventeen of the respondent in our survey said that they would sell the timber with their land in the future.

Payment Table Statistics

An important feature of the questionnaire discussed in Section IV was the payment table. This table presented survey respondents with a variety of per acre prices for harvesting their forest. For each bid level the landowners were offered a spectrum of confidence levels from which they could choose. They were able to select from the following choices for each bid: definitely not, probably not, not sure, probably yes, and definitely yes. The results from these questions are located in Appendix 2 in tables 3-9. The responses are also broken down by the size of the tract in question, timber bequest motives of the landowner, and absentee/resident classification. Recall this is consistent with the breakdown made with the descriptive statistics presented earlier.

Table 3 presents the full sample of respondents. The values in the table represent the percentage of respondents who indicated that they would accept a specific bid level at each confidence level. The higher the percentage in the table, the greater the number landowners who said that they would harvest at that price. The overall trends in Table 3 seem to be consistent with the expected behavior of landowners and from our descriptive statistics. As the bids increased, more respondents indicated that they would harvest

timber, for most confidence categories. The "not sure" category seems to increase with the higher bid levels and then more or less flatten out after the $5,000 offer. When we compare the "probably yes" and "definitely yes" options in Table 3, we can also notice that the "definitely yes" category increases much more dramatically as higher bids are offered. These bids are consistent with the theory presented in equation (8), i.e., that high prices make the condition for harvesting more likely to be satisfied.

The responses of landowners with and without timber bequest motives can be compared using tables 4 and 5. Clearly, there are substantial differences in landowner voting for these two types of landowners. Landowners without timber bequest motives were slightly more likely to answer "definitely yes" for the larger bid levels. Naturally, if landowners have intentions to leave their land with heirs in the future, they might want to leave the timber standing. The same differences in percentages can be seen in the "probably yes" category. Again landowners without timber bequest motives are more likely to accept bid offer for harvest.

Tables 6 and 7 show the responses of absentee and resident landowners respectively. Some interesting observations come to mind when we look at the tables individually and when they are compared. In both tables there appear to be certain bid levels in which the number of respondents who voted in the "definitely yes" column increases substantially. For absentee landowner in Table 6 there is large jump in positive responses between the $5,000 and $6,500 bid levels.

Interestingly, there is a different pattern for resident landowners. Table 7 shows that jump in positive response lies between the $6,500 and $8,500 per acre bid levels. From the results it seems that absentee landowners would be more likely to accept lower amounts for their harvest timber. It can also be seen that a higher percentage of absentee

landowners answered “definitely yes” to the $13,000 offer. A slightly higher percentage of absentee landowner said that they would definitely not accept the $500 offer for harvest.

Tables 8 and 9 show the responses for the owners of small and large tracts respectively, which show substantial differences. When we compare the “not sure” categories in these two tables we can see that higher percentages of landowners holding small tracts indicated that they were not sure about how they would vote for a range of different bid levels. Perhaps this difference could be due to the fact that the owners of larger tracts might be more familiar with the timber market, i.e., they may be tree farmers or are holding land as a timber investment (they may also have obtained consultant advice). They would have more information with which harvest decisions can be made. Overall, the owners of the larger tracts were also more likely to accept the larger bids for harvest. Since they have more land they could be more willing to harvest at least a part of it. There also a more gradual change in percentages between bid levels for small tract owners.

The payment table results suggest that landowners who are resident or have large tracts have the highest response rates for the choices on the “definitely yes” category over a range of bid levels. Generally, we cannot say whether different types of landowners are less sure about accepting bids, as the results are inconclusive in these cases.

VI. Econometric Estimation of Decisions to Accept Bid Offers

Comparing the descriptive statistics with the payment table results shows that there may be differences in the probability that a landowner would accept bids over different ranges. We also found distinct differences depending on whether the landowner was absentee or resident, or whether they have timber bequest motives or large tracts. We can now more formally investigate these findings by estimating LOGIT models that specify the probability a landowner accepts a bid as a function of landowner and market characteristics. The goal is to determine which aspects of landowners and markets, as well as land characteristics, are most important in the decisions to accept bids for harvesting. We will also investigate the issue of scale in reservation price decisions, by determining the probability that a landowner will harvest all or some portion of their forests at certain bid offers. Specifically, we will estimate a LOGIT model where we consider the decision of whether a landowner would harvest more than one acre at a variety of prices.

The variables included in these LOGIT models should account for different landowner attributes, ownership characteristics, land characteristics, and preferences that may play a role in harvest decisions (as identified in the theory section). Referring to Table 1 of definitions, the variables INCMID, EMPLOYED, DEBT, and CHILDREN represent attributes of the landowner. INCMID is the landowner's yearly income, EMPLOYED indicates whether or not he or she is employed, DEBT is the total debt of the landowner, and CHILDREN is the number of sons and daughters in the family (an indication of heirs). The variables that represent ownership characteristics include ABSENT, NONCONT, INHERIT, and YRSOWN. ABSENT indicates whether or not a landowner is an absentee or a resident as measured by distance the landowner resides

from the property. A landowner living more than 50 miles away is considered an absentee landowner for the purposes of this study. NONCONT is the total number of days the survey respondent was involved in nonconsumptive timber activities, INHERIT accounts for whether or not the land in question was inherited, and YRSOWN is the number of years that the respondent has had possession of the land. Land characteristics are represented with the variables MILEFROM, ROADS, CHACRES, and ACREFOR. MILEFORM is the number of miles that the respondents residence is from the land parcel in question, ROADS is the miles of roads on the property, CHACRES is the total acres contained in the property, and ACREFOR is the number of forested acres as reported by the landowner. Finally, the preferences of the landowner are represented by the variables PLANGIVE, ENVIREA, FUTGEN, and RISKGROW. The decision to timber bequest the timber is accounted for by PLANGIVE. For the remaining variables, landowners were asked to indicate their responses on a scale of one to five. ENVIREA is importance of owning the land for environmental reasons, FUTGEN is the importance of owning the land for future generations, and RISKGROW is the risk that the landowner associates with growing timber. The complete description of all of the variables used in this study is located in Table 1 in Appendix 2.

LOGIT Model for the Decision to Never Harvest

Table 10 presents LOGIT model estimation results, which considers the decision of a landowner to never harvest. After accounting for missing data, there were responses from 142 landowners that were used in the estimation of this model. The model correctly predicts the decision to never harvest 89% of time. The four significant variables in this LOGIT model are PLANGIVE, INHERIT, ROADS, CHILDREN. Both the decision to leave timber with heirs and the miles of roads on the property have positive coefficients.

If a landowner indicated that he or she would timber bequest timber they are more likely to never harvest. Obviously if there is an intent to leave timber for heirs, a landowner is less likely to cut those trees. Perhaps the positive coefficient associated with the ROADS variable could be explained by the fact that if there are more roads on the property there is more extensive agriculture being practiced, or the land has already been harvested recently and so the landowner is less likely to consider it harvestable. The remaining two significant variables, CHILDREN and INHERIT, have negative coefficients. Obviously, if a landowner has a large number of heirs, and they also inherited the land, we would expect them to never harvest. However, consider that a landowner with a large number of children might have high debts, or loans such as college educations to pay off. Such a landowner may be more likely to harvest and therefore less likely to say they will never harvest timber. Evidence in support of this comes from our descriptive statistics for the payment table, which showed that high debt landowners are more likely to accept a range of bids than those with low debt.

Other variables of interest in the regression include CHACRES and YRSOWN. The more acres landowners have, the less likely they are to indicate a decision to never harvest. With more acres, they would be able to harvest some timber without a dramatic decrease in nontimber benefits. They might also know that the probability of accepting a bid in the high range is more likely. The longer a landowner has had possession of the land the less likely they are to never harvest. Perhaps these landowners are those that are holding timber as a long-term investment, eventually planning to harvest at some point in the future.

LOGIT Models For the Decision to Harvest at the Lowest and Highest Price That There Was a Positive Response

Tables 11-12 present LOGIT model estimation results that relate to the decision to cut all of the landowner's trees for the lowest and highest price respectively that the landowner voted "Definitely Yes" or "Probably Yes." This regression examines whether the amount of the landowner's property that is offered affects the probability the landowner will accept a bid for harvesting. The first regression yields a 69% correct prediction and a Chi-squared value of .0159, while the second one gives a 79% correct prediction and a Chi-squared value of .000614. These two regressions have four significant variables in common. They include INCMID, INHERIT, EMPLOYED, and CHILDREN. The last three all have positive coefficients. The INCMID variable has a negative coefficient. For both regressions the higher the landowner's income the less likely they are to harvest all of their timber at either the high or low bid price. This makes sense given that higher income landowners have been shown in other work to be more interested in holding land for amenities (Conway 1998). In the regression that we ran for the lowest price, the NONCONT variable is significant and negative. It seems that at lower prices nonconsumptive non-timber activities may play a larger role in harvest decisions. In this case, landowners who spend more time in nonconsumptive activities are less likely to harvest all of their forests at the low prices, although this variable is insignificant for the regression in Table 12 performed for the high bid price accepted. Clearly, higher prices induce landowners with nonconsumptive interests to accept the bid and harvest. The more days that a landowner is involved in these activities, the less likely they are to harvest.

Landowners who previously inherited their land (Table 11) are more important in the decision to accept a bid for harvesting all of their timber at the lower price, which is consistent with our results in the decision to never harvest above. Landowners with

increased road density are less likely to harvest all of their trees, again because these tracts may have been previously harvested or they may indicate high agricultural uses. Consistent with what we found for the never harvest decision, those landowners with a high number of children are more likely to harvest all of their property at the lowest price accepted; this variable affects the decision to harvest all forests at the low and high bid price equally, comparing Tables 11 and 12. Whether the landowner is employed also impacts the decision to harvest all of their forest for both high and low bids. Finally, higher income of landowners makes it less likely that they will harvest all of their timber, at both the high and the low bid they are willing to accept. Although, comparing Tables 11 – 12, it is clear that this income effect is more pronounced for bids on the low end. These results have important implications for surveys designed to determine reservation prices. Clearly, if a reservation price is considered to be the lowest price a landowner will accept to harvest, then the question of how much to harvest is unclear. We establish here that the decision of how much to harvest depends on theoretically the lowest and highest bid a landowner would consider.

LOGIT Models For the Decision to Harvest at the $10,500, $13,000, $2,000 Bid Levels

The models, presented in Tables 13-17, compare the decision to accept different bids. Table 13 presents the probability a landowner in the sample is not sure whether they will accept the $10,500 bid level, Table 14 gives the probability that the landowner will vote probably yes at the $10,500 level, Table 15 examine the decision to vote definitely yes for the $10,500 bid level, Table 16 presents the decision to vote probably yes at the 13,000 bid level, and Table 17 presents the decision to vote definitely yes at the $2,000 bid level. All bids are given on a per acre basis for harvesting one acre of forest the landowner owns.

Comparing Tables 13-15, we can see that different factors are important in determining the decision to harvest for different levels of certainty. These regressions look at the decision to vote "Not sure", "Probably Yes", and "Definitely Yes" for the $10,500 bid. The three LOGIT regressions do not have any significant variables in common, indicating that the different confidence levels for which bids can be accepted depend on different landowner characteristics. In Table 13 we see that for the "Not Sure" category RISKGROW, CHACRES, and PLANGIVE are significant, and in Table 14 the variables NONCONT, MILEFROM, ENVIREA, and CHILDREN are significant. In Table 15 only RESONP, DEBT, and YRSOWN variables are significant. If a landowner's residence is on the property they are less likely to indicate "Definitely Yes." The higher landowner's debt and the longer that they have had possession of the property, the more likely they are to accept the $10,500 bid. If landowners perceive high risk associated with holding timber or own a large number of acres, they are more likely to be not sure about accepting the bid. However, they are more likely to not be sure when they plan to give their timber to heirs as a timber bequest. Considering the decisions to vote probably or definitely yes, we see that the probably yes vote is determined positively by miles the landowner lives from the residence. This indicates that absentee landowners are more likely to vote probably yes to this bid level than resident landowners. Finally, when considering the decision to vote definitely yes for the 10,500 bid level (Table 15), we see that debt is an important positive predictor of the probability a landowner will accept this bid, as is the number of years the landowner has owned the property. As we showed in Table 14 (probably yes), if the landowner has a residence on the property they are less likely to accept the bid; this reinforces what we found in Table 14 concerning distance the landowner lives from the property.

The bid level 10,500 is on the high end of bids a landowner might receive for our sample region. Conversely, a bid of 2,000 is close to the low end of a bid the landowner might receive for mature hardwoods at stocking levels normally observed in the sample area. Referring to Table 17, we see that different variables are important in driving the decision to take a low bid. Debt is positive as expected but not significant. But income is positive and significant. The larger the tract, the less likely a landowner will accept a low bid. Perhaps this is because these landowners are those that are holding their land as an investment and probably are familiar with the market. Landowners who have strong environmental reasons for holding their property also are less likely to accept a low price, although we found that this was not important in their decision to accept high prices. This indicates that, essentially, nontimber preferences must be very strong for a landowner to never accept a bid. Finally, landowners with large numbers of children (possible heirs) will generally be less likely to accept low bids.

LOGIT Models For the Decision to Harvest at the $2,000 and $5,000 Bid Levels

The remaining tables (Tables 18-19) consider the probability of voting probably yes for the 2,000 and 5,000 bid levels. The bid level 5,000 is about the midpoint of our payment table. We find some interesting variables that are significant, but again they are different than what we find at the other bid levels. Whether the landowner is absentee is a strong significant and positive indicator of whether the landowner will adopt the 5,000 bid level with a confidence of 'probably yes.' This is also true for the 2,000 level, but recall that these landowners are more likely to be not sure at higher bid levels. Landowners who have preferences for preserving timber for future generations are less likely to accept the 5,000 bid level, although this is not a significant variable in the 2,000 bid decision.

VII. Conclusions

This thesis considers how the probability that landowners would accept various bids for harvesting timber depends on preferences and site characteristics. We also examined what motivates landowners to never harvest, or to harvest all of their forests at different bid levels. The answers to these questions came from estimating a series of LOGIT models considering the probability a landowner would vote in a certain manner and relating this probability to indicators of preferences and other characteristics. The data to estimate these models was collected from a mail out survey based on the multiple discrete bounded payment table approach, where respondents are given several possible bids with which they can vote yes or no with different levels of confidence. Bid levels were constructed using open-ended pre-testing as well as market data for the region sampled. The multiple bid offer approach is based on the literature in contingent valuation that establishes acceptable methods to elicit willingness to accept values. In the case of this thesis, willingness to accept is related to the minimum price (reservation price) that a landowner would accept to harvest timber. Finally, we also consider how absentee versus resident, those with high versus low timber bequest intentions, and those with large versus small tracts impact the results. The work contributes by going beyond the usual study of harvesting and reforestation to determine what actually motivates landowners to enter markets.

Several broad conclusions can be drawn from our work. We summarize these below:

1. Landowners are generally more likely to accept high bids than to accept low bids. Interestingly, landowners are more likely to not be sure for a mid-range of price offers.
2. Landowners with timber bequest motives or environmental preferences are generally less likely to accept bids as the bid offer increases. Our descriptive statistics for these landowners showed that the percent of landowners voting definitely or probably yes did not increase as rapidly than it did for landowners where these were not factors.
3. Conversely, a greater proportion of landowners with high debt or large tracts will vote probably or definitely yes as bids levels rise.
4. The percent of landowners voting no versus yes seems to increase dramatically at the 5-8,000 dollar bid level for most types of landowners.
5. When the scale of activity (i.e., area of forest harvested) is considered, different variables motivate the decision to adopt high and low bids. When the decision to harvest all timber owned at the prevailing bid is examined, low bid acceptances are positively related to employment, income, access to land (roads), and the number of children landowners have, while high bid acceptances are determined by children, income, and employment, but nonconsumptive activities do not play a role. This suggests that bids, which are high enough, might induce landowners to substitute away from nontimber activities toward large scale harvesting.
6. The decision to adopt high bids is generally driven by tract size, absenteeism, number of children, and environmental reasons, while the decision to adopt low bids is generally determined more by employment, absenteeism, and income. For

bids in the midrange levels, absenteeism and tract size remain important, as do preferences for preserving land for future generations.

7. Resident and absentee landowners behave differently with respect to bid acceptance, as do landowners with large and small tracts.
8. The decision to never accept an offered bid, at least within the range we examine, is determined mainly by timber bequest motives and number of heirs the landowner has.

Future research may include calculating specific reservation prices for landowners. Once these values are known, they could be incorporated into timber supply models. This information may help researchers better understand how a change in market prices would effect timber supply.

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Appendix 1:

Virginia Landowner Survey 2000

Conducted By:

College of Natural Resources
Virginia Tech
304 Cheatham Hall (0324)
Blacksburg, VA 24061

Contact People:

Nathan Kennedy, graduate student, Virginia Tech, College of Natural Resources (SURVEY CONTACT)
(540) 231-3596

Greg Amacher, professor, Virginia Tech, College of Natural Resources

Purpose of Our Survey and Need for Your Involvement:

You have been selected to participate in an important survey of forest landowners throughout Virginia. Researchers at Virginia Tech are trying to determine what factors cause landowners to decide to sell timber, or to keep land and forests in their family. Your answers to these questions will be very important in future predictions about Virginia's economy and natural resource base. Please answer each question truthfully. There is no "right" or "wrong" answer, so please think about each one carefully and answer as if you faced the situation we are describing. You have our assurance that your answers and information will be kept strictly confidential and will only be seen by the professor and student working on this project. The information we collect will never be given out to any government or state agency, company, individual, or other entity. Your information will be identified only by a number and not by your name or address. Landowner names and addresses we use for purposes of this mailing will be destroyed as soon as the survey information is received. After the research is complete, all data will also be destroyed. If you would like to obtain a copy of our results to see how confidentiality has been preserved, we will be happy to send you a copy if you indicate so on your survey. The survey should take about 10 minutes to complete. Thank you very much for taking the time and helping us with our work.

Please check the box in front of your answer, where applicable.

Please answer the following questions for your property specified in the cover letter **only**.

1. A. How did you acquire your land in ---------- County?
   - ☐ I INHERITED IT
   - ☐ I BOUGHT IT

   If you BOUGHT the land how much did you pay for the land?

   $_____ PER ACRE, OR

   $_____ TOTAL (# OF ACRES: _____)

   B. Is your property in a residential neighborhood _____YES _____ NO
   (IF YES, PLEASE DO NOT ANSWER ANY MORE QUESTIONS AND PLEASE RETURN THIS SURVEY USING THE ENVELOPE PROVIDED

2. How long has the land been owned by you/your family?

   _____ YEARS

3. If you were to consider selling your land now, at what price would you consider selling it?

   $_____ PER ACRE

4. What do you plan to do with your land in the future?

   - ☐ GIVE IT ALL TO MY HEIRS
   - ☐ GIVE ONLY PART OF IT TO MY HEIRS (IF SO, HOW MANY ACRES? _____)
   - ☐ SELL THE LAND

Please answer the following questions for your property specified in the cover letter **only**.

5. How would you classify the general terrain of your property?
   - ☐ RELATIVELY FLAT
   - ☐ ROLLING HILLS
   - ☐ STEEP AND MOUNTAINOUS

6. How many miles of dirt or paved roads would you estimate are on your property?

   _____ MILES

7. Do you have any permanent structures on your property?

 YES (PLEASE SPECIFY): HOUSE
 BARN
_____ OTHER: _____
 NO

8. Approximately how many **acres** of land do you have in the following?

_____ FORESTLAND
_____ AGRICULTURE (PATURE/GRAZING AND CROPLAND)
_____ OPEN LAND FOR WILDLIFE HABITAT / BRUSHLAND
_____ OTHER (PLEASE SPECIFY):

_____

9. In the past 10 years, have you converted or switched any portion(s) of your land to other uses?
 YES
 NO

If you answered YES to QUESTION 9, please tell us approximately how many **acres** you switched from AGRICULTURE to another use:
(If none, write "0")

_____FROM AGRICULTURE TO FORESTLAND:
_____FROM AGRICULTURE TO OPEN LAND FOR WILDLIFE
_____FROM AGRICULTURE TO RESIDENTIAL / COMMERCIAL DEVELOPMENT
_____OTHER (PLEASE SPECIFY):

_____

If you answered YES to QUESTION 9, please tell us approximately how many **acres** you switched from FOREST to another use:
(If none, write "0")

_____ FROM FORESTLAND TO AGRICULTURE
_____ FROM FORESTLAND TO OPEN LAND FOR WILDLIFE
_____ FROM FORESTLAND TO RESIDENTIAL / COMMERCIAL DEVELOPMENT
_____ OTHER (PLEASE SPECIFY):

_____

If you answered YES to QUESTION 9, please tell us approximately how many **acres** you switched from OPEN/BRUSH to another use:
(If none, write "0")

_____ FROM OPEN LAND TO FORESTLAND
_____ FROM OPEN LAND TO AGRICULTURE
_____ FROM OPEN LAND TO RESIDENTIAL / COMMERCIAL DEVELOPMENT
_____ OTHER (PLEASE SPECIFY):

_____

10. Forests can provide a number of goods and services. If forests are harvested, they provide income for the owner. Standing timber provides habitat for wildlife and recreational opportunities for landowners. Forests can be harvested about once every 50 years in your area, and landowners typically receive $1,000 - $6,000 per acre when they harvest depending on the quality of the trees cut (an acre is roughly the size of a football playing field--100 yards by 55 yards). In your area, a new forest will establish itself on cutover land if left alone. Harvesting of trees can also be done in a way to ensure that a new forest is established within one year after cutting.

Reminder: This information will be kept STRICTLY CONFIDENTIAL, and landowner names/addresses will not be attached to these answers.

Suppose you had forests old enough to harvest for wood, and you were given a dollar offer for harvesting. The table below lists some specific amounts that you could receive per acre by harvesting. Please indicate for each amount whether you would accept the money and harvest your forest, or whether you would not accept the money and keep your forest standing.

Would you accept the following payments to harvest your forest?

Payment made to you	Definitely Not	Probably Not	Not Sure	Probably Yes	Definitely Yes
$500 per acre					
$1,000 per acre					
$2,000 per acre					
$3,500 per acre					
$5,000 per acre					
$6,500 per acre					
$8,500 per acre					
$10,500 per acre					
$13,000 per acre					

If you would never harvest your forest matter what the amount offered, please check here: □

If you checked the NOT SURE box anywhere in the table above, could you tell us why?

□ I AM NOT FAMILIAR ENOUGH WITH MY PROPERTY TO ANSWER
□ I AM NOT THE DECISION-MAKER FOR THE PROPERTY IN QUESTION
□ I DO NOT KNOW IF I HAVE FORESTS ON MY PROPERTY
□ I DO NOT UNDERSTAND THE QUESTION
□ OTHER (PLEASE SPECIFY): _____

For the LOWEST amount you checked PROBABLY YES or DEFINITELY YES above, please indicate how much of the forests on your property you would consider harvesting (please check all that apply)
(PLEASE SKIP THIS QUESTION IF YOU DID NOT ANSWER PROBABLY OR DEFINITELY YES TO ANY NUMBER IN THE TABLE)

25% _____
50%_____
ALL_____
OTHER_____

For the HIGHEST amount you checked PROBABLY YES or DEFINITELY YES above, please indicate how much of the forests on your property you would consider harvesting (please check all that apply)
(PLEASE SKIP THIS QUESTION IF YOU DID NOT ANSWER PROBABLY OR DEFINITELY YES TO ANY NUMBER IN THE TABLE)

25% _____
50%_____
ALL_____
OTHER_____

12. Approximately how much income in each of the following categories did you earn last year? (If none, write "0". If you have owned your land less than 1 year, please answer based on the amount of time you have owned your land.)

SELLING TIMBER $_____

SELLING FIREWOOD $_____

AGRICULTURAL INCOME $_____

12. If you earned any income from agriculture over the last five years, what was the primary source of that income? (Examples: crop sales, leasing income, livestock sales, dairy product sales, agricultural subsidies, etc.)

PRIMARY SOURCE OF AGRICULTURAL INCOME: _____

13. How important are the following reasons for owning your land? (1 is not important, 5 is very important)

ENVIRONMENTAL REASONS (Examples: protection of habitat, water quality, protection against soil erosion)

1 2 3 4 5

TO KEEP FOR FUTURE GENERATIONS

1 2 3 4 5

SCENIC BEAUTY

1 2 3 4 5

INCOME FROM TIMBER PRODUCTION

1 2 3 4 5

LAND INVESTMENT/REAL ESTATE

1 2 3 4 5

RECREATION (Examples: hunting, fishing, hiking, observing wildlife)

1 2 3 4 5

PRIMARY RESIDENCE

1 2 3 4 5

14. How important is involvement in recreational activities like hunting and fishing to you on your land?
(1 is not important, 5 is very important)

1 2 3 4 5

15. How important is involvement in recreational activities like observing wildlife/scenery, hiking, biking, horses/pasturing, and picnicking to you on your land? (1 is not important, 5 is very important)

1 2 3 4 5

Please answer the following questions for your property specified in the cover letter **only**.

16. Approximately how many **days** were you involved in each of the following activities within the past year?
(If none, write "0")

_____ BIKING
_____ BIRD WATCHING
_____ CAMPING
_____ FISHING
_____ FLOWER, PLANT, OR BERRY PICKING
_____ HORSES / PASTURING
_____ HUNTING
_____ OBSERVING WILDLIFE
_____ PHOTOGRAPHY
_____ PICNICKING
_____ RUNNING
_____ WALKING / HIKING
_____ OTHER (PLEASE SPECIFY):_____

17. How would you rate the degree of risk associated with growing trees as opposed to typical investments like stocks and bonds?
(1 is the least risk, 5 is the most risk)

1 2 3 4 5

18. How would you rate the degree of risk associated with losing your timber to fire, insects, ice damage, or other natural occurrences?
(1 is least risk, 5 is most risk)

1 2 3 4 5

19. Have you had trees cut on this tract of land for the sale of timber?

□ YES
□ NO

If so, approximately how many years ago? _____ YEARS AGO

20. What do you plan to do with the trees that are now on your land?

□ EVENTUALLY CUT THE TIMBER
□ GIVE ALL OF THE TIMBER TO HEIRS
□ GIVE PART OF THE TIMBER TO HEIRS AND SELL THE REST (WHAT PERCENT TO HEIRS? _____)
□ SELL THE TIMBER WHEN I SELL THE LAND IN THE FUTURE
□ OTHER (PLEASE SPECIFY):

_____

The following questions will help us obtain background variables for statistical purposes. Again, as is true for the rest of the survey, all information is strictly confidential. The information here will be identified only with the 4-digit number at the top of your survey, and all surveys and landowner name lists will be destroyed once the information is collected.

21. Is your primary residence located on your property in _____ County?

□ YES
□ NO

If you answered NO to question 21:

A. Approximately how many miles away is your primary residence from your land in _____ County?

_____ MILES

B. Approximately how many days did you visit your property in 1999?

_____ DAYS

22. What is your age?

_____ YEARS

23. What is your sex?

□ MALE
□ FEMALE

24. What is your present marital status?

□ SINGLE
□ MARRIED
□ DIVORCED
□ WIDOWED

25. How many children do you have? (If none, write "0")

_____ CHILDREN

26. Are you presently:

□ EMPLOYED
□ UNEMPLOYED
□ RETIRED

REMINDER: please keep in mind that all information in this survey will be kept strictly confidential.

27. What was your approximate gross family income (before taxes) in 1999?

- LESS THAN $10,000
- $10,000 TO $19,999
- $20,000 TO $29,999
- $30,000 TO $39,999
- $40,000 TO $49,999
- $50,000 TO $59,999
- $60,000 TO $69,999
- $70,000 TO $79,999
- $80,000 TO $89,999
- $90,000 TO $99,999
- $100,000 TO $124,999
- $125,000 TO $149,999
- $150,000 TO $199,999
- $200,000 OR GREATER

28. What is an estimate of the total amount of money you owe as of March 2000? (total of home mortgages, car or other loans, credit card balances, etc.)

$ _____

29. Please rank from highest to lowest how much you owe in the following categories: (1 is your largest debt, 5 is your smallest debt)

_____ HOME MORTGAGE
_____ CAR LOANS
_____ EDUCATION LOANS
_____ CREDIT CARD BALANCES
_____ OTHER (PLEASE SPECIFY):_____

30. What is the highest level of education that you completed?

- NO FORMAL EDUCATION
- ELEMENTARY SCHOOL
- JUNIOR HIGH SCHOOL
- HIGH SCHOOL
- SOME COLLEGE
- COLLEGE (PLEASE SPECIFY HIGHEST DEGREE AND MAJOR):

_____

31. Were you able to understand and complete the survey?

YES _____

NO _____

If NO, can you tell us why?

- I DON'T HAVE ENOUGH INFORMATION ABOUT THE PROPERTY YOU ASK ABOUT
- I THINK THE SURVEY IS TOO HYPOTHETICAL
- I THINK THE SURVEY IS MORALLY OFFENSIVE
- I HAVE OTHER REASONS (PLEASE SPECIFY):

_____

Thank you for VERY MUCH for taking the time to respond to our survey. If you have additional comments, please write them in the space below. If you would like a copy of our results, please also indicate that here.

Appendix 2:

Table 1. Definitions of Variables Used in the Study

Variable	Definition (units)
INHERIT	1 if property was inherited, else 0
BOUGHT	1 if property was bought, else 0
BGHTDAC	if the property was bought, how much was paid for it ($/ac)
BGHTDT	if the property was bought, how much was paid for it ($)
BOUGHTAC	number of acres that was bought
RESIDEN	1 if property is in a residential neighborhood, else 0
YRSOWNE	years that the property has been in possession
SELLDAC	if the land was to be sold, what would be the price ($/ac)
DONTKNOW	1 if the respondent indicated that they do not know what the price would be, else 0
NOSELL	1 if the respondent indicated that they would never sell their property, else 0
FUTHIER	1 if the respondent would give the land to heirs in the future, else 0
FUTPHIER	1 if the respondent would give part of the land to heirs in the future, else 0
FUTHIERN	number of acres that the respondent would give to heirs
FUTSELL	1 if respondent would sell the land in the future, else 0
FUTCONS	1 if the respondent indicated that they would give the land to a conservancy
TERFLAT	1 if land is predominately flat, else 0
TERHILL	1 if land is predominately rolling hills, else 0
TERMOUNT	1 if land is predominately steep and mountainous, else 0
ROADS	miles of roads on property
STRUCT	1 if there are structures on the property, else 0
STRUCTHS	1 if there is a house on the property, else 0
STRUCTBA	1 if there is a barn on the property, else 0
STRUCTO	1 if there are other structures on the property, else 0
ACREFOR	acres of forest land
ACREAG	acres of agricultural land
ACREOPEN	acres of open land
ACREOTH	acres of land for other uses
SWTCHUSE	1 if landowner has ever switched land to a different use in the past 10 years, else 0
AGTOFOR	acres switched from agriculture to forests
AGTOOPEN	acres switched from agriculture to open land
AGTORES	acres switched from agriculture to residential
AGTOOTH	acres switched from agriculture to other
FORTOAG	acres switched from forests to agriculture
FORTOPEN	acres switched from forests to open land
FORTORES	acres switched from forests to residential
FORTOOTH	acres switched from forests to other
OPENTOF	acres switched from open to forests
OPENTOAG	acres switched from open to agriculture
OPENTOR	acres switched from open to residential
OPENTOTH	acres switched from open to other
NOFOREST	1 if the respondent did complete the payment table because they indicated that they do not have forests, else 0
NEVHARV	1 if the respondent would never harvest no matter what price offered, else 0
NOTFAM	1 if the respondent indicated not sure in the payment table because they are not familiar enough with their property, else 0
NOTDM	1 if the respondent indicated not sure in the payment table because they were not the decision maker, else 0
DNKIFFOR	1 if the respondent indicated not sure in the payment table because they did not knoe if they had forests on their property, else 0
DONOTU	1 if the respondent indicated not sure in the payment table because they did not understand, else 0
OTHER	1 if the respondent indicated not sure in the payment table for other reasons
LOW25	1 if harvest 25% for the low bid, else 0

Table 1, cont.

LOW50	1 if harvest 50% for the low bid, else 0
LOWALL	1 if harvest all for the low bid, else 0
LOWOTH	1 if harvest other for the low bid, else 0
HIGH25	1 if harvest 25% for the high bid, else 0
HIGH50	1 if harvest 50% for the high bid, else 0
HIGHALL	1 if harvest all for the high bid, else 0
HIGHOTH	1 if harvest other for the high bid, else 0
INCTIM	income from selling timber ($)
INFIRE	income from selling firewood ($)
INCAG	agricultural income ($)
ENVIREA	owning, importance: environmental reasons (1-5)
FUTGEN	owning, importance: to keep for future generations (1-5)
BEAUTY	owning, importance: scenic beauty (1-5)
INCTIMB	owning, importance: income from timber production (1-5)
LANDINV	owning, importance: land investment/real estate (1-5)
RECREA	owning, importance: recreation (1-5)
RESID	owning, importance: primary residence (1-5)
HUNTFISH	importance: hunting and fishing (1-5)
OTHRIMP	importance: other recreation (1-5)
DHUNT	within the past year, days spent hunting on the property
RISKGROW	risk of growing timber (1-5)
RISKLOSS	risk of losing timber (1-5)
SALETIMB	1 if respondent has ever sold timber from the tract, else 0
YEARSALE	years ago that the timber was sold
PLANCUT	1 if they would eventually cut the timber, else 0
PLANGIVE	1 if they would eventually give the timber to heirs, else 0
PLANPART	1 if they would eventually give part of the timber to heirs, else 0
PERHIER	percent of timber to heirs
PLANSELL	1 if they would eventually sell timber with land, else 0
PLANOTH	1 if they plan to do something else with the timber, else 0
PLANCONS	1 if they indicated that the plan to give the timber to a conservancy, else 0
RESONP	1 if residence is on the property, else 0
MILEFROM	distance from residence to property (miles)
DAYSVIS	days respondent visited property
AGE	Age (years)
MALE	1 if male, else 0
FEMALE	1 if female, else 0
SINGLE	1 if single, else 0
MARRIED	1 if married, else 0
DIVOR	1 if divorced, else 0
WIDOW	1 if widowed, else 0
CHILDREN	number of children
EMPLOYED	1 if employed, else 0
UNEMPLOY	1 if unemployed, else 0
RETIRED	1 if retired, else 0
DEBT	total debt
DEBTHM	debt, home mortgage (1-5)
DEBTCL	debt, car loans (1-5)
DEBTEL	debt, education loans (1-5)
DEBTCCB	debt, credit card balance (1-5)
DEBTOTH	debt, other (1-5)
COLLEGE	1 if the respondent has finished college, else 0
UNDERS	1 if the respondent understood the survey, else 0
NOINFO	1 if the respondent didn't understand the survey because they didn't have enough information, else 0

NOHYPO	1 if the respondent didn't understand the survey because they though it was to hypothetical, else 0
NOMOROF	1 if the respondent didn't understand the survey because they though it was morally offensive, else 0
NOOTHREA	1 if the respondent didn't understand the survey because of other reasons, else 0

Table 2. Descriptive Statistics of important variables from the survey

	Mean				
Variable	**Total**	**Asentee**	**Resident**	**Large**	**Small**
INHERIT		.21	.30	.29	.29
BOUGHT		.83	.73	.79	.68
BGHTDAC		619.23	833.54	750.43	931.96
BGHTDT		60073.91	83409.62	70319.76	90187.27
BOUGHTAC		159.39	145.50	182.87	76.46
YRSOWNE		36.06	42.58	37.80	47.40
NOSELL		.18	.18	.18	.20
FUTHIER		.68	.73	.69	.75
FUTPHIER		.50	.61	.85	.043
FUTHIERN		1.51	.45	.65	.61
FUTSELL		.22	.25	.26	.24
TERFLAT	.074	.77	.071	.057	.084
TERHILL		.50	.56	.59	.52
TERMOUNT		.56	.55	.54	.56
ROADS		.70	1.12	1.35	.70
ACREFOR		67.80	68.45	82.10	47.88
ACREAG		34.70	38.39	56.54	13.64
ACREOPEN		3.6	7.67	8.60	3.99
ACREOTH		1.28	1.27	1.75	.70
SWTCHUSE		.096	.13	.12	.11
AGTOFOR		.096	3.80	5.76	.042
AGTOOPEN		.29	.23	.30	.16
AGTORES		.14	.12	.12	.13
AGTOOTH	.0062	0	.0074	.011	0
FORTOAG		0	.48	.38	.42
FORTOPEN		0	.22	.11	.20
FORTORES	.068	0	.082	.11	.014
FORTOOTH		.039	.039	.068	.35
OPENTOF		.096	.24	.20	.24
OPENTOAG		0	.22	.79	.32
OPENTOR		.096	.19	.28	.49
OPENTOTH		0	0	0	0
NEVHARV		.22	.21	.18	.23
NOTFAM		.98	.13	.12	.12
NOTDM	.020	0	.025	.025	.15
DNKIFFOR	.024	0	.029	.019	.31
DONOTU	.014	.20	.012	.019	.0077
OTHER	.27	.33	.26	.22	.34
LOW25	.099	.98	.100	.12	.076
LOW50	.16	.18	.15	.14	.17
LOWALL	.21	.24	.21	.21	.22
LOWOTH	.30	.059	.35	.66	.60
HIGH25	.063	.059	.064	.78	.46
HIGH50	.13	.18	.12	.12	.13
HIGHALL	.29	.28	.29	.29	.31
HIGHOTH	.28	.39	.33	.042	.60

Table 2 cont.

Variable	Total	Asentee	Resident	Large	Small
INCTIM	569.6	865.39	516.29	814.29	286.17
INFIRE	8.22	0	9.89	4.00	13.76
INCAG	41688.49	567.31	50168.18	75738.64	2092.16
ENVIREA	3.70	3.76	3.69	3.67	3.72
FUTGEN	4.07	4.25	4.04	4.08	4.03
BEAUTY	4.18	4.08	4.20	4.13	4.24
INCTIMB	1.82	1.65	1.85	1.85	1.06
LANDINV	3.30	3.22	3.31	3.12	1.48
RECREA	3.69	3.56	3.70	3.63	3.76
RESID	3.30	2.17	3.54	3.16	3.43
HUNTFISH	2.92	2.78	2.95	2.96	2.86
OTHRIMP	3.61	3.37	3.64	3.59	3.63
DHUNT	13.46	5.13	15.15	15.56	10.83
RISKGROW	2.49	2.28	2.54	2.51	2.50
RISKLOSS	2.96	2.82	2.98	2.87	3.05
SALETIMB	.29	.24	.30	.33	.23
YEARSALE	3.79	2.53	4.05	4.42	2.76
PLANCUT	.24	.18	.25	.26	.23
PLANGIVE	.39	.38	.39	.38	.39
PLANPART	.068	.10	.062	.072	.58
PERHIER	2.66	4.49	2.32	3.63	1.53
PLANSELL	.17	.18	.17	.15	.20
PLANOTH	.17	.22	.16	.16	.18
PLANCONS	.013	0	.016	.024	0
RESONP	.48	0	.58	.49	.46
MILEFROM	61.91	356.83	4.91	50.01	78.93
DAYSVIS	108.61	33.43	141.01	131.69	81.64
AGE	59.6	60.94	59.34	61.33	57.89
MALE	.80	.73	.81	.81	.80
FEMALE	.21	.27	.20	.19	.21
CHILDREN	2.40	2.08	2.45	2.29	2.57
EMPLOYED	.54	.54	.54	.48	.61
UNEMPLOY	.013	0	.015	.017	.0071
RETIRED	.51	.64	.49	.62	.38
DEBT	65789.21	47282.61	67665.95	62375	70386.99
SOMECOL	.20	.17	.20	.20	.19
COLLEGE	.54	.65	.52	.48	.60
UNDERS	.92	.89	.95	.95	.89
NOINFO	.22	.096	.0077	.023	.022
NOHYPO	.19	0	.023	.011	.029
NOMOROF	.013	0	.0077	.017	.72
NOOTHREA	.025	.019	.019	.0057	.50
INCMID	58819.06	90576.92	61078.07	63244.85	57376.54
NONCONT	247.64	96.76	278.67	212.65	287.29
INCOM	.076				
ACRESCH	86.54				
ABSENTEE	.14	1	0	.13	.16
LARGE	.54	.50	.56	1	0

Table 3: Percent of Landowners Who Responded to Payment Table– Full Sample (n = 305)

Payment made for Harvest (one acre)	Definitely Not	Probably Not	Not Sure	Probably Yes	Definitely Yes
$500	59.0	4.1	10.0	2.0	2.0
$1,000	50.0	9.2	10.5	6.2	2.0
$2,000	34.4	15.0	12.2	7.8	6.2
$3,500	24.6	15.8	16.1	7.9	9.6
$5,000	18.7	7.9	18.4	14.8	13.2
$6,500	16.7	5.6	16.1	13.5	19.4
$8,500	14.4	5.6	14.1	12.5	25.9
$10,500	12.3	4.5	12.4	11.1	31.1
$13,000	11.8	2.3	14.1	10.5	36.5

Table 4: Percent of Landowners Who Responded to Payment Table – Landowners with Timber bequest Motives (n = 105)

Payment made for Harvest (one acre)	Definitely Not	Probably Not	Not Sure	Probably Yes	Definitely Yes
$500	64.0	3.8	7.6	1.9	.9
$1,000	51.0	12.3	9.5	5.7	.9
$2,000	35.2	15.2	17.3	4.8	3.8
$3,500	28.8	13.4	24.0	8.6	9.5
$5,000	20.0	7.7	19.0	12.3	8.8
$6,500	4.8	4.8	20.9	12.5	16.3
$8,500	15.0	6.6	14.3	9.5	25.7
$10,500	3.7	4.8	14.2	10.5	27.5
$13,000	1.2	1.9	15.2	11.4	30.5

Table 5: Percent of Landowners Who Responded to the Payment Table– Landowners Without Timber bequest Motives (n = 160)

Payment made for Harvest (one acre)	Definitely Not	Probably Not	Not Sure	Probably Yes	Definitely Yes
$500	59.3	3.8	10.0	2.5	1.9
$1,000	52.5	6.2	10.0	5.6	2.5
$2,000	36.2	16.2	9.1	9.7	7.8
$3,500	18.2	19.5	13.6	6.3	8.8
$5,000	19.4	8.1	19.4	15.6	14.3
$6,500	17.3	5.2	16.2	16.3	19.5
$8,500	15.0	5.0	13.8	15.1	24.4
$10,500		4.4	12.5	32.5	33.7
$13,000	11.9	2.5	13.1	10.6	36.9

Table 6: Percent of Landowners Who Responded to Payment Table– Absentee Landowners (n = 62)

Payment made for Harvest (one acre)	Definitely Not	Probably Not	Not Sure	Probably Yes	Definitely Yes
$500	64.3	4.1	10.8	0	1.1
$1,000	48.6	10.8	12.1	5.4	1.3
$2,000	35.1	16.2	7.6	11.4	7.5
$3,500	26.5	11.3	8.8	9.5	9.6
$5,000	18.9	9.5	16.2	18.9	10.1
$6,500	50.6	8.8	50.6	11.4	27.8
$8,500	13.5	6.7	12.2	12.3	28.4
$10,500		6.8	8.1	12.2	33.8
$13,000	12.2	4.0	9.5	10.8	39.2

Table 7: Percent of Landowners Who Responded to Payment Table– Resident Landowners (n = 231)

Payment made for Harvest (one acre)	Definitely Not	Probably Not	Not Sure	Probably Yes	Definitely Yes
$500	59.3	3.0	11.0	2.3	1.9
$1,000	49.0	8.7	10.6	6.4	2.3
$2,000	33.1	14.4	13.5	6.6	6.2
$3,500	25.8	16.2	17.0	8.0	10.3
$5,000	17.9	7.2	18.2	15.2	12.7
$6,500	16.1	5.0	17.8	13.1	18.5
$8,500	14.1	4.9	14.8	11.8	27.0
$10,500		3.8	13.7	10.6	31.9
$13,000	11.2	1.5	15.6	10.2	35.0

Table 8: Percent of Landowners Who Responded to Payment Table – Landowners With Small Tracts < 50 acres (n = 182)

Payment made for Harvest (one acre)	Definitely Not	Probably Not	Not Sure	Probably Yes	Definitely Yes
$500	59.0	5.6	10.9	1.1	5.5
$1,000	49.2	10.3	12.0	6.5	1.1
$2,000	34.8	15.8	13.2	8.2	5.5
$3,500	24.7	14.8	18.1	7.6	7.5
$5,000	19.1	8.2	21.3	12.5	13.2
$6,500	16.3	4.9	17.0	13.7	19.2
$8,500	14.8	60	16.3	10.9	23.5
$10,500	14.2	4.9	15.3	10.9	27.3
$13,000	12.0	2.2	15.8	10.9	30.6

Table 9: Percent of Landowners Who Responded to Payment Table– Landowners With Large Tracts > 50 acres (n = 85)

Payment made for Harvest (one acre)	Definitely Not	Probably Not	Not Sure	Probably Yes	Definitely Yes
$500	64.3	1.2	5.7	46	3.4
$1,000	56.3	6.9	4.6	3.4	3.4
$2,000	36.7	16.1	10.5	8.2	7.0
$3,500	21.2	16.4	1.5	7.0	10.3
$5,000	20.7	8.0	13.7	18.4	9.4
$6,500	17.1	3.5	18.8	15.3	15.3
$8,500	16.1	5.7	9.2	17.4	27.6
$10,500		4.6	6.9	12.7	35.6
$13,000	13.7	3.5	10.3	10.3	40.2

Table 10: LOGIT Model for the Decision to Never Harvest. Dependent Variable is Willingness to Accept Bid (1=yes, 0=no) (n = 142)

89% Correct Prediction

Variable	Coefficient	t-stat
NONCONT	.000467	.723
PLANGIVE	1.83	2.983*
MILEFROM	.000657	.309
INCMID	.00000199	.360
INHERIT	-1.39	-1.947*
ROADS	.31	1.873*
CHACRES	-.00826	-1.468
ENVIREA	.0615	.287
FUTGEN	-.173	-.841
EMPLOYED	-.576	-.964
DEBT	.00000019	0.098
YRSOWN	-.0112	-1.458
RISKGROW	.118	0.567
CHILDREN	-.532	-2.835*
χ^2= .0217		

* = significance at the .05 level

Table11: LOGIT Model for the Decision to Cut all of their Trees at the Lowest Price the Landowner Voted Definitely Yes or Probably Yes. Dependent Variable is Willingness to Accept Bid (1=yes, 0=no) (n = 140)

79% Correct Prediction

Variable	Coefficient	t-stat
NONCONT	-.00231	-2.79*
PLANGIVE	-.353	-.638
MILEFROM	-.00208	-.527
INCMID	-.0000146	-2.619*
INHERIT	2.28	3.185*
ROADS	-.458	-1.688*
CHACRES	-.00445	-.945
ENVIREA	-.213	-1.085
FUTGEN	-1.32	-.667
EMPLOYED	1.33	2.362*
DEBT	.0192	1.218
YRSOWN	-.00667	-1.353
RISKGROW	.0509	.251
CHILDREN	.714	3.568*
χ^2= .000614		

* = significance at the .05 level

Table 12: LOGIT Model for the Decision to Cut all of their Trees at the Highest Price the Landowner Voted Definitely Yes or Probably Yes. Dependent Variable is Willingness to Accept Bid (1=yes, 0=no) (n = 140)

69% Correct Prediction

Variable	Coefficient	t-stat
NONCONT	-.000406	-.783
PLANGIVE	.118	.254
MILEFROM	.00203	1.073
INCMID	-.00000701	-1.538*
INHERIT	.954	1.702*
ROADS	-.139	-.642
CHACRES	-.00499	-1.237
ENVIREA	-.260	-1.545*
FUTGEN	-.167	-.985
EMPLOYED	1.01	2.064*
DEBT	.118	.863
YRSOWN	-.0029	-.668
RISKGROW	.0454	.267
CHILDREN	.572	3.584*
$\chi^2 = .0159$		

* = significance at the .05 level

Table 13: LOGIT Model for the Decision to Vote Not Sure for the $10,500 Bid. Dependent Variable is Willingness to Accept Bid (1=yes, 0=no) (n = 121)

88% Correct Prediction

Variable	Coefficient	t-stat
NONCONT	.000304	.298
PLANGIVE	1.04	1.506*
MILEFROM	-.0394	-1.235
INCMID	-.0000068	.940
INHERIT	1.19	1.401
ROADS	-.634	-.998
CHACRES	-.0258	-1.914*
ENVIREA	-.0242	-.083
RESONP	-.469	-.547
FUTGEN	.293	.915
EMPLOYED	-.932	-1.116
DEBT	-.0000013	-.272
YRSOWN	-.104	-9.57
RISKGROW	-.574	-1.822*
CHILDREN	.135	.595
χ^2 =		

* = significance at the .05 level

Table 14: LOGIT Model for the Decision to Vote Probably Yes for the $10,500 Bid. Dependent Variable is Willingness to Accept Bid (1=yes, 0=no) (n = 122)

86% Correct Prediction

Variable	Coefficient	t-stat
NONCONT	.00164	2.244*
PLANGIVE	-.388	-.556
MILEFROM	.00731	1.745*
INCMID	.00000499	.688
INHERIT	-1.05	-1.058
ROADS	-.00998	-.045
CHACRES	-.00203	-.329
ENVIREA	-.446	-1.922*
RESONP	.0344	.044
FUTGEN	.189	.713
EMPLOYED	-.723	-.941
DEBT	.00000264	.835
YRSOWN	-.00272	-.365
RISKGROW	-.21	-.806
CHILDREN	-.426	-1.785*
χ^2 =		

* = significance at the .05 level

Table 15: LOGIT Model for the Decision to Vote Definitely Yes for the $10,500 Bid. Dependent Variable is Willingness to Accept Bid (1=yes, 0=no)

Variable	Coefficient	t-stat
NONCONT	-.0000322	-.274
PLANGIVE	-.0389	-.414
MILEFROM	-.000326	-.801
INCMID	.000000421	.465
INHERIT	-.115	-1.008
ROADS	.0295	1.064
CHACRES	.000167	.205
ENVIREA	.00618	.175
RESONP	-.217	-2.140*
FUTGEN	.00812	.221
EMPLOYED	.108	1.084
DEBT	.000000886	1.729*
YRSOWN	.00181	2.000*
RISKGROW	.0511	1.401
CHILDREN	.0102	.332
χ^2 =		

* = significance at the .05 level

Table 16: LOGIT Model for the Decision to Vote Probably Yes for the $13,000 Bid. Dependent Variable is Willingness to Accept Bid (1=yes, 0=no)

Variable	Coefficient	t-stat
NONCONT	.00135	2.028*
PLANGIVE	.00964	.179
MILEFROM	-.0000124	-.036
INCMID	.00000097	2.112*
INHERIT	-.117	-1.832*
ROADS	-.0218	-1.291
ACREFOR	.000735	3.081*
ENVIREA	.0000473	.429
CHACRES	-.00000206	-.006
FUTGEN	.00154	.092
EMPLOYED	-.000966	-.017
DEBT	-.000000338	-1.144
YRSOWN	.0000294	.408
RISKGROW	.0378	1.862*
CHILDREN	-.0322	-1.879
χ^2 =		

* = significance at the .05 level

Table 17: LOGIT Model for the Decision to Vote Definitely Yes for the $2,000 Bid. Dependent Variable is Willingness to Accept Bid (1=yes, 0=no)

Variable	Coefficient	t-stat
NONCONT	-.00292	-1.199
PLANGIVE	1.31	1.196
ABSENT	1.02	.795
INCMID	.0000159	2.033*
INHERIT	-2.68	-1.407
ROADS	-1.18	-1.086
ACREFOR	-.017	-1.686*
ENVIREA	-.00295	-1.796*
CHACRES	.0192	1.771*
FUTGEN	-.262	-.849
EMPLOYED	-.282	-.221
DEBT	.00000485	1.408
YRSOWN	-.0000598	-.046
RISKGROW	-1.23	-2.288*
CHILDREN	-.601	-1.649*
χ^2 =		

* = significance at the .05 level

Table 18: LOGIT Model for the Decision to Vote Probably Yes for the $2,000 Bid (n = 160) . Dependent Variable is Willingness to Accept Bid (1=yes, 0=no)

88% Correct Prediction

Variable	Coefficient	t-stat
NONCONT	.000278	.457
PLANGIVE	-.485	.777
ABSENT	1.37	2.107*
INCMID	.00000821	1.609*
INHERIT	-.682	-.944
ROADS	.0586	.457
ACREFOR	-.0000399	-.013
CHACRES	-.00476	-1.098
ENVIREA	.0063	.320
FUTGEN	.0868	.476
EMPLOYED	-1.69	-2.590*
DEBT	-.00000284	-.867
YRSOWN	.0000697	.087
RISKGROW	-.301	-1.373
CHILDREN	-.87	-1.918*
χ^2 =		

* = significance at the .05 level

Table 19: LOGIT Model for the Decision to Vote Probably Yes for the $5,000 Bid (n = 176) . Dependent Variable is Willingness to Accept Bid (1=yes, 0=no)

85% Correct Prediction

Variable	Coefficient	t-stat
NONCONT	-.000721	-.987
PLANGIVE	.22	.424
ABSENT	1.18	2.026*
INCMID	-.00000386	-.888
INHERIT	-.855	-1.217
ROADS	-.259	-.931
ACREFOR	.00446	2.121*
ENVIREA	.0004	.340
CHACRES	-.00251	-.640
FUTGEN	-.342	-2.306*
EMPLOYED	-.0695	-.132
DEBT	.00000339	1.435
YRSOWN	.0000456	.073
RISKGROW	.135	.729
CHILDREN	-.164	-1.038
χ^2 =		

* = significance at the .05 level

VITA

Nathan Kennedy was born in Rochester, NY on October 29, 1976. He attended and graduated high school in Clinton, NJ. In 1999 he graduated with a BS in Biology and a BA in economics from Virginia Tech in Blacksburg, VA, and he is scheduled to receive a MS in Forestry from the same institution in July of 2001.